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Using Personal Meaning Maps to Study the Relationship Between Visit Type and Learning in a Scientific Museum

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Abstract

This case is based on research conducted at the Museo Nazionale della Scienza e della Tecnologia "Leonardo da Vinci" in Milan and it is aimed at exploring how museum visitors' learning and experience change due to the kind of visit they take part in. The research considers free tours, guided tours, and interactive labs, which are the three kinds of visits offered by the museum. The method adopted is based on personal meaning mapping, a methodology commonly used in the museum studies field to assess visitors' learning and perception about a topic.

Personal meaning mapping provides qualitative data that consider the background of the visitors

before the visit and their new knowledge after the experience. The method also allows the participant to express his or her personal perception. The qualitative data are suitable to be interpreted through a quantitative analysis, after schematizing the visitors' contributions in proper indexes.

The case describes how this methodology can be adapted to this specific research design, changing the frame of analysis of the gathered data and presenting how to use it. The case provides also some general reflections about the issues to be considered if personal meaning mapping is adopted.

Learning Outcomes

By the end of this case, students should be able to

- Define what the personal meaning mapping (PMM) is, and the theoretical framework that inspires its structure
- Know how to apply the standard procedure to use PMM as a tool for data collection
- Know the characteristics of the learning process in the museum context, and the points that are important to take into account to analyze this phenomenon
- Understand a possible way to change the standard procedure of the PMM by adopting a theoretical categorization of the museum experience
- Assess the pros and cons of using PMM as a way to analyze data

Case Study

Research Context and Project Overview

Today, the notion of learning has evolved beyond cognition-oriented definitions toward a more situated and contextualized vision, considering perception, emotions, cognitive biases, social interactions, motivation, and embodiment as equally fundamental aspects in the learning process (Barsalou, 1999). This change may be considered as a paradigm shift. Cognitive psychologists W. K. Estes (1960) and Robert M. Gagné (1962) argued for learning as the acquisition and the use of knowledge through top-down teaching approaches and called for the transformation of concrete matters to be learned into an abstract code to be stored in the mind, leaving situational aspects out of the process. This position has been challenged by schools of thought supporting the notion of learning as a process of negotiation between the participant and the environment (Brown, Collins, & Duguid, 1989), while the conceptual system has evolved to include abundant information previously considered at most as supplementary data (Lave, 2009).

Consequently, concepts may be considered as a way of thinking and explaining phenomena. It seems that learners use rich representations as cognitive tools to handle theoretical models, events, objects, or evidence (Barsalou, & Wiemer-Hastings, 2005; Glenberg, & Kaschak, 2010; Pecher, Boot, & Van Dantzig, 2011). In particular, they use scientific concepts in the form of flexible and coherent representations that allow connections among different conceptual and experiential domains. This indicates that not only deductive (i.e., reasoning that leads to certain conclusion starting with one or more premises) and inductive (i.e., the ability to derive a general principle from observations) processes should be evoked to explain how a scientific concept is acquired, but that contextual characteristics and personal experience, contribute to finding, implementing, and consolidating the connections, needed to build a rich representation of a phenomenon.

Drawing on these considerations, we can argue that the way we teach science needs to be changed. A more situated, active, and engaging approach is needed to help learners engage directly in building their own meaning-making and learning (Soloway, Jackson, Klein, et al., 1996).

A natural context in which this aim is likely to be achieved is the museum. Museums are considered informal learning contexts in which “free-choice learning” normally takes place (Falk, Dierking, 1992). It is the visitors who choose what, why, how, and whether to learn and determine the nature, structure, and timing of their experience. Moreover, learning in museums is subject to different factors in addition to the visitor’s own repertoire of knowledge and experience, including the amount of time available, the cost of the ticket, the presence of other people (either as companions or “strangers” encountered during the time spent there), distraction, available things to do, and the physical environment.

In addition, we can also claim that learning means the development of new abilities, ideas, emotions, and capacity of reflection (Hooper-Greenhill, 2000). According to scholars in the constructivist school of thought, such as John Dewey and Jean Piaget, and for the museum field George Hein, the learner plays a central role in how the process is defined, shaped, and evolves, and determines the type and the value of the experience. These experts argue that learning is an active process, where meaning-making takes place through the use of language and social interaction with others.

All this influences museums’ work for the development of activities, resources, and tools that need to reflect, build on, and reinforce learning as described earlier (Merzagora, Rodari, 2011). In most cases, visitors would be invited to choose among a range of different programs,

including free exploration of the museum, a guided tour, and participation in an experimental/experiential activity.

All this makes the visit and learning itself a highly qualitative and complex experience, not easy to evaluate. When researching learning in museums, there is the need to make the right methodological choices to respect and reflect correctly that very richness and complexity.

This case presents the results of a study aiming to analyze how visitors' learning and experience change in relation to the kind of visit they engage with (Villa, 2016). It sets the following research questions:

- Do free tours, guided tours, and activities in learning labs stimulate a different kind of learning, distinct for each of the three types of visit?
- How do these three types of visit affect the cognitive variables of the visitor?

The study took place at the Museo della Scienza e della Tecnologia "Leonardo da Vinci" (National Museum of Science and Technology Leonardo da Vinci) of Milan, Italy, and was supervised by the University of Milan in collaboration with the museum. The project was the subject of a master's thesis in cognitive science and decision making.

The Museo della Scienza e della Tecnologia of Milan develops and offers a number of learning activities, exhibitions, and guided tours. The variety of the educational offer aims to satisfy the different visit styles the public expresses while approaching the museum. The Museo della Scienza e della Tecnologia of Milan embeds in its educational programs a theoretical vision that puts the learner at the center of the learning process: It develops and offers a number of

learning activities, exhibitions, and guided tours encouraging visitors to express their uniqueness and give their own understanding and meaning of the museum message (Xanthoudaki, 2013).

Studying the Learning Process in the Museum Context

The study aimed to bring together the museum learning research field with the cognitive science field. The topic of the research (visitors' learning experience in museums) was determined by the cognition categories as those can be situated in the particular setting of the museum. In this study, the concept of learning is defined in relation to the museum context and finds its specific connotation in the field of museum studies, which takes into account the relevant and specific dynamics of the museum, especially when compared with formal learning at school.

The theoretical and methodological background was built on the following fundamental arguments:

- The museum is a free-choice learning context;
- The museum is among the social agents with a strong role in, and contribution to, lifelong learning;
- Learning is a multi-faceted, rich, and complex process and is shaped by multiple stimuli and factors that could differ from person to person;
- The impact of the museum experience on learning is not easily measurable;
- Each individual plays an active role in shaping his or her learning.

To study visitors' learning in this context requires using a research methodology capable of capturing the qualitative and multi-faceted nature of learning. The methodology must be

suitable for grasping the individual perspective of each visitor and consequently the variability of feedback.

Several studies focused on the external behavior of visitors. Some did so through the tracking of the pathways visitors take inside the museum, in an attempt to explore which factors influence their choices (Bitgood, 2011; Serrell, 2010). Others sought proof of so-called museum fatigue (Gilman, 1916) or investigated the subjective perception of the visitors using interviews immediately after the visit or even months later (Falk, Dierking, 2000). Among the various methods used in the museum research field, the personal meaning mapping (PMM) (Falk, 2003) is considered an effective tool for analyzing how the visit influences the visitor's learning by taking into account his or her previous knowledge and personal points of view. PMM was the main research tool adopted in this study and is aimed at analyzing the qualitative experience of the museum visitors.

Methods in Action

The study aspires to give voice to an articulated and personal experience. To do this, it builds on the dynamics of a visit to a museum on one hand, and the theoretical background and educational policy of the Museo della Scienza e della Tecnologia on the other. Adopting a quantitative research approach would have run the risk of oversimplifying the phenomenon and of limiting visitors' freedom to express the peculiarity of their perspective. By using PMM instead, we have the opportunity to collect qualitative data on the personal meaning provoked or evoked in people's minds by the visit itself and on the individual differences that everyone brings when entering into a museum (Falk, 2003).

PMM is based upon a relativist-constructivist approach of measuring learning. It emphasizes the importance of capturing a personal point of view on an experience, and on the process of construction of the personal meaning, based upon the individual's personal background. This point of view, rather than the passive acquisition of conceptual notions, determines the elaboration, every time unique, of the learning outcome. It is important to understand how each individual gives rise to a specific body of knowledge starting with a negotiation process between personal, social, and physical context (Falk & Dierking, 2000). Consequently, PMM asks participants to express their own sense-making, which is the result of the interaction of

- Personal perceptions;
- Previous knowledge;
- The influence of the social interactions;
- The physical setting.

The maps are the outcome of a blend between previous personal experiences and the learning and experiential path followed during a visit. This blending process is considered the core of the learning process.

The PMM is a tool designed by John Falk, who with Lynn Dierking developed the contextual model of learning (Falk & Dierking, 1992, 2000). They argue that learning in the museum is the result of the continuous mutual influence among three contextual dimensions: the personal, the social, and the physical. The way in which the three contexts interact with each other is unique, and specific for each individual. The PMM translates theory to a research methodology. Although one can find similarities between PMM and the concept map, the main

difference lies in the fact that the concept map is used to compare the learner's knowledge with a "correct" scheme, giving less importance to the expression of the personal perspective of the participant.

There are specific instructions on how to use PMM and how to gather or analyze data; however, in this study, the canonical procedure has been modified. The challenge of this research was to provide an interpretation of the qualitative data gathered through the maps (expressing the perception of a topic before and after the visit), focusing specifically on the cognitive dimensions relating to three possible types of visit: free tour, guided tour, and activity in the interactive lab.

The PMM stimulates the expression of the subjective perspective. The aim of the research project also required the researchers to identify common and transversal cognitive categories to compare the three kinds of visits. It has been necessary to identify in the diversity of the visitors' contributions those common dimensions to the three kinds of visits, and to investigate whether these dimensions are expressed in different ways.

To do this, the use of the PMM has been modified maintaining the original procedure during the data-collecting phase but using a different approach during the subsequent data analysis.

In fact, when the data were collected and their quantity and richness came up clearly, it became more obvious that the approach to the data analysis proposed by Falk did not fit perfectly to the research questions. Following a logic inspired by grounded theory (Glaser & Strauss, 1967), the analysis of the PMM was thus modified to attribute the visitors' contributions to a number of theoretical categories.

It is not the first time that PMM has been used in a different way: There are other examples of studies where the basic procedure of the map was slightly modified. Researchers usually adopt PMM as a powerful tool to gather qualitative data and to stimulate the visitor's mind. For example, PMM can be used to record the general perception of a topic or to use the contributions written on the map as a base to foster a discussion with the participants interviewed (Cook & Cousens, 2009; McCreedy & Dierking, 2013).

In this case, the map was compiled by 90 adult visitors. Each one of them took part in one of the three kinds of visit at the Museo della Scienza e della Tecnologia between November 2014 and February 2015.

In the next section, we present the canonical instructions for the use of the PMM, the reasons why they were changed for this project, and the different interpretation system adopted expressly for this case.

Use of PMM

The PMM use involves the moments before and after a visit to a museum. Visitors are approached by the researcher, who asks them to write on a blank page concepts, ideas, images, phrases, memories, or any thought that comes to their mind in relation to a central topic, expressed with a keyword in the middle of the page, as shown in Figure 1. The keyword should help visitors to let their mind go.

Figure 1.

Caption: The empty map in the original language, with the keyword in the middle referring to the concept of “Space.”

What is then written down on the page by the visitors becomes the basis for a non-structured interview where people are invited to elaborate on the relation between what they have written down and the keyword. This is their opportunity to articulate their thoughts and ideas better. During the interview, researcher documents what is said on the same page, using the participant’s own words, but taking notes in an ink color different from the one used beforehand by the visitor. When the interview ends, the participant proceeds with his or her visit. At the end of the visit, the researcher approaches the visitor once more. In this case, visitors are asked to write on the same map any change, additional comment, or review on the basis of their experience during the visit. In this case, the participant indicates changes using a third ink color. Finally, the visitor’s considerations are discussed in a follow-up interview and documented by the researcher with a fourth ink color. At the end, the map looks as shown in Figure 2.

Figure 2.

Caption: The PMM at the final stage (original and translated). Order of the use of the colors: black, blue, green, and red.

There are no specific methodological indications with regards to the research sample to use or what should be the optimal number of maps. The number of maps used in previous studies varies from 40 to 200.

The Use of PMM in This Research: Index of Analysis for the Visitors’ Contributions

For the analysis of the PMM, Falk considers four parameters:

- *Extent*. Extent is measured by counting each word or phrase used in the pre- and post-phases and serves to assess the change in the use of appropriate vocabulary and the extension of knowledge of a topic.
- *Breadth*. Breadth refers to the extent of the visitor's comprehension. It measures the change in the number of appropriate concepts adopted.
- *Depth*. Depth involves the level of understanding and is determined on the basis of a scale four or five levels, from "superficial" to "deep."
- *Mastery*. Mastery refers to how easily the visitor masters the concepts he or she uses. It is an expression of the quality of one's understanding and whether it is closer to that of a novice or of an expert.

During the research, it emerged that these four categories were not suitable for following reasons:

- *Extent, breadth, depth, and mastery* mostly represent the quantity and the quality of the new information, focusing the analysis on a cognitive-notional aspect of the visit. However, the definition of learning adopted in this study is broader; it fosters emotional involvement, the relation with personal memories, as well as individual reflections. The increase of subject knowledge is just one element among others.
- In the examples mentioned by Falk, we can mostly find maps written by children. The way the four categories measure experience is probably more appropriate for younger visitors than for adults. If children, especially of school age, tend to provide long contributions about their visit, adult visitors tend to be more succinct and schematic. They tend to express just the main aspects, even if they might have more to tell.

- Another factor that compromises the efficacy of counting phrases and words is that the maps were not compiled in an ideal time and setting. The researcher did not have an organized location to meet visitors (e.g., there was no place to sit down and talk) and this probably accentuated the visitors' tendency to synthesize. Consequently, there is a need to value the maps on the basis of the quality of the contributions rather than the quantity.

These elements called for the need to adopt a different approach to reading and analyzing maps and written material. Falk himself invites researchers to adapt the PMM in a variety of ways.

In our case, words and the phrases of the participants were interpreted through two dimensions used in previous research studies. The first consists of a set of categories expressing the kind of experiences that are possible in a museum context. The second identifies a scale of parameters that define the depth of reflection and of conceptual elaboration that the participant shows when building on his or her already existing knowledge.

The set of categories referring to the “type of experience” emerges from a study by Andrew Pekarik, Zahava Doering, and David Karns in 1999. The researchers carried out long interviews with visitors to the Smithsonian Institution and identified 14 typologies of visits, grouped in four macro-categories (Pekarik, Doering & Karns, 1999), as shown in Table 1.

Table 1.

Caption: The typology of experience (Pekarik, Doering, & Karns, 1999).

Object experience	Seeing “the real thing”
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	Seeing rare/uncommon/valuable objects
	Being moved by beauty
	Imagining what owning this type of object may be like
	Carrying on with my professional development
Cognitive experience	Gaining information or knowledge
	Enriching understanding
Introspective experience	Imagining different places and times
	Reflecting on the meaning of what I was seeing
	Reminiscing about my journeys/the experiences of my life/other
	Memories
	Perceiving a spiritual connection
Social experience	Spending time with friends/family/other people
	Seeing my children learning new things

In our case, this categorization was used to analyze what visitors wrote on the map after their experience in the museum, to distinguish how the different aspects of the visit were linked to what each visitor specifically engaged with (free, guided, and lab).

In regards to the “depth” of visitors’ comments, the analysis and interpretation were based on a scheme proposed by Norman Webb and colleagues in 2005. Their four-level scale was used to define the difference between the visitors who simply reported their thoughts superficially from others who articulated them in more detail, making connections and deeper considerations (Webb, Alt, Ely, & Vesperman, 2005).

The four levels of depth go from the lowest one, which refers to a simple and immediate expression of a mnemonic notion, to the highest one referring to the capacity to elaborate on what has been learned to trigger a new insight and related argumentations. Table 2 shows the particular characteristics of each level.

Table 2.

Caption: Levels of the depth of the comments (Webb et al., 2005).

Level	Learner’s action	Key actions
Level 1: Recall	Requires the recall of information, such as a fact, a definition, a term or a simple procedure.	List, Tell, Define, Classify, Identify, Name, State, Write, Place
Level 2: Concept	Involves mental skills and concepts or produces a response.	Estimate, Compare, Organize, Interpret, Modify, Make Predictions, Establish Cause/Effect Relations, Summarize

Level 3: Strategic Thinking	Requires reasoning, planning, using evidence and a higher level of thinking.	Criticize, Formulate, Speculate, Build, Review, Investigate, Differentiate, Compare
Level 4: Extended Thinking	Requires complex reasoning, experimental design and planning, development and thinking. Cognitive effort is more demanding and learners have to make connections within and among the domains of the subjects.	Design, Connect, Synthesize, Apply, Criticize, Analyze, Create, Try

Each consideration reported from the visitors in the phases of pre- and post-visit was assigned to one of the four levels. This operation allowed us to compare the depth of conceptual expressions on a topic before and after the visit.

Below we present a few examples of maps illustrating how the interpretation was conducted (Villa, 2016).

In Figure 3, the visitor’s statement recalls a piece of information, a notion. It is interpreted as cognitive and assigned to the Depth Level 1 (Recall) as the association of a word to its definition appears to be a simple reminiscence.

Figure 3.

Caption: Extract from PMM: “Rail transport”—Guided Tour.

Origin of some words (cocchio1, bus2): 1 (carriage) From the name of the inventor; 2 From “omnibus,” meaning for everyone.

In Figure 4, we see a statement of a social nature: It expresses how the participant was impressed by watching children learn and engage in the activity. Considering that the expression of the concept was also accompanied by a personal opinion, this statement was assigned to Depth Level 2 (Concept).

Figure 4.

Caption: Extract from PMM: “Leonardo da Vinci”—Lab.

Engagement of children in the explanation of Leonardo’s ideas. Especially the children, although it was not simple concepts.

In Figure 5, the statement represents the experience of an object; the visitor declares being impressed by the beauty of locomotives. Rather than defining the locomotives just as “beautiful,” the visitor gives a more specific connotation adding the notion of “ancient.” This evidence was assigned to Depth Level 2.

Figure 5.

Caption: Extract from PMM: “Rail transport”—Guided tour.

It’s a beautiful, ancient type of “old things”

Figure 6 expresses two aspects that we can define as introspective: On one hand, the visitor reflects on the sense of what he observed; one the other, he refers to an emotional

experience. This person reported a critical thought and the evidence was assigned Level 3 for depth (Strategic Thinking).

Figure 6.

Caption: Extract from PMM: “Space”—Free tour.

There is a conflict between the idea that space is infinite and unexplored and the physical evidence of what was actually done. If complicated, formulas do not convey emotions.

The Use of PMM in This Research: Quantitative Data Processing and Comparisons

Following the data analysis, the research focused on the comparison among the three kinds of visit based on the empirical data. The interpretation of data from the maps and their categorization according to “types of experience” and “depth of considerations” followed a qualitative research approach, but the comparison was based on a quantitative research approach. Every single statement present on the map was considered as the expression of a type of experience and of a level of depth of reflection. For each map, we calculated the number of expressions for each category of the two dimensions. This number was divided by the total number of statements present on the maps and multiplied per 100 to calculate the percentage. For example, on one map, a visitor expressed an introspective typology of experience in two sentences; the participant wrote in total 10 statements therefore that specific map indicates 20% of the visitor’s experience was introspective.

This computation allowed us to calculate an average percentage for each of the two dimensions under examination and compare the values across the three visit types. With regard

to the dimension of “type of experience,” the comparison was conducted for the post-visit phase only as the four typologies (cognitive, introspective, social, object) in the literature specifically refer to how visits influence visitors’ perception. For the “depth” dimension, the comparison considered the increase or decrease of depth of reflection between the pre-visit and the post-visit. Comparisons revealed differences among the three visit types, suggesting the need for deeper investigation in future research.

Research in Practice: Ideal and Reality

The researcher is not a neutral witness of a phenomenon: He or she has a fundamental role in fostering the expression of the visitor’s point of view. In this case, in particular, a series of aspects that might appear implicit or easy-to-handle for an expert researcher could be critical for a scholar with limited experience in the field. In addition to the results and answers to the research questions, this study reveals a number of points that might not be adequately addressed by handbooks or papers providing a guide for research procedures:

- When asking a museum visitor to compile a map, the researcher has to consider that this is a request for the visitor to do something outside his or her agenda and that the visitor’s priority is, most probably, to maximize the time and the benefit of the visit (also in relation to the cost of the ticket). In addition, this person does not necessarily share with the researcher the research objectives. The researcher should consider the skills necessary for convincing people to dedicate time and attention to the research and should also consider that many visitors will refuse to participate.
- The PMM is designed in a way as not to be perceived as an assessment test; nevertheless, during the pre-visit compilation, participants showed shyness and a sort of performance

anxiety. After the visit, several individuals affirmed that the interview was a pleasant moment for them: an opportunity to share impressions about a nice experience.

Facilitating the passage from the initial suspicion to the willingness to express themselves requires skill and attention.

- The PMM is a tool that requests visitors to write something, followed by a conversation that could last several minutes. Having the right setting increases the probability of a rich dialogue rather than obtaining a synthetic contribution often in a hurry. When this is not possible, the visitors' motivation might be compromised.

The pilot phase is a fundamental moment to find solutions to these difficulties:

- Falk argues that the PMM requires training because it is important that the researcher manages to stimulate the visitors' expression without influencing them too much. This is not an easy task especially considering the initial anxiety and reluctance discussed previously.
- The PMM provides qualitative data that need to be analyzed. To support and validate interpretation, we recommend that a team of experts is involved. The PMM is an inexpensive tool (it is fundamentally a pen and paper tool), but its interpretation requires more human resources than certain other tools. In this study, a comparison with other points of view during the analysis was not possible, as there weren't researchers outside of the study to share their perspectives on the maps and prevent the raising of subjective biased interpretations.
- A final consideration: It is useful to adopt other methodologies in parallel with the use of the PMM to give more consistency to the interpretation and to have more elements that

could help in the comprehension of the visitors' words. In the museum field, observation, tracking, and follow-up using telephone interview are suitable to this aim.

Conclusion

When much time is spent reading and listening to the visitors' narratives, it becomes clear how extremely subjective and varied they are. Using a qualitative approach requires facing a complexity of multi-faced data, sometimes sacrificing precision in favor of abundance. That is the approach that really reflects the phenomenon being examined. The PMM is a powerful tool to handle this complexity. It requires some attention to make it a proper and effective tool, but it is versatile and provides rich data, both qualitative and quantitative, suitable to be interpreted in different ways in congruence with the study's aims.

During the study, it emerged that PMM is not only an interesting tool for researchers but in many cases, the visitors appeared to enjoy expressing themselves through the PMM. The PMM added value to their experience of the visit because they could deeply reflect about the meaning of their perception and they could share their thoughts with other people. The use of PMM seems to give visitors concluding their visit the chance to reflect on the raw information accumulated and to process that information to find deeper meaning and, probably, memories. It might be suggested that using PMM (or similar tools) after the museum visit may elicit a sense of engagement improving the cognitive effect of the experience.

Exercises and Discussion Questions

1. In which research contexts could the PMM be considered a good option as a research tool?

2. Considering the data gathered, thanks to the PMM (list of words and sentences), which dimensions of learning can be analyzed?
3. What factors would you consider in deciding what kind of word or image to use in the center of the map to stimulate the reflection of the subject?
4. What do you think are the advantages and disadvantages of the PMM method?

Further Reading

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