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THE MULTIPLE ROLES OF EXHIBIT LEARNING IMPACT ASSESSMENTS IN A SCIENCE CENTRE

Dr. Paulo Henrique Nico Monteiro
Instituto Butantan
Chantal Barriault
Laurentian University
Nelio Bizzo
Universidade de São Paulo

ABSTRACT: Visitor's engagement with an exhibit could be considered as an important learning indicator and predictor. Based on this idea, Barriault and Pearson (2010) proposed an assessment framework, which has been constantly used by a Canadian Science Centre - Science North for different areas and proposes since 2005. This paper presents and analyses this experience as well as discuss some features of this framework as accuracy, feasibility and adaptability for other contexts. Documental analysis and interviews with Science North science staff and directors were held in order to deeply understand how this assessment method has been used at this Science Centre over these 10 years. All interviewees pointed that data collected through this method has been used to make changes in an exhibit in order to improve visitor's engagement, in floor-staff training programmes, as an important information for international partnerships and sales and, more recently, as a Centre's management indicators. In addition, all respondents stressed the accuracy and feasibility as strengths of the tool as far as data collected is easy to understand and "make sense" for all staff. Science North's experience shows that collecting and analysing learning data can play an important role in providing useful findings for different areas of a science centre, and could be an important way to improve visitor's experience at the museum.

KEYWORDS: Learning; Assessment; Museum.

INTRODUCTION

There is currently consensus that scientific knowledge is not only gained through formal schooling, but also through important informal opportunities for the general education of citizens. There are many ways and places that purport to discuss and engage people in scientific topics. Among these, there are the science museums and science centres, that occupy an increasingly important space in society and mostly, though exhibitions and activities with clear educational goals.

There is little doubt that museums and science centres are places where learning related to science concepts, methods and scientific procedures can occur (Hooper-Greenhill, 1994; Falk, 2000 and 2011; Benze and Lemelin, 2001). In other words, it is widely accepted that museums and science centres are learning venues.

Due to the unique characteristics of museums, the learning and skills which are developed through the activities in these spaces, must be understood and studied with different methodologies than those employed in the school environment, to the extent that there are different and distinct factors that influence the learning process, as well as the characteristics of the environment and the situation in which the learning occurs. Aspects such as the relative brevity of the visit, time management, the centrality of the object in the pedagogical relationship and the possibility to choose *what*, *how* and *when* to learn in a free-choice learning process (Falk, 2001) are fundamental to the understanding of how learning occurs in the museological spaces.

As a result, it can be challenging to assess learning in these settings. There are many frameworks and methods such as pre and post questionnaires, stimulated recall by video or photos, Personal Meaning Mapping (Falk, 2000), among others and each method focuses on particular aspects of learning and has its limitations.

The variety of studies and theoretical frameworks that address learning in informal settings has led to a diversity of methods to assess the learning that occurs in these settings. This diversity stems from the variety of types of museums (Hein, 1998) and from the different ways that museum professionals understand the nature of learning (Rennie and Johnston, 2004).

Based on the understanding that learning is an active process of meaning making, and that it is influenced by social and cultural contexts, Barriault and Pearson (2010) developed a framework to assess the learning experience in science centres. The authors argue that the visitor's engagement with an exhibit is an important learning indicator and predictor. Barriault and Pearson (2010), among others (see Boisvert and Slez, 1995; Falk, 2001; Rennie and Johnston, 2004) suggest that to assess learning in museums and science centers, it is necessary to include characteristics related to the engagement of the visitor with the exhibit and that engagement can be observed through visitors' behavior and dialogue as they interact with an exhibit or object. Their framework consists of a series of observable behaviours within engagement levels that capture the nature of the learning experience with the exhibit. (Barriault and Pearson, 2010). It is important to point out that the goal of the framework is to assess the potential learning impact of the exhibits or the object. Therefore, the tool does not focus on visitor characteristics nor does it aim to evaluate visitors' knowledge about the object or issue discussed.

Figure 1 briefly presents the visitor engagement levels and the first level of observable behaviours, which, in turn, can be indicators of learning.

Engagement Levels	**Learning behaviours**
Initiation	Doing the activity Spending time watching others engaging in activity or observing the exhibit
Transition	Repeating the activity Expressing positive emotional response in reaction to engaging in activity

Breakthrough	Referring to past experiences while engaging in the activity Seeking and sharing information Engaged and Involved: testing variables, making comparisons, using information gained from activity

Figure 1: Visitor's Engagement Levels. Adapted from Barriault and Pearson, 2010, p.96

By applying this tool to observations of visitor behaviours as they interact with an exhibit, and by quantifying the engagement levels in a graph, one can create a "visitor engagement profile" (VEP) for individual exhibits. The VEP indicates the percentage of visitors that achieve each of the three levels of engagement. (Barriault & Pearson, 2010, p.98).

In this same article, the authors present a series of observable behaviors, such as "doing an activity incompletely", "changing variables to analyze the results and testing hypotheses", "carefully reading the information" and "discussions with the museum team or with the group ", among others, and relate them to the levels of involvement described above. From this analysis, profiles of engagement of the evaluated information were elaborated indicating the percentage of visitors that work at each of the three levels. These profiles indicate, therefore, the visitor engagement profile of a specific exhibit. These profiles are the subject of discussion by the team responsible for various areas of the center in order to seek explanations and suggestions for improvements in views that are not displayed in the desired or expected profiles.

In addition, they present a model - Visitor Engagement and Exhibit Assessment Model (VEEAM) - that seeks to synthesize the relationship between the collected data, the educational references that underpin the method, the visitors' engagement profiles of the exhibition and the process of modifying the exhibition itself. "The Model outlines the process for (a) analyzing the engagement behaviors elicited by an exhibit and then (b) using

the analysis to modify the visitor experience of that exhibit." (Barriault & Pearson, 2010, p. 101)

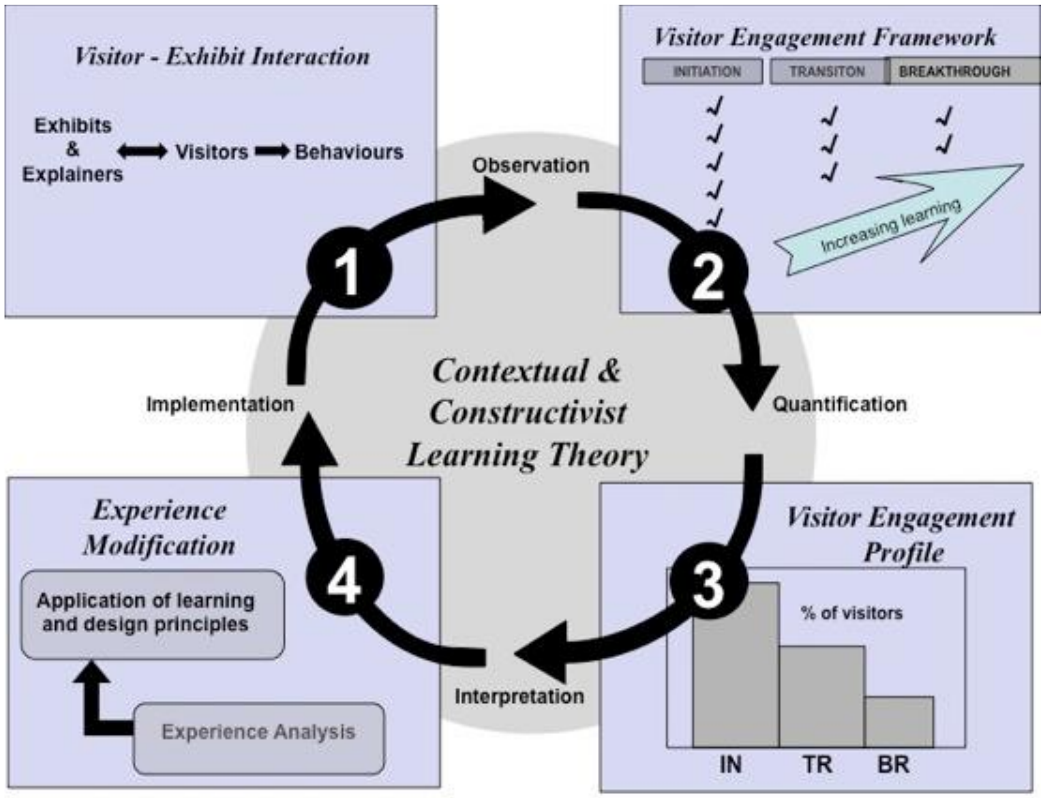

Fig.2 – the visitor Engagement and exhibit Assessment Model – VEEAM. (Barriault & Pearson, 2010, p. 101)

Since 2005, a Canadian science centre – Science North, Sudbury, ON. (SN) – has been using this framework in many ways and for different purposes. This paper aims to present some of these applications and discuss how information about the potential learning impact of exhibits can be useful in improving the visitor experience and as a management tool in a science center. In addition, we discuss some features of the tool in order to understand if data collected through it make sense and are useful for people who work at the centre.

METHODS

Interviews with Science North's staff and directors were conducted, in order to understand the role that information about the learning impact of exhibits plays in different departments of the museum and in various management levels and if this information is useful in day-to-day work at the museum. These interviews are the main data source of this paper and would be referred to as I1, I2 until I11.

In addition, documents such as Science North internal reports were analysed to better understand the applicability and usability of this framework and its methods. Meetings were held with science staff in order to understand how information about the learning impact of exhibits is used in the daily operations and the strategic long term planning of the science centre.

RESULTS AND DISCUSSION VARIOUS USES OF INFORMATION ABOUT ENGAGEMENT AND LEARNING

Besides the inherent function to generate information about the visitor engagement profile (VEP) of individual exhibits and possible visitor learning outcomes as a result of the interactions between visitor and exhibits, the proposed assessment model has been used in last 10 years in various areas and with various purposes at Science North.

It is worthwhile noting that Science North's staff and directors strongly believe that not all exhibits have or need to have the same engagement potential. Their goal is that the visitor may have a significant experience in the Centre as a whole. The following two excerpts clearly indicate the common understanding of the Centre's professionals about the need to provide a balanced experience: "so when we design an exhibit we say we want a certain percentage of breakthrough behaviours exhibits, a certain percentage of

transitional exhibits" (I3); "So you want to balance exhibit types, you also want to see balanced engagement levels". (I8)

The concern is that visitors do not feel tired or unmotivated during the visit with a high level of engagement required by the visit as a whole: "what we found very interesting is that we determined how to build exhibits to get more breakthrough behavior, but what's really interesting is that we discovered that we can't have too many of those exhibits because then we have visitor fatigue."(I2) and

> You know, from our experience, we understand that the Science North as a whole must offer a balanced experience: 30% of the exhibits should provide a high degree of involvement (breakthrough), 40% medium (transition) and 30% lower (initiation). Without this, visitors can be exhausted and uninterested by our exhibits. (I10).

First, the main result of this evaluation is the opportunity to propose changes in an exhibition based concrete information and empirical evidence. The information enables, for example, the analysis of the location of explanatory panels, the emphasis on one type of information over another, the exhibit features geared to certain age groups, the testing of new exhibits, the spatial arrangement of objects etc.. This is demonstrated by the following quotes from interviews: "if we can observe people interacting [with the exhibit] we can change them, especially if you have the possibility of making prototypes before" (I4); "we have made several assessments in our prototypes to see if what we think and what we think is good on paper actually involves visitors" (I1);

> When we made a general change on the live animals' floor we were asked for a complete evaluation of almost all exhibits. We have seen, for example, where the panels with information about the animals (signage) was not good. We thought it was all right and many people do not see these panels. It was only changing the position and content and we realized that people did come to read and engage more with the exhibit. Some

> changes in the layout of the habitats on the floor were also based on that information. (I3).

The second important finding from this study is that Science North uses the framework to inform training of the explainers or floor staff. The results of exhibit assessment have been used in educators' (Bluecoats) training in each of the areas, in order to qualify their perception of the engagement of visitors. Some of the interview responses reinforce the formative role of the tool: "I use the evaluation reports for the training of my Bluecoats team." (I5); "always discussed with them [the floor staff] this framework." (I2); "part of the job with my group of Bluecoats is to discuss the engagement levels." (I7);

> When new Bluecoats are hired, they undergo a period of training and work with the evaluation reports [using this tool]. They also spend a few hours understanding how the filming is done, and how coding and analysing visitors' behaviour. (I10)

It is also worth mentioning that much of the exhibits at Science North have been structured in such a way as to allow objects (or animals, in some cases) related to the exhibits to be handled by the visitors in a "laboratory bench" style space, where floor staff engage with visitors, trigger discussions or explanations and develop experiments on the subject in question. The idea is to simulate the scientists working in the area and this makes the team working with the public playing an integral part of to the visitor's experience. Because of that, Science North needs a floor staff capable of recognising and understanding behavioural indicators about visitors' engagement in order to encourage and improve it. This framework tool helps the development of this kind of skill and perception in staff.

In addition, results from this assessment method are widely used by the International Sales department, which is responsible for establishing business partnerships with other institutions. This department is important in the strategic direction of Science North, to the extent that it is responsible for

approximately one-third of the annual budget of the Centre. In the interview with the Senior Manager for this department (Travelling Exhibits), the importance of such information to qualify and, in a way, add value to the institution was clear:

> So, we can present a special product that is proven to succeed well from an educational point of view and pointing this out to our customers for their success as well. So, this team uses this framework [evaluation] as a sales tool. (I7)

For this senior manager, the inclusion of information about learning assessment in Science North's promotional materials provides important and relevant information, "for all who work in museums and science centres" and "shows the seriousness of Science North in regard to our educational intentions". In addition, she pointed out that the decisive factor for some partnerships with other institutions is the availability of the learning impact information: "I can say that at least three of them [partnerships] were signed on the basis of this information on learning". In addition, she stressed that this kind of information about learning impact of exhibits is unprecedented, and somehow original, in evaluation museums' reports and promotional materials, "I have never seen material [promotional] that has been presented with this kind of information." (I7).

Finally, since 2008, evaluation data on exhibit engagement profiles and learning impact have become part of the institution's overall evaluation report, which they refer to as the Organizational Scorecard. In addition, the results of these evaluations are part of Science North's official reports to the provincial ministry, from which the centre receives some of its operational funding. All respondents considered this as confirmation of the central role that learning assessment plays in centre as well as at a statement of the seriousness, reliability and accuracy of the method and tools used:

> For us it was a battle to put such information in this document [Scorecard] which deals with institutional goals and objectives achieved or not (...). We had to convince managers [CEOs] that the information was serious and the methodology quite rigorous. It was indeed a victory and today this information makes up an important part of this report and is indicator of quality. (I10)

This information has become part of the Centre's management indicators for the development of their strategic plans, "the educational dimension became part of the Scorecard (...). Administrators were not accustomed to discussing this kind of information. Today it happens naturally" (I10). Science North now considers information about learning as one of four pillars of institutional success, which gives credibility to the educational goals and achievements of the centre.

> Typically, organizational performance is measured by financial performance, achievement of goals and visitor satisfaction. The Science North Scorecard now includes an assessment of learning. This inclusion shows the importance of learning assessment studies in assembling the steering strategies and begins to guide decisions about the visitor experience at the executive level of the institution. (Barriault, Pink & Henson, 2011, p.81)

CHARACTERISTICS OF THE ASSESSMENT METHOD: FEASIBILITY, ACCURACY AND APPLICABILITY

For the purposes of this paper, feasibility is understood as the ease with which this assessment process can be put into practice, as well as the challenges that one might face in practice. Two dimensions of feasibility will be discussed. One is related to the understanding and relevance of the information for all the Centre staff and the other is related to necessary conditions to implement this kind of assessment process in a science centre or museum.

The first dimension of feasibility was brought up often by the respondents in this study and that it is one of the main positive features of the method as a whole. All respondents claim that the framework and tools are easy to understand even upon first learning it, and that information collected "make sense" (I4) for those who deal with the public on a daily basis: "It came pretty easily, easy to discern what level of interaction a visitor was having with a particular exhibit" (I5); "Yes, I mean we, we always discuss with our staff things that we learn with this information." (I1).

Another positive feature is that the behaviors described by the tool are quite familiar to professionals who work with visitors, so the assessment tool confirms perceptions that professionals may already have about how visitors are engaging with exhibits. The following examples clearly show this aspect of the tool: "it made sense to them [floor staff] because they had also watched visitors do that" (I10); " they [floor staff] haven't studied it that much, but they know that the goal is to create it [the engagement]" (I5) ; "in our opinion it's clear to understand, it's easy to understand this, this tools, this labelling, these behaviours, these methods, the levels of breakthrough (...). These behaviours happen every day" (I4); "it's easy to understand and it doesn't seem very complicated, it's easy to see those behaviours in visitors." (I9).

These statements point out that the method is easy to understand both for the professionals dealing with the educational dimension of the museum and for those who do not deal directly with this issue, such as directors and managers.

In contrast, the manner that this assessment method has been used seems to be a limiting aspect of its deployment. Based on the accumulated experience of the last 10 years using the tool, Science North's research team has set the minimum number of visitors to be observed at 100, for each exhibit to be assessed. Furthermore, the days and periods of observation for data collection are chosen randomly to prevent bias. Currently, data are collected

through video recordings and analysed using the *StudioCode*® software that allows marking the times when behaviours of interest occur, coding these behaviours in their own digital video file and exporting this information to other software. To address ethical issues, all the exhibits being assessed display posters informing visitors that video recordings are being held at certain times.

In order to conduct this research, the museum or centre needs a qualified, experienced and available team responsible for analysing such large amount of video data, as well as equipment hardware and software that are not always easy to allocate. Even with this in place, the process itself requires a considerable amount of working hours to analyse hours of video recordings:

> I find it hard to analyze when visitors stay for a very long time, and they repeat a lot of the behaviours. And sometimes you can miss things. So you'll have to go back and watch it again. And you'll really have to watch their behaviour, pay attention to the conversations, try to figure out if they're acknowledging relevance (I9);

> In ten years are we going to have a new software [to assess exhibits]. So it's just if, and I believe we'll see it go that way – there will be enough of a demand that will dictate and push the development of a better tool to apply the framework. Not [a new] framework, but a tool, because that's the limiting factor right now. But in terms of the value of it and the validity of it, it's tremendous (I7)

Therefore, in order to reach the full potential of research and evaluation of the learning impact of exhibits, the institution as a whole needs to believe that this kind of assessment is important and useful to different departments, and make the material, human and financial resources available. Ultimately, the equipment and human resources have to be seen as part of the structure and operation of the museum.

In order to investigate the framework's accuracy or ability to generate relevant, rigorous and useful information about public engagement with

exhibits, a specific question was asked to the respondents: "Does this model of exhibit assessment add something useful and different from what is seen in your daily interaction with visitors?". In other words, we wanted to investigate if the use of this framework adds information to something that was already noticed in daily work or does it just reinforce what was known intuitively. Again, there emerged two aspects in the findings from this question.

The first finding deals with the possibility of generating new information on the interaction of visitors with exhibits and the possibility of illuminating issues that go unnoticed in daily work. The following excerpt clearly addresses this: "I will have to say, there are some aspects we just don't notice (...) it. [the tool] has really helped to improve certain processes for how we provide the best visitor experience as possible" (I3). In addition, applying the framework reveals new information about exhibits that were considered as successful: "people are not robots, so they always surprise you and one of the challenges is that even though an exhibit worked fifteen years ago, it does not mean that it will work today" (I4).

The second aspect relates to the generation of objective data on something that floor staff intuitively notice. Some interviewees emphasized this aspect, mainly because the framework and its results enables staff to quantify these intuitive perceptions. According to these respondents, the methodology of the framework gives rigour and credibility to the assessment, as well providing a way to share results: "It does. It adds the rigour. It adds the concrete data analysis" (I8); "It makes it [the assessment] concrete, not only personal" (I5); "Concrete data. I mean, observational things are personal and it provides concrete things." (I6).

Finally, it is important to note that the framework's applicability in other contexts has been studied. Barriault (2014) investigated the relevance of the framework's application in settings other than science centres and tested the model in North American zoos and aquaria. Her work resulted in changes in

the described set of behaviours for each engagement levels. The author points out that the nature of live animal exhibits is different than traditional interactive, object-based exhibits in science centres and therefor would elicit different visitor reactions and behaviours, which led to a revision of the model itself.

> The "Visitor Engagement and Exhibit Assessment Model", an extension of the framework, describes and predicts relationships between exhibits, visitors and observable learning behaviours. The framework and model have the potential to become practical learning and exhibit assessment tools for practitioners across informal science learning settings, including zoos and aquaria. (...)The revised Visitor-Based Learning Framework provides zoo and aquarium practitioners, and researchers with a valuable tool to assess the learning impact of live animal exhibits through observable behavioural indicators. (Barriault, 2014)

This points to the flexibility of the tool, which has the potential to be applied in different kinds of institutions. Even though there are infrastructure and operational needs to implement the framework as an integral part of an institution, it is noteworthy that this assessment method can be used for pilot studies, individual studies and even in the scope of larger research projects.

Furthermore, it is essential to have clear learning objectives for the exhibit to be assessed as well as expectations of the visitor behaviors as they interact with that exhibit:

> When people ask me if it is possible to apply this proposal in other Centres or science museums, I say that the first step is to discuss what is expected for the exhibit. I ask them: 'what is initial engagement to you in that specific exhibit? What about breakthrough? What do you expect about learning? So, they [tools and framework] have to be understood as flexible enough to be useful to the museum (I11).

FINAL COMMENTS

Science museums and science centres need to have clear learning goals for their visitor experiences with exhibits. Knowing the learning impact potential of exhibits by using tools like the VEP, can be the foundation for museums and science centres to understand and improve the exhibits. Thus, instead of relying only on personal insights, anecdotes or intuition, museums and science centres can base their decisions on concrete data about learning, collected by a rigorous method and analysed through a robust framework. The simplicity and clarity of the assessment method are important features of the tool's usability.

In addition, information that arises from the assessment process can be very useful in many different areas of the centre, such as for training programmes, management, sales, and design, among others.

After 10 years of use at Science North, the assessment tool has become part of "institutional culture". Science North's experience shows that collecting and analysing learning data can play an important role in providing useful findings for different areas of a science centre, and could be an important way to improve visitor's experience at the museum.

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REFERENCES:

Barriault, C. (2014). Assessing Visitor Learning in Zoos and Aquaria: A Revised Framework**.** *Annual International Conference of the National Association for Research in Science Teaching*, Pittsburgh, PA. Avaliable at: https://www.narst.org/annualconference/2014_Abstracts.pdf. Acess: June 10th 2016.

Barriault, C. & Pearson, D. (2010) Assessing exhibits for learning in Science Centers: a practical tool. *Visitor Studies*, 13 (1), 90-106.

Barriault, C.; Pink, J. & Henson, A. (2011). Learning Impact as a Measure of Organizational Success. *24th Annual Visitor Studies Association Conference Proceedings.* Chicago, USA. p. 81. Avaliable: http://visitorstudies.org/uploads/documents/2011%20Documents/VSA%20Abstracts%202011.pdf. Access: 20th aug. 2016.

Bencze J. & Lemelin, N. (2001) Doing Science at a Science Centre: Enabling Independent Knowledge Construction in the Context of Schools' Museum Visits. *Museum Management and Curatorship,* 19 (2), 141–57.

Boisvert, D. L. & Slez, B. J. (1995). The relationship between exhibits characteristics and learning-associated behaviors in a science museum discovery space. *Science Education*, 79, 503-18.

Falk, J. H. (2000) *Learning from museums. Visitors Experiences and the Making of Meaning.* Walnut Creek: Altamira Press.

Falk, J. H. (2001). Free-Choice Science Learning: Framing the Discussion. In: J. H. Falk, (ed.) *Free-Choice Science Education: How We Learn Science outside of School* (chap.1, pp.3-21)**.** New York: Teachers College Press.

Hein, G. E. (1998). *Learning in the Museum***.** London, UK: Routledge.

Hooper-Greenhil, E. (1994) Education, communication and interpretation: towards a critical pedagogy in museums. In: E. Hooper-Greenhil (ed.). *The Educational Hole of the Museum.* (chap.1, pp. 3-27). London, UK: Routhledge.

Rennie, L. J. & Johnston, D. J. (2004). The nature of learning and its implications for research on learning from museums. *Science Education* 88(Suppl. 1), S4–S16.

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