

Understanding Science Centre Engagement in Making an Exhibition Experience

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Abstract: Reaching and engaging visitors within exhibitions, as well as throughout the entire museum environment, recurred as an area of design concern and struggle. The paper discusses various science centre methodological approaches to encourage visitor into having a response. This brings effects on visitors' participation and immersion. The review highlights multiple learning theories underpinning how visitors learn and how these theories impact a museum's exhibition design efforts. Using the recent experience of The Mind Museum, Philippines, Questacon Australia as primary case-studies and The Experimentarium, Denmark with The Powerhouse Museum as further reference, this paper examines different perspectives and methodological approaches. Nurturing visitor interest through an exhibition experience represents an important recurring concept which strike at the core of the exhibition design process. Visitors act as celebrants of science information in an edutainment context, motivated by a quest for social and enlightening experiences. How do science centre nurture an exhibition experience? How do they support quality visitor experience and informal learning intentions? Answers to these questions are the essence of this paper.

Key words: Exhibition design • Informal learning • Science Centre • Visitor experience

INTRODUCTION

The biggest challenge for science centre institutions is to strategically provide opportunities for cognitive and affective learning while simultaneously facilitating 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 [1]. In most instances, families say that they come to the centre to learn something new, to enjoy themselves and to spend quality time together [2]. 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 deeply affects the kinds of thinking engaged in by visitors [3]. In science centre the varieties of exhibits spanning various disciplines are basically incubators of scientific knowledge and emphasises hands-on exploratory learning. Using the recent experience of selected renowned Science Centres as case-studies, this paper examines the responses of the centre managements in order to explore the extent to which the process occurs. The nature of their roles at the respective Science Centres

had resulted in a correspondingly wide-ranging mesh of findings. The theme making an exhibition experience represents significant recurring concepts which strike at the core of the exhibition design process. A comparison of approaches across science centre institutions which differ in size, type and location offer a better understanding from different perspectives and approaches.

Literature Review: Exhibition design as a way of intentionally organizing and orchestrating the museum visitor experience began to receive greater prominence in the 1980s [4]. In the museum context, exhibitions have been likened to a play: an exhibition has an overarching theme or storyline (plot) that can be divided into acts (galleries or subdivided spaces) and scenes (display clusters). Individual elements such as text panels, images and objects can in turn be related to dialogues, soliloquies and props [5, 6]. Similarly, Yellis [7] draws parallels between the museum and the theatre in the sense that both have the capacity to transform visitors on an emotional level. He argues that both a strong narrative as well as attention to the exhibition staging, or atmospherics, are important for enacting this

transformation. While there has been much interest in experiences in the museum, tourism and broader consumption literature, the term itself has been used interchangeably to describe a number of different concepts [8]. "Experience" can be a noun or a verb: a product that is marketed and consumed; or a process that unfolds spatially and temporally. In a museum, experience can be seen as a process of mutual interaction or "dialogue" between a visitor and their setting [9]. The conception of visitor experience used in this study aligns with the definition as "an individual's immediate subjective and personal response to an activity, setting or event outside their usual environment" [8].

The museum field is rich with literature that addresses the concept of informal learning or "free-choice" learning in museums [10, 11]. Hein [12] suggested that museums typically do not have set formal curriculum, rather they provide visitors with informal education opportunities. Visitors largely come by their own choice and are thus intrinsically motivated. They engage in activities in a self-directed manner and therefore, their methods of learning are varied [13]. In describing the integration of intrinsic motivation into a theory of learning, Rice [14] highlighted the task of museum educators is to move people into becoming learners. "...In 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 [14]. A theory of learning that integrates into it the function of motivation is ultimately one that can reconcile affective experiences with the construction of meaning. According to Perry [15], requirements 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 is further discussed.

Meaningful learning has two components. First, the content should be meaningful and motivating for 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 [16]. The phenomenon is closely related to the growing impact of science and technology in our everyday lives. The aim is not solely to produce more scientists and technologists; it is also 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 [17].

Behaviorism models are drawn from traditional classroom practices and have been used to design museum exhibits in the nineteenth and early twentieth century [18]. This led to authoritative, didactic displays, frequently arranged to illustrate conventional epistemological hierarchies and classifications [19]. Behavior-based objectives are not always the most efficient approach to facilitate learning, especially in unstructured or informal learning environments [19, 20]. Within the past three decades, other learning theories have become prevalent in exhibitions. Along with the change in theories, an altered definition of learning itself has come into play.

"Learning is now seen as an active participation of the learner with the environment...and therefore, (museums) become central to any educational effort when the focus shifts from the written word to learners' active participation through interaction with objects" [19]. 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.

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 with interaction and environments for learning can be attributed to Dewey's [21] 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 [22]. 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 individual previous experiences and their present experience in the museum. Dewey also acknowledged the continuity of personal experience; that one experience builds upon the previous. Within a museum, this implies that visitors' learning is not a static operation and learning is an ongoing, lifelong process. He also recognized the relationship between a learner's context and the way in which they learn.

According to Dewey [21], "the principle of continuity of experience both takes up something from those which have gone before and modifies 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. An experience is as it is because of *the transaction* taking place between “an individual and what, at the time, constitutes his environment” [21]. For a museum environment, these two principles suggest that individual visitor backgrounds and the environment impact one’s experience.

The experiential learning theory [23] 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 in these ideas.

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” [24]. 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. Furthermore, visitors ‘construct’ their own knowledge from the meaning in the exhibit. This leads to a different focus when considering 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” [25]. 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 growing 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” [20].

Contextual Model of Learning: Falk and Dierking [10, 11] 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 ephemeral, always changing. Ultimately, then, learning can be viewed as the never-ending integration and interaction of these three contexts over time in order to make meaning.

Each of these three contexts is continuously constructed by the visitor 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 accounts for far more contexts than any of the previous theories and is specifically aimed at museum type learning. Falk and Dierking [11] acknowledge that there are numerous 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 (i.e. a family group); facilitated learning (i.e. docent interactions); pre-arrival orientation; design; and reinforcing events outside of the museum. The success of the museum learning is varied and based upon the successful implementation of these eight factors. For effective learning to take place within a museum, all eight of these factors should be considered when planning.

Multiple Intelligences Theory: Howard Gardner’s Multiple Intelligences theory recognizes 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: (1) linguistic (out of which writers and poets are made); (2) logical mathematical, which traditionally leads to success in school and of which scientists are made; (3) musical; (4) spatial (pilots, architects, chess players and surgeons exhibit these

skills); (5) bodily kinesthetic (in which the body serves as the agent for solving problems or fashioning products-dancers or mechanics exhibit this intelligence); (6) interpersonal (understanding other people, exhibited by salespeople and therapists); and (7) intrapersonal (understanding self) [26]. 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 [26]. These multiple intelligences are widely considered when planning for exhibition design.

Conceptual Framework: An earlier discussion of learning and educational theory is examined with implications 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 paper discusses the methods used to encourage visitor into having a response and the effect 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, *creating connections through an exhibition experience*, focuses around 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 in effort 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) preparing to deliver a message, (2) setting the scene, (3) designing a whole through the parts and (4) providing layers of information.

Research method: The research question that guided the investigation:

- What are the methods used to encourage visitor into having a response?
- 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 [27, 28] and used now by researchers worldwide (see for example Flinders, [29]; Barone, [30]; Uhrmacher & Mathews, [31]). 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 [28]. 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 are 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 [27]. Thematic in educational criticism are "recurring messages that pervade the situation... a theme is like a pervasive quality" [27]. 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 Exhibition Designer at the Powerhouse Museum, Design and Online Services Manager of Questacon, Head of Concepts and Education of Questacon and the Curator of The Mind Museum, Philippines at their respective centre. Another significant meeting was conducted at Petrosains, Malaysia with The Executive Director of Experimentarium, Denmark during his recent visit.

Next, the author observed and record 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 the ways in which creating interest and curiosity themes actually emerged at the core of the exhibition design process. Next, following Eisner's ideas about "selecting a focus" and "building a plot" [27], 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 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 in 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.

Preparing to Deliver a Message: An opening to any exhibition exploration is simply by reading the title. As the visitor may have read the title even before setting foot in the museum, is it important to select a title which will be clear and marketable to the general public. Curator of the Mind Museum, Maria Isabel Garcia stressed the need for brief, but suggestive titles to elicit personal interest:

[Exhibition] titles are important to the marketing department because when we create collateral, you want something that is going to be easy to market and easy for people to grasp and understand as they visually see it.

As expressed by Garcia, exhibition titles are important - they can serve to introduce the topic, set the overall theme and provide visitors with enough insight to the message behind the exhibition to draw them into the museum. Visitors begin to reason the potential value of the topic and message behind an exhibition in a numerous way. It is important that science centres provide cognitive understanding in delivering the message. Asger Hoeg, Executive Director of Experimentarium revealed the stages of visitors' cognitive experience:

And I also explained the 5 stages of ... [cognitive understanding] ...you had to perceive and then the intrinsic translation of what is happening and then the explicit translation of what is happening and the other evaluation. If you evaluate positive than you actually cognitive...you understand it and also emotionally you understand it, so these 5 stages are very important.

As mentioned by Hoeg, emotional understanding comes from positive evaluation that happened in many stages. These stages of translation in cognitive understanding leads towards the meaning making in exhibition experience. Accordingly, the exhibition design and the overall experience a visitor has in the exhibition space will ultimately deliver the message. The exhibits, the space, the flow, the overall design - these elements of the exhibition all impact the visitor's experience.



Fig. 1: Universe Exhibition Gallery of The Mind Museum

Every detail about how the design is conceived affects how visitors will react and connect with the exhibition and its content. The design is an important part of the message explained Fiona Blades, Exhibition Designer at the Powerhouse Museum:

I think the way you have [an exhibition] set up has a huge impact on how people view what's there. I mean, the kind of design we do really is part of the overall experience and it helps people... You send messages with the kind of design you do as much as the topic you're doing and what exhibits on display. The design is all part of that message that you're sending out. So, I think it's important in the way you lead people through the exhibitions, what you show first, what you give more emphasis to, it's all part of that.

As suggested by Blades, the way an exhibition is designed should reinforce the message and content behind it. The objects, colors and path through an exhibition are most effective if selected for reasons which support the idea they are striving to tell. Transparency of the design elements can add to the affectivity of communicating the message. Sometimes the aspects of an exhibition design which go unnoticed can be the most important to delivering a message, noted John Richardson, Design and Online Services Manager:

As at the MiniQ furniture, that is about scale. 0 to 6 is massive age difference ability and so on, physically as well, so within that space there are a few spaces for very tiny kids where everything is at various scales. We also have to recognize parents and guardians taking their children through. So that is why it is a separate set of experience as well, because the older and the younger ones, putting that aside, is about trying to communicate scale, which is relevant to that audience. There is also because our workplace safety, legislation and so on.

As suggested by Richardson, how the message is conceived physically all play into designing the message that will be received. The targeted audience for a particular exhibition is an important consideration for the Museum relative to the design. Providing elements in the design that make the audience feel welcome and comfortable in the exhibition can go a long way in terms of helping visitors find a connection with both the exhibition space and the message.

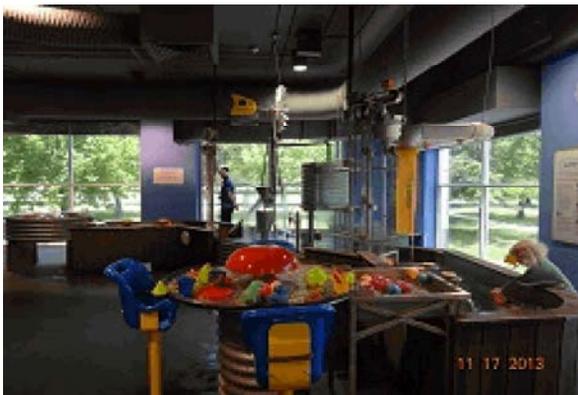


Fig. 2: MiniQ of Questacon

The selection of colors or objects, as described by Maria Isabel Garcia, Curator of the Mind Museum, are both design elements which can provide visitors with a sense of comfort and familiarity:

Maybe the most important thing that design can do is get people a kind of comfort level. Like, this feels familiar, or they're speaking to me or there's a color that speaks in a more positive way. Part of it is trying to understand it and, again, I think the design needs to speak to them somehow...through the combination of things.

As explained by Garcia, the Mind Museum seeks to carefully chose and align the specifics of an exhibition design with their target audience(s). The designers hope to combine design details that will speak to visitors, but only if the overall space feels inviting enough will it make them look closer. The data further suggests that objects at the Mind Museum are presented in a context to provide both a point of entry to science and to help visitors to shape their experience and ideas. The display elements, informative text, visuals, audio and multimedia components are utilized to help provide a more concrete experience and contribute to the lens through which visitors view the objects on display.

The integration of all these elements adds to their collective impact - there is strength in the gestalt of combined elements working together to tell the same story. As described by Barry (1994), "gestalt...embodies a sense of natural unity in which combining elements complement each other so strongly that they become something different" (pp. 116). Based on the descriptions of science centre exhibitions, when elements are combined effectively, the visitor's exhibition viewing is transformed into a whole experience.

Setting the Scene: Science Centres are an environment where science discoveries, visual imagery and interactive technology can meld together to elicit new personal connections and experiences. The combination of elements in a science exhibition can offer visitors a unique experience in a space that cannot be found elsewhere. Cindy Chambers, Head of Concepts and Education at Questacon, described exhibitions as pushing the boundaries of learning:

[Exhibits] ...can be wonderful, nowhere else can you go into these spaces that kind of transform floor space into hands-on settings and explore topics that you can't do by reading a book. This is always the example.

As suggested by Chambers, museum exhibitions have the potential of being immersive environments that bring ideas and science to life. The space in a science

gallery can be designed to temporarily transport visitors to another time and place. The layout, visual appeal and feel of an exhibition space set the scene to immerse visitors in a transformative experience. The physical space has an impact on people, explained Maria Isabel Garcia, Curator of the Mind Museum:

I think things that have impact on people are the space they're in. It's like the feeling in a space under the night sky. I mean you walk in there and immediately it's darker. It's more intimate. It focuses you on those views ...the planet...you walk into the rotating tunnel and it opens up. I think the experience of three-dimensional space really impact people. I think people respond to great objects, particularly big ones.

Garcia's comments support the notion that whether through the layout, the lighting, or the objects, the overall impression of an exhibition space needs to make an impact to draw in visitors and make them want to see more. Exhibition Designer at The Powerhouse Museum, Fiona Blades, emphasized the importance of an engaging physical exhibition space:

It needs to be interesting... I think being engaging is the most important. I think a lot of people, specifically now with technology and just the level of where we are in terms of entertainment and being entertained, it has to compete with that because as a museum, we compete with movie theatres; we compete with things they think is culture. So, the definition has become so loose where now it's lumped into this whole leisure time activity part of that. So, it has to be engaging enough to compete.

As Blades suggested, although the Museum offers unique experiences, it must compete for visitors with other leisure activities, including movies, gaming and other venues with high-end, interactive technology experiences. Staying competitive with entertainment options driven by technology is particularly important when it comes to younger audiences. Integrating technology into the Questacon is always in the design plan, described Head of Concepts and Education Cindy Chambers, particularly for interactive spaces designed with excitement in mind, it was the design factor:

We knew for the ExciteQ's gallery we wanted technology to be a tool for connecting visitors to science and senses. So, technology was always part of the plan.

Chambers acknowledged that using technology in the Questacon was important to draw and engage certain audiences. Technology was included as a design element that would make the exhibition interaction more conducive to helping visitors make connections with science. For some visitors establishing connections might be aided by providing interactive technology; for other visitors, immersive contexts and informative graphics might be more effective in forging an understanding of the content presented. Since visitor age and reactions vary, design methods should vary as well. Design is the key factor for experience, stressed Asger Hoeg Executive Director of Experimentarium:

Design is a key factor. Yes, it is because if you do not remember all this good points, then you design an exhibit where people cannot understand what is happening and the function is not quite clear, you don't use the idea of nudging and so on and then you got frustrated visitor that walk out and will never come back again. If you do not understand what is going on you never go there again.

Hoeg's remarks suggest that the experiences that are delivered to visitors in science centres must be designed in a way that makes one understood, feel good and transformed. Ultimately the end goal is to design an exhibition space which help visitors connect with the content - connect with the science phenomena. As stated by John Richardson, Design and Online Services Manager:

If they are not connecting with what they are seeing, then nothing we do that follows up on that visit is going to help very much. If they are disinterested or disoriented or unhappy...that's hard to overcome and the centre is in one sense it's a physical space with interactive that you want to share with the public.

Richardson's comments suggest that although the exhibition design is built on details, the overall look and feel created by the combination of those details is what sets the scene for visitors to enter an exhibition ready to interact with the space and walk away with new information. The variations of exhibition gallery space are a part of Experimentarium renewal and expansion as commented by its Executive Director Asger Hoeg:

This is five levels. It is about 2800sqm so it is not open plan, levels on levels. On the 1st floor it will be the light gallery. That is gallery that accept light

coming down. The third floor will be the dark gallery. There will really be no light coming in. On the third floor we also have the exhibition area where you can come out to exhibition area that is also a dark room and then the 4th floor will be open air. When they change the exterior of the building then it was the chosen project.

As stated by Hoeg, the variation of light and dark galleries suggests change of mood happening in various levels. The exterior design is as equally important in determining the overall impact of a science centre. The exterior physical form is a landmark and the interior exhibition galleries are the setting for different science theme. The physical space is the hook to the emotional connection - which, according to Maria Isabel Garcia, Curator of the Mind Museum, is what visitors will take away with them:

I think it's the power of being in a physical space that challenges you to connect to the information in some way, it's the whole, I believe in the whole aesthetic.... I'm much more interested in the power of museum learning to stimulate people's imagination and kind of the affective outcome, their emotional reaction to a topic or to an experience. I feel that's what attached to people.

Garcia stressed that creating a whole aesthetic experience is what will leave a lasting impression on museum visitors. As commented by Asger Hoeg Executive Director of Experimentarium, the application of scenography in science centre is necessary:

In the Experimentarium there is no scenography. Well my comment is that when I started 25 years ago I said scenography is not necessary. Today I would say that you have to immerse your visitor into a kind of kingdom and you must use scenography in a gentle way to nudge the visitor to feel that they are in an environment where they are supposed to be curious and so on. You need scenography but scenography alone is not enough. There are a lot of science centre in the United States where 90% scenography and 10% hands on. That's not good.

Hoeg acknowledged that the used of scenography is expected in today's experience economy. However, hands-on exhibits will still remain the real tool for informal learning. Designing a complete exhibition experience requires careful consideration and assembly of many separate parts.

Designing a Whole through the Parts: As suggested by a number of the respective interviewers, the design whole is more than the sum of its individual elements. The benefit of four kinds of experiences is suggested by Asger Hoeg Executive Director of Experimentarium:

For sure that if you had four kind of the experiences, then you are in the sweet spot. Then you have really the pleasures of the mind then you go out of the Experimentarium willing to come back again. That is why I want to add a kind of experience also in a science centre. If you go to an Art museum, there are a lot of aesthetic, also escapist experiences but not so much entertaining and perhaps not so much educational. That is why I want to mix art, artifacts and hands-on. I think if you look at an animal, perhaps an animal is entertaining and also aesthetic, but perhaps not so much educational and perhaps not so much escapist. A science centre to (entertaining and educational) area, therefore I want all kind of experiences design into those experiences.

Hoeg commented that repeat visitors are a result of 'pleasures of the mind' when they had all the four kind of experiences. Science centre needs to deliver a successful experience that involve all four realms of educational, entertaining, aesthetic and escapist experiences as an underline theory by Pine and Gilmore.

The design of an exhibition includes every small detail that surrounds the visitor and the combined impression of all those details is what impacts the experience a visitor will have. However, there are the limitations in practice as described by Design and Online Services Manager, John Richardson:

In terms of working out all of the experiences from design perspectives, I guess we don't really get ask to comment on that. We just get ask to make work what the idea being presented either from exhibition concept perspectives or what the executives want. If it's too much of the same, although we do not decide on the variety of experiences, we throw ideas whether we can do this differently. Make it a 'different' feel so you can be having a different experience than the previous gallery that you visit to.

As commented by Richardson, designers are cautious of the visitor experiences and do suggests on varying the experiences where ever possible through differentiating

the feel from one gallery to the other. The designed elements and the way a visitor connects with them form a designed experience, as explained by Curator of the Mind Museum, Maria Isabel Garcia:

I think what important to remember is that it is all design. Every exhibit you walk into, it's all about the design. When you as the visitor, experience an exhibit, what you're experiencing are the interactive and designed spaces.to the visitor, what matters is what my experience is in that gallery and my experience in that gallery is a designed experience.



Fig. 3: Central space at Questacon

According to Garcia, a designed exhibition experience is shaped by the integration of all the parts. This kind of integration should result in a fluid exhibition design, immerse like reading a good book. Part of the design challenge faced by science centres exhibitions, is finding ways to make all the pieces work well together and contribute to the whole. Another common issue in designing exhibitions is overcoming museum fatigue as highlighted by Design and Online Services Manager, John Richardson:

It's important about pacing, giving this new experience each time. This is important as museum fatigue aspect of them. It is presumably over the visit, their interest starts diminish as

they go through so we try to make them engaged as much as possible by differentiating the experience there. Each one is different and the moods of course to support that. But, as said before, the main focus is still on the exhibits. Some of the spaces like the big drum space have that mood, light and dark and all of those intertwined.

Richardson suggested that modulate different experiences be considered in the layout. Visitor interest is controlled by pacing and this benefit how an exhibition will be received. Curator of The Mind Museum understood the need to meet this challenge to integrate design elements. Garcia reflected on the core aim to be aware of the interconnection established between all the design elements:

The colors and the graphics worked extremely well throughout the space. It was a huge consideration. We strove to make sure that all the spaces related and that throughout the use of fonts, and graphics and color palettes that there was this constant relationship between the spaces, yet a certain amount of individual identity to each.

As emphasized by Garcia, the individual design elements carry weight and importance of their own, but they also should contribute to the larger complete experience. The interplay among energized spaces and how the contemplation spaces relate to the information presented are critical in communicating content to visitors. To create a strong exhibition design, the layout must be balance. Similarly, the separate elements and the whole look of the exhibition must be aligned with the content and descriptive labels. As stated by Exhibition Designer Fiona Blades:

The look of the exhibit has to be in tune with the content. So, for example, if you had designed it to look the way it does, but then you had labels so long with heavy information and you didn't have the interactivity but you just had the fun look of the space, it wouldn't be a cohesive exhibition. A lot of times people don't notice when something is designed well because, they notice when something's wrong. For example, the exhibit at the central space, it's quite difficult but well designed for the content.

Blades' quote supports the notion that separate exhibit pieces must support the whole and the design must fit the content. If designed well visitors will not focus on the design or the combination of pieces, but they will appreciate the content and be drawn into the cohesive exhibition experience. Good design or bad design can make or break an exhibition; design can promote an evocative experience for visitors or crush the potential to help visitors connect with meaningful content.



Fig. 4: Differentiation lighting at Excite@Q of Questacon

John Richardson highlighted the meanings of immersive in science centre through its connection with the exhibit:

Questacon point of view is that in exhibition design, the most important thing is the exhibit and not the surrounding. If it is the balance, then the shift is to the exhibits. Immersive in exploring the exhibits is the unique thing that we offer - the rest of it; the immersive feel is there to support it. The 'pay-off' if you'd like - to the public, is the experience they had with the exhibits. Both things apply. Because we present different exhibition and each have a different identity, branding and feel to the design, we do it for the marketing perspective. We can hire the travelling exhibition out and it's a new product, it's a new dynamic experience different from the last one set. We invest in that kind of set work.

Richardson commented that experience with the exhibits is the real benefit of immersion in science centre. The travelling exhibition also benefit from these quality exhibits that offer unique identity and feel to the design. Asger Hoeg Executive Director of Experimentarium comments on the importance of scenography in science centre exhibitions:

Scenography is only the tool to make people work with the hands-on exhibits. So you need scenography but not too much and don't believe that scenography can do the work. It is the hands-on exhibits that do the work but scenography can nudge the visitors to do and work with the hands-on exhibits.

As suggested by Hoeg, scenography is only a tool to nudge the visitor to be curious with the context and be more immersed in the hands-on exhibits. Furthermore, he stressed the crucial role that design plays in providing visitors with a rich exhibition experience:

The theme in a science centre is a challenge. What can the visitor find out? What is now happening...and what is now happening? I can give you a very good example of scenography because there was a submarine conquered 1944 in World War II that go to Chicago and it was then displayed in the Museum of Science and Industry in Chicago. I visited this submarine 20 years ago and OK there was a submarine, but then they built a building around the submarine and then they used the submarine via scenography ...and then after let say 20 minutes of introduction, you came to the submarine and I got tears in my eyes. There it was and so I was much more interested in the topic. So the scenography is to make people be ready to work with what you're supposed to do, to look at the submarine, to be interested in the story. So you could actually say scenography should bring visitor to a flow. Help them bring them into flow with the help of the surrounding.

According to Hoeg, the design must unify the content, objects and exhibition elements in a comprehensive and powerful way in order to reach visitors. He acknowledged that scenography acts as a flow in the narrative context. The object and information is enhanced in an immersive environment. Hoeg suggested merging elements to create a cohesive exhibition is necessary. Not only must the parts of an exhibition be assembled in a manner that generates a powerful and meaningful whole, the design team must take into account the variety of visitors who may pass through the exhibition. One way to address the range of possible visitors in an exhibition is to introduce different levels or layers to the presentation of content in an exhibition.

Providing Layers of Information: Layering information can be achieved by varying the depth of information provided, or by using different formats and styles to engage visitors. Exhibition Designer Fiona Blades described how addressing visitor needs and layering information are part of their design process:

We always think when we go through a design process; we try to always think in terms of: what is the take away message? How is the visitor going to react to this? Does this meet the basic audience visitor needs? We always try to provide a study track for those who have more time and what to dive in deeper into a message and we also try to provide a fast track for people who have a more limited time and interest, get the big picture and move through an area a little more quickly.

Blades acknowledged the need to design with the understanding that different visitors plan to spend more or less time in an exhibition and expect to gather different amounts of information from their visit. Some want to emerge with detailed knowledge; others just want to understand the primary message. Presenting exhibition content at varying levels of detail provides enough depth to meet various visitor needs. Since different people also absorb information in different ways - depending upon age, education, background, interests and a whole host of other factors - allowing for multiple levels of visitor interaction is important. An exhibition design has to be engaging on so many different levels - visually, sensory, intellectually, emotionally.



Fig. 5: Exhibitions with variety at The Powerhouse Museum

Designing layers into the presentation of information can provide a cross-section of planes through which visitors can make connections with the exhibition content.

Layering the exhibition content is in line with Gardner's theory of learning styles and multiple intelligences [32], which as Cindy Chambers, Head of Concepts and Education at Questacon explained, applies to everyone:

I think its layering, different ways, I mean this is the educator [talking]...the Gardner theory of learning styles isn't just for children. It's for adults so the layering of information...We knew that from testing that children need little invitation to become involved. So the experience has to be the first thing they do. The riding on the wheels, the climbing on the construction site, the leaning over and we wrote the labels in a tone that while the kid is doing that we know the parent can be reading that either aloud or to themselves.

As noted by Chambers, some visitors need a nudge of encouragement when it comes to looking more closely at museum exhibitions. Using layers can be a means to draw people in, by getting their attention through an outwardly obvious and engaging layer and using that layer to encourage visitors to look more deeply below the surface.

According to Serrell [33], exhibit planners frequently use the words "layers" or "levels" to describe the way exhibition information is organized. Relative to exhibition labels, she suggests that the types of layers or levels which prove to be the most effective to convey a hierarchical nature are: purpose, intrinsic complexity and amount of time required for visitors to use them. The science centres provide a mixture of learning opportunities for visitors by varying the topics, design elements, interactive and media used in exhibitions. Layers and multiple points of entry for making connections are possible through variety. The Powerhouse Museum tries to offer variety, said Exhibition Designer Fiona Blades:

We try to make sure there are a variety of things. Given the different ways people learn, you know? You just don't want all words or all...but putting a mix of things in there because people have different learning styles, putting audio and video in there, putting interactives in there to sort of engage people, all of those are really important considerations to make when you're thinking about the audience and the subject matter together so I think you have to keep all of those things in mind.

Blades indicate that the Museum offers exhibitions with variety on multiple levels - in the kind objects displayed, the sensory experiences provided, the layers of information presented, the learning styles implemented, the types of media utilized and the levels of interactivity afforded to visitors. The layering of all these individual design components contributes to the strength of the whole.

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, *cultivating connections through an exhibition experience*, 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 preparing to deliver a message, setting the scene, designing a whole through the parts and providing layers of information. The various design techniques discussed correspond quite closely with findings in Hood's [34] 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 key component to 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 combined to create a whole multi-layered visitor experience. The case studies offer multiple levels on which visitors can make connections with the varieties of subject range in addition to interdisciplinary approach to exhibition themes. Science centre strives to convey science concepts, issues and its related technology in application to human life and the environment. Careful attention is given on how the exhibition design elements and physical space are combined and presented to create an appealing, inclusive, multi-layered visitor experience.

Pine and Gilmore [35] 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 truly 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.

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