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A Prototype Evaluation Tool for Museum Exhibition Design: Aligning Display Techniques with Learning Identities

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A prototype evaluation tool for museum exhibition design: Aligning display techniques with learning identities

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Keywords:
Museum exhibition design, public participation, communication of meaning, static exhibition, interactive exhibits, learning behaviour, learning identity, natural history museums

ABSTRACT

Museums have been forced by the pressure of change to switch practices and outlooks to transform museum visitors from passive consumers in a collection-focused 'static exhibition' to active participants in a visitor-centred 'interactive technology exhibition'. This paper aims to model a framework for museum exhibition design that can be used as a prototype evaluation tool. It is achieved throughout analysing the interrelationships between museum visitors learning identities and their museum experiences and what are the display techniques that can be used to increase museum visitors' social interaction with the museum environment and how each technique will affect the visitor's learning behaviour and the nature of museum visitor experience in a digitally responsive interactive exhibition. Three quantitative methods tested and evaluated the museum visitors learning identities and their experiences on Giza Zoo zoological museum and modelling the prototype evaluation tool that can be used as a tool for future museum exhibition design, redesign, and evaluation.

1. INTRODUCTION

Recently, designers of museums started being aware of the importance of figuring out who their visitors are and why these visitors visit the museum [3], [21]. According to Black, quantitative report analysis of museum visitors and potential visitors pointed that the museums should change the museum visitors approach through transforming them from visitors to active participants to ensure that their visit is enjoyable through providing opportunities of social interaction encouraging the visitors to revisit the museum [3].

[4] has claimed that the museum is whether organizing permanent collection exhibition, temporary exhibition or combination of both, the museum visitors' experience of the exhibits will be enhanced if they are supported and provided by a wide range activities and programs that reinforce the communication of the museum exhibitions core messages.

Public participation is one of the main goals for museum visitors' satisfaction, which is directly associated with the learning experience, discovery, interaction, and involvement in motivating the museums learning behaviour. This will raise the museums in the direction of shaping a sustainable future for the museums lifelong learning [1]. To sustain museums lifelong learning, adapting museum visitors as active participants in an interactive experience will result in transforming museum visitors experience to be positive, thus enhancing more museum visitors and revisited visitors.

If the museum exhibitions are intended as communication devices, then developing such activities, programs and technologies are consistent with the museum exhibition theme. The determination of museum visitors' participation level with adapting visitors to participate with engaging and interacting with the exhibits display techniques became an important role utilizing of alternative display media and presentation techniques leads to appeal on the scenario way to a wider range of preferred learning styles, interest level, intellectual capacities, and visitor interaction [7], [8].

This paper has pointed out the participation of museums' visitors in the way that provides different choices of media display and presentation techniques leading to how each technique can affect the visitor's learning identity each time they visit the museum. This paper, therefore, aims to model a museum exhibition design framework that can be used as a prototype exhibition evaluation tool.

To achieve the abovementioned aim, this paper raises three main questions that are addressed through three methods complementing each other:
RQ1: Are there interrelationships between museum visitors learning identities and their museum experiences?
RQ2: How can museum exhibitions display techniques increase the number of visitors and revisited visitors?
RQ3: How can designers play a straight neutral bridge between the curator/transmitter and the visitor/receiver in the perspectives of exhibition to transform visitors to active participants rather than passive consumers?

2. LITERATURE BACKGROUND

Design is a constructive and communicative means that play important role in conveying meaning by representative models (that include graphics, dimensional, graphics, or virtual objects) [9], [10]. The research shall examine this subject from two prospective: the approaches of examining the relationship among different museum exhibitions and their associated meaning and or messages on different cultures. The first approach is based on Ferdinand de Saussure's theory related to 'sign and its signification'. For de Saussure [21], the signs operation consists of two main elements: the element that needs to be signified (usually the non-material meaning) and its signifier element (that is the physical entity). Another way for understanding how the sign operates is by using the realist approach developed by Peirce's model. This model presents a third element, interpretant. Peirce's [22], theory describes the sign as a set of material objects that point to their related object either tangible or non-tangible ones via an interpretant. Peirce's model makes the exhibition points to its objects, cultural meanings, and messages, through the interpretation process. These two models show no direct correlations between both signs and meaning. This strengthens the existence of two different orders of in the representation system 'the order of things and the order of their meaning, of representation and reality' [19]. Therefore, in museum exhibitions, as a system that generally signifies culture, design plays a direct strong role in conveying construed items [23].

Although there are possibly as numerous ways of exploring museum exhibitions as there are visitors, modes

of visitor apprehension [16] may generally be classified under four headings as follows: (1) Contemplation where the visitor contemplation and apprehension is important issue in the art museums that aims for aesthetic experience especially in the science or history museum, (2) Comprehension where natural and history science museums are likely to feature thematic or contextual exhibitions where the specimens, artefacts and / or other displayed objects are not intended for studying as individual standalone objects, (3) Discovery that is a motionless or static of intellectually and visually active mean for visitor engagement of museum exhibition, and (4) Interaction whereas most kinaesthetically involves apprehension mode, and is favoured for children museums and science centres.

[6] has mentioned that the museum environment involves and should meet learner and visitors needs in being active participants not a passive one during the learning process. The Types of learning are usually related to the level of visitors' understanding and ability to regulate their thinking process. The types of learning behaviour, according to [6], are cognitive, affective, social, psychomotor, and mental, and personal. [8] developed theory on the different ways used by the individuals to learn and process the provided information. This theory is called 'the multiple intelligences theory.' For Gardner's theory, visitors show well-built learning skills in seven main styles. The visual/spatial learner who enjoys looking at pictures, watching movies, drawing, designing and creative three-dimensional representations, and learns best by visualizing, dreaming, working with colours and pictures. The linguistic learner who enjoys reading, writing, and telling stories, debating, reading aloud, drama and creative writing, and learns best by saying, hearing, and seeing words. The logical/mathematical learner enjoys doing experiments, exploring patterns and relationships, and asking questions, and learns best be working with abstract patterns, categorizing, and classifying. The musical learner enjoys singing, listening to music, and playing instruments, and learns best by music, melody, and rhythm. The kinetic learner enjoys moving around, touching, and talking, and learns best by touching and moving, and processing knowledge through action. The social learner enjoys talking to people and being with friends, and learns best by sharing, cooperating, comparing, and interviewing. The solitary/introspective learner enjoys pursuing their own interests and working alone and learns best by self-paced instructions and individual projects.

[12], [18] have developed a comprehensive study for identifying that the motivations and drivers for museum visitors and assured that they should be considered in broader social context. Another study developed by [20] explores and evaluated the influence of 6 motivations, adapted from the 'Selinda Model of Learning'. He described those motivations in the context of hands-on exhibit principles that can be applied in general cases. Those six motivations are communication, curiosity, confidence, challenge, control, and play. Today, in the communication technology explosion, many museums in developed world use advanced interactive display techniques for educating visitors and enjoying them. According to [5] the interactive display, sheer the new role for covering the space, entertain and tells the story.

The Museum Association define interpret as taken to cover diverse fields as research, displays, publications, and educations. Interpretation in museum: explaining the objects and its significance [23]. The interpretation of museum exhibition was defined also in diverse ways. The interpretation techniques are static-dynamic, objects-live interpretations, texts/labels-sounds guides, models-guides, drawings-lectures, photographs-video, dioramas-animations, tableaux-computer base interactive, information sheets-mechanical interactive, guidebooks-objects for handling, worksheets-drama, and website. Interactivity is incredibly important for museums [17]. [2] have presented the types of display methods presentation techniques including graphics, three-dimensional techniques, using people, and audio-visual and interactive techniques.

Interactive display method is a new way to exhibit the subjects in a fun way. Heritage museums display the archives in traditional showcase with full of texts. For grabbing the attention of young visitors and to motivate them to repeat their visit to museums and appreciate the archives. These display methods should be to beyond their demand. In such technology and science revolution, interactive technology has increased the use in museums both heritage and museums science as well. The integration of interactive methods and heritage museums was recommended to display and make a change in the mindset of heritage's exhibition [14].

From the literature scenario, the classification of museum experience and learning behaviour can correlated. These categories are modelled as a framework that can be used as a prototype evaluation tool for designers to help them in creating and evaluating museums exhibits. The museum experience and learning behaviour should constitute the ‘x-axis' and the display techniques should constitute the ‘y-axis’.

3. METHOD

Due to the broader framework that depicts inductive approaches; an inductive and integrated approach was determined. This inductive approach that appears relevant because theory arises from the exploration of data, of which most is qualitative. The main empirical study objective was a combination of exploratory research, as it intended to gain familiarity into the specific phenomenon of the feasibility of museum display techniques, and descriptive, in part, to portray the characteristics of the phenomenon.

A questionnaire can be used as a method to analyse quantitatively the museum experiences and the display techniques that can transform museum visitors from passive consumers in a collection focused ‘static exhibition’ to active participants in a visitor centred ‘interactive technology exhibition.’ After analysing the questionnaire, the framework model can be built for the museum exhibition design that can be used as a prototype evaluation tool. The methodology consists of three methods:

(1) Method A is the museum experience and learning behaviour questionnaire is ‘museum visitor experience’ quantitative Agree/Disagree, Yes/No and multiple-choice questions which analyse the designers experience in the museum considering the museum environment surroundings (the exhibition space and its features not the whole museum) concentrating on the layout and general atmosphere of the space not the specific content of individual exhibits.

(2) Method B is the display techniques questionnaire is ‘museum display techniques’ quantitative Rating and multiple-choice questions which will focus on what are the display techniques that can be used to transform museum visitors to active participants throughout increasing their interactivity.

(3) Method C Modelling a museum exhibition design framework that can be used as a prototype evaluation tool between museum visitors’ experiences and learning behaviour (x-axis) and museum display techniques (y-axis), to transform museum visitors from passive consumers in a collection focused ‘static exhibition’ to active participants in a visitor centred ‘interactive technology exhibition’.

To investigate the perceptions about museum exhibition design display techniques and how it affects the interrelationships between museum visitors learning identities and their museum experiences and their opinions about the perspective of implementing the strategy, survey questionnaires were administrated to museum visitors and architects. The selection of participants relied on a convenience and snowballing sampling approach [11]. The respondents included 32 museum visitors and 51 architects, participated through the three methods

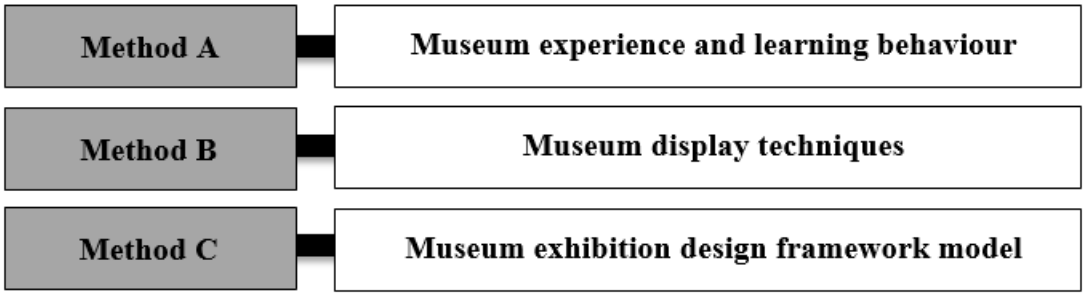

Figure (1) Research Methodology

3.1 Method (A): Museum experience and learning behaviour

The first section (exhibition environment setting section) included eight different short written descriptions which indicate how much the participant agree about the exhibition environment, design and way of presentation. The survey questionnaire asked them to rate their degree of agreement with different statements on a five-point [15] (5 = agree strongly, 4 = agree slightly, 3 = neither agree nor disagree, 2 = disagree slightly, 1 = disagree strongly).

These answers would be important when evaluating what components to emphasize during the actual design of museum exhibition display techniques. The second section (overall assessment), this part is rating an overall assessment of the participant experience through the museum exhibits from a scale from 0 to 10 where the 0 scale is the lowest rating and the 10 scale is the highest rating. The third section (experience survey) participant is asked eight different yes or no questions and if yes there are included eight different short written descriptions so that the participant can indicate from the multiple choice provided which is more likely significant to the experience The fourth section (respondents information) included questions asking about participants' basic personal information about gender, age and current position as well as a questions asking about if they are interested in participating in the accompanied visits stage for further work and if yes what time/day convenient addresses architects in criteria to description of sample according to area of professional practices.

3.2 Method (B): Museum display techniques

The first four sections (visual survey) the survey questionnaire asked them to rate their degree of agreement with different statements on a five-point [15] a scale from 0 to 5 where 0 is the lowest rating and 5 is the highest rating. The participants featured several photographs depicting representative examples of different display techniques applications to introduce the strategy to participants who might have not been familiar with it. Participants are asked to evaluate these display techniques according to different physical attributes and affective qualities that will be discussed later in this chapter. Average of answers was elaborated to determine the most evaluative measure to the museum exhibition design. The fifth section (respondents' information) included questions asking about participants' basic personal information about gender, age, and current position addresses architects in criteria to description of sample according to area of professional practices.

3.3 Method (C): Museum exhibition design framework model

The first section (respondents' information) included questions asking about participants' basic personal information about gender, age, and current position addresses architects in criteria to description of sample according to area of professional practices. The second section (prototype evaluation tool) see Figure 2, modelling a museum exhibition design framework that can be used as a prototype evaluation tool between museum visitors' experiences and learning behaviour (x-axis) see Table 1 and museum display techniques

(y-axis) see Table 2, to transform museum visitors from passive consumers in a collection focused 'static exhibition' to active participants in a visitor centred 'interactive technology exhibition'.

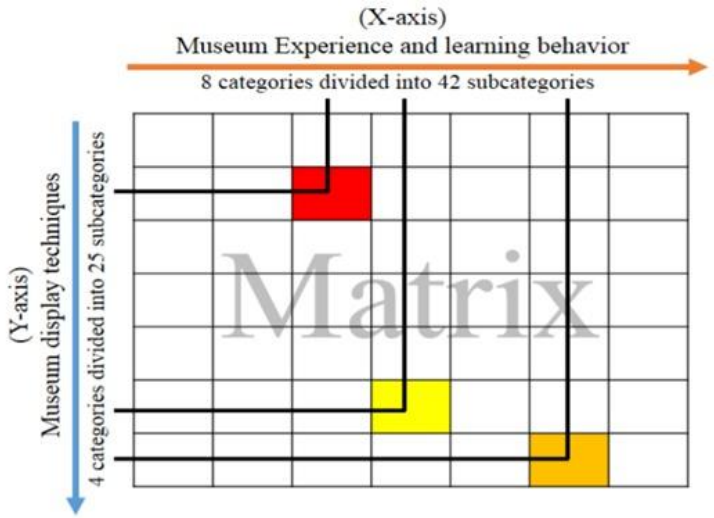

Figure (2) Museum exhibition design framework model

Table 1 - Museum visitors learning identities and experiences [7]

Type of exhibition technique	Aesthetic
	Didactic
	Hands-on
	Multimedia
	Minds-on
	Immersive Environments
Mode of Visitor Apprehension	Contemplation
	Comprehension
	Discovery
	Interaction
Type of Learning Behaviour	Cognitive
	Affective
	Social
	Psychomotor and Mental
	Personal
Type of Learner	Visual/Spatial Learner
	Linguistic Learner
	Logical/Mathematical Learner
	Musical Learner
	Kinetic Learner
	Social Learner
	Solitary/Introspective Learner
Visitor Engagement Needs	Socially Motivated Visitor
	Intellectually Motivated Visitor
	Emotionally Motivated Visitor
	Physical Motivated Visitor
Type of Motivation	Communication
	Curiosity
	Confidence
	Challenge

	Control
	Play
Type of Visitor	Experience Seeker
	Explorer
	Facilitator
	Hobbyist and Professional
	Recharger
Visitor Interaction Dimensions	Connecting
	Sharing
	Reviewing
	Participating
	Collaborating

Table 2 - Museum exhibition display techniques.

Using People	Introductory Lecture
	Guided Tour and Books
	People Movers
	Play Actor
	Gift Shop
Graphics	Display Screens
	Website Portal
	Digital Library
	Exhibits Electronic Database
	Mobile Applications and Wireless Network
	Hands-on Changing Screens
	Interactive Map Tour
	Welcome Talking Screens
Three Dimensional	I MAX
	Hosting Events
	VR Games
	People Movers Machines
	Working Models Embedded Skeleton
Audio-Visual and Interactive	Audio Systems
	Sound and Light
	Skin and Bones
	Talking Head Costume Model
	Animatronics
	Hologram
	Peppers Ghost

4. RESULTS AND FINDINGS

4.1 Museum experience and learning behaviour

In the questionnaire of Method (A), 51 architects responded to these set of questions resulting as 64% of them were female architects and 36% male. Their age range varies where the majority are 17-20 years 56% ,24% 20-25 years, 14% 25-40 years, 4% 40-50 years and 2% above 50 years. The percentages of respondents indicated that they had architectural knowledge as their current architectural positions as 14% professors, 6% associate professors, 8% assistant lecturers, 30% teaching assistants and 42% architectural students.

For further work participation, architects were asked if they are interested or not in participating in the accompanied visits stage of this study or not, and if yes they are asked to provide more details to contact and indicate which days/times are more likely to be convenient putting into consideration that Giza Zoo Zoological Museum opens from 9 AM and closes at 5 PM. 82% of the respondents are interested in further work and they indicated their convenient time as 12% of them are available at weekends morning, 6% weekends afternoon, 54% weekdays morning, 28% weekdays afternoon.

The responses to the first section on exhibition environment setting are shown in Figure 3, the responses to the second section on the overall assessment are shown in Figure 4, the responses to the third section on the experience survey are shown in Figure 5 whereas: (A) Communication of meaning devices of exhibition techniques is identified in the museum learning (B) Museum exhibition design and layout helps in exploring the museum exhibits (C) Type of learning introduced in the museum setting is related to how well I understand and regulate my own thinking process (D) Exhibition galleries addresses a wide range of learning skills (E) I felt the sense of engagement, participation and involvement (F) Museum offering effective learning with multiple experiences and evolved of learning outcome (G) I will visit the museum exhibition for a specific goal (H) The museum exhibits encourage sources of interaction, participation and involvement. Lastly, the overall evaluation to the Giza Zoo zoological museum is shown in Table 3.

Museum Experience and learning behavior	Disagree Strongly	Disagree Slightly	Neither Agree nor Disagree	Agree Slightly	Agree Strongly
This exhibition's environment really invites me to explore it	4%	6%	12%	64%	14%
This exhibition's design helps spark my interest	2%	6%	24%	56%	12%
It is enjoyable to spend time in this environment	2%	0%	36%	46%	16%
This exhibition's design and layout help me make a sense of what the exhibition is about	4%	2%	38%	48%	8%
This environment engages all my senses	34%	56%	4%	6%	0%
This exhibition provides enough options of presentation techniques to choose from	74%	20%	2%	4%	0%
The museum exhibitions are presented in an interactive way that involve public participation	76%	12%	6%	4%	2%
The museum engaged me as an interactive participant not as a passive consumer	94%	4%	2%	0%	0%

Figure (3) Museum visitors experience and learning behaviour ratings.

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Assessment Rate	
#	%
0	0%
1	0%
2	0%
3	2%
4	2%
5	6%
6	32%
7	54%
8	4%
9	0%
10	0%

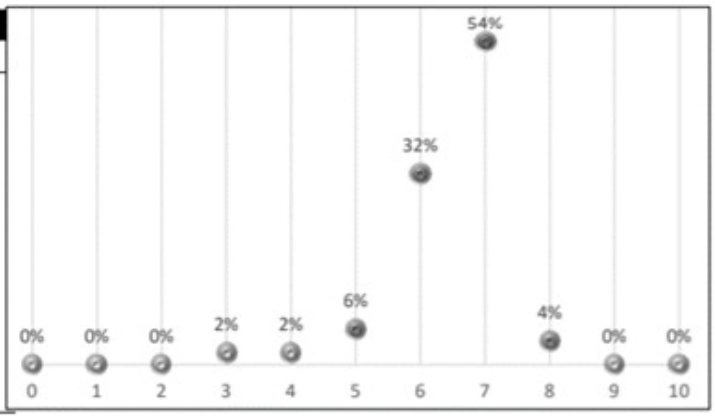

Figure (4) Architects overall experience assessment throughout the museum exhibits.

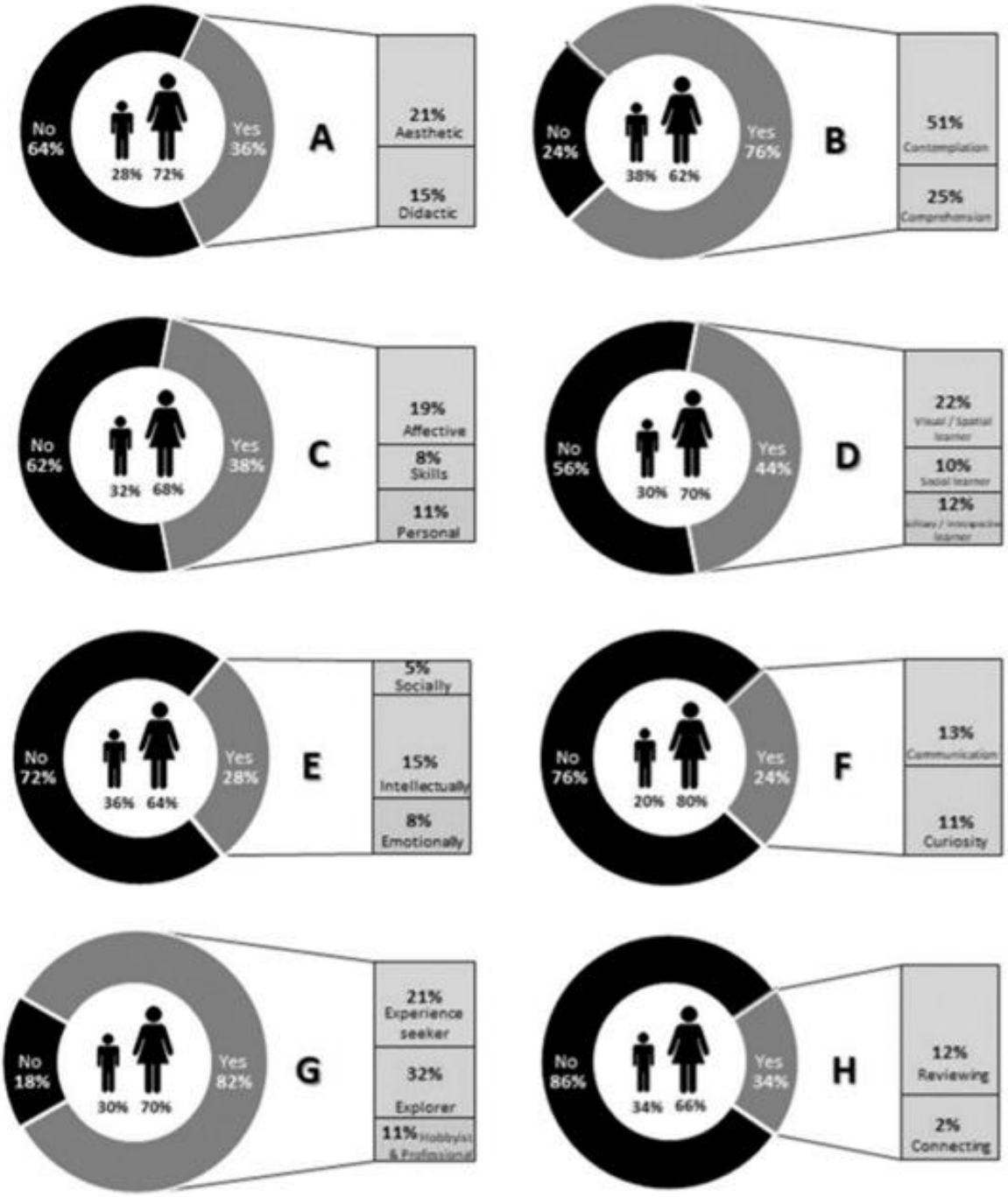

Figure (5) Architects' responses about what best describes their experience.

Table 3 – Giza Zoo zoological museum evaluation.

Type of exhibition technique	Aesthetic	58%
	Didactic	42%
	Hands-on	
	Multimedia	
	Minds-on	
	Immersive Environments	
Mode of Visitor Apprehension	Contemplation	67%
	Comprehension	33%
	Discovery	

	Interaction	
Type of Learning Behaviour	Cognitive	
	Affective	50%
	Social	
	Psychomotor and Mental	21%
	Personal	29%
Type of Learner	Visual/Spatial Learner	50%
	Linguistic Learner	
	Logical/Mathematical Learner	
	Musical Learner	
	Kinetic Learner	
	Social Learner	10%
	Solitary/Introspective Learner	12%
Visitor Engagement Needs	Socially Motivated Visitor	18%
	Intellectually Motivated Visitor	54%
	Emotionally Motivated Visitor	28%
	Physical Motivated Visitor	
Type of Motivation	Communication	54%
	Curiosity	46%
	Confidence	
	Challenge	
	Control	
	Play	
Type of Visitor	Experience Seeker	48%
	Explorer	39%
	Facilitator	
	Hobbyist and Professional	13%
	Recharger	
Visitor Interaction Dimensions	Connecting	86%
	Sharing	
	Reviewing	14%
	Participating	
	Collaborating	

4.2 Museum display techniques

The following results show the analysis of architects' and museum visitors' responses to the analytical section in museum display techniques questionnaire were the museum visitors who responded are the Giza Zoo Zoological natural history museum in field visitors and architects as experts in the design field. 75 respondents responded to these set of questions 43% of them were in field museum visitors 57% were architects who have museum design knowledge as 11% professors, 4% associate professors, 5% assistant lecturers, 13% teaching assistants and 24% architectural students. 44% of the respondents were female architects and 56% male. Their age range varies were the majority are 20-25 years 40%, 29% 17-20 years, 12% 25-40 years, 15% 40-50 years and 4% above 50 years. To assess the perceptions of participants (architects and museum visitors) about potential benefits of using different museum display techniques and their eventual concerns about the application of the strategy, the survey questionnaire asked them to rate their degree of agreement with different display techniques in natural history museums from a scale from 0 to 5 where the 0 scale is the lowest rating and the 5 scale is the highest rating. These answers would be important when evaluating what display techniques can be used to emphasize during the actual design of natural history museum exhibits.

This First section presented five different display techniques 5 photographs depicting representative examples of different display techniques applications to introduce the strategy to participants who might have not been familiar with it. Rating the photographs from 0 to 5 will indicate how much the participant agree about the exhibition environment, design and way of presentation which would be important when evaluating what components to emphasize during the actual design of museum exhibition display techniques. Figure 6 illustrates the ratings to the first section. The second section presented eight different display techniques 8 photographs depicting representative examples of different display techniques applications to introduce the strategy to participants who might have not been familiar with it. Figure 7 illustrates the ratings to the second section. The third section presented six different display techniques 8 photographs depicting representative examples of different display techniques applications to introduce the strategy to participants who might have not been familiar with it. Ratings are shown in Figure 8. The fourth section presented seven different display techniques 7 photographs depicting representative examples of different display techniques applications to introduce the strategy to participants who might have not been familiar with it. Figure 9 illustrates their ratings.

Using People Display Techniques	0	1	2	3	4	5
Introductory lecture	6%	40%	48%	6%	0%	0%
Guided tour and books	6%	24%	38%	14%	12%	6%
People Movers	0%	4%	9%	23%	46%	18%
Play actors	0%	2%	10%	8%	58%	22%
Gift shop	0%	4%	52%	34%	5%	5%

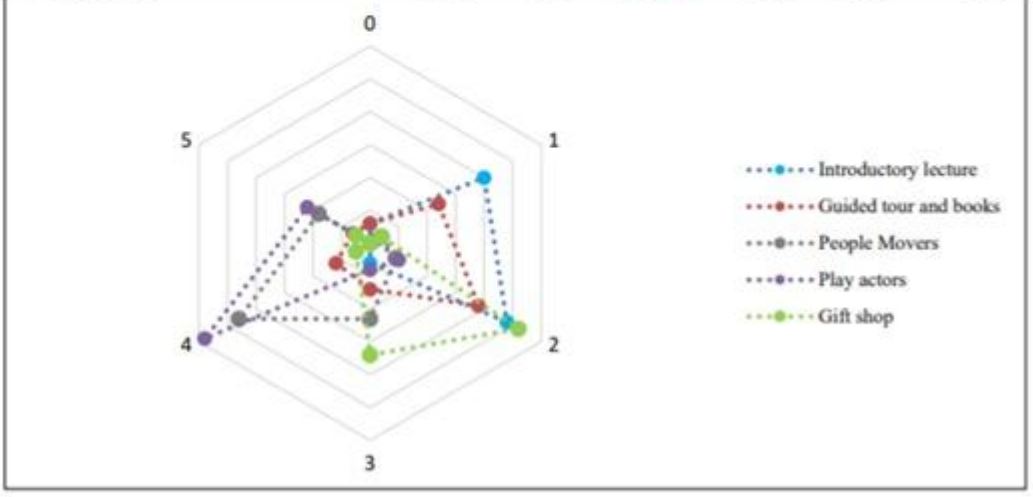

Figure (6) Section A - Using People Display Technique Results

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Graphics Display Techniques	0	1	2	3	4	5
Display screens	6%	14%	28%	34%	16%	2%
Website portal	0%	24%	46%	26%	4%	0%
Digital library	0%	22%	36%	27%	11%	4%
Exhibits electronic database	0%	7%	5%	38%	28%	12%
Mobile applications and wireless network	2%	8%	13%	32%	40%	5%
Hands on changing screens	0%	2%	10%	35%	42%	11%
Interactive map tour	0%	0%	4%	12%	26%	58%
Welcome talking screen	0%	2%	2%	18%	34%	44%

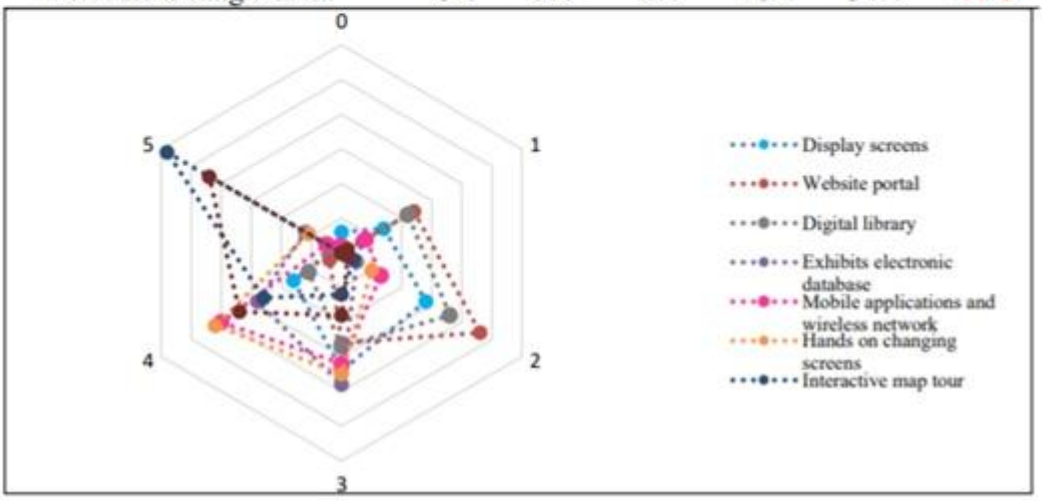

Figure (7) Section B - Graphics Display Technique Results

Three dimensional Display Techniques	0	1	2	3	4	5
I-MAX	0%	0%	2%	32%	58%	8%
Hosting events	0%	0%	7%	41%	38%	14%
VR games	0%	0%	2%	20%	36%	42%
People movers machines	0%	4%	6%	36%	51%	2%
Working models embedded skeleton	0%	0%	4%	16%	32%	48%

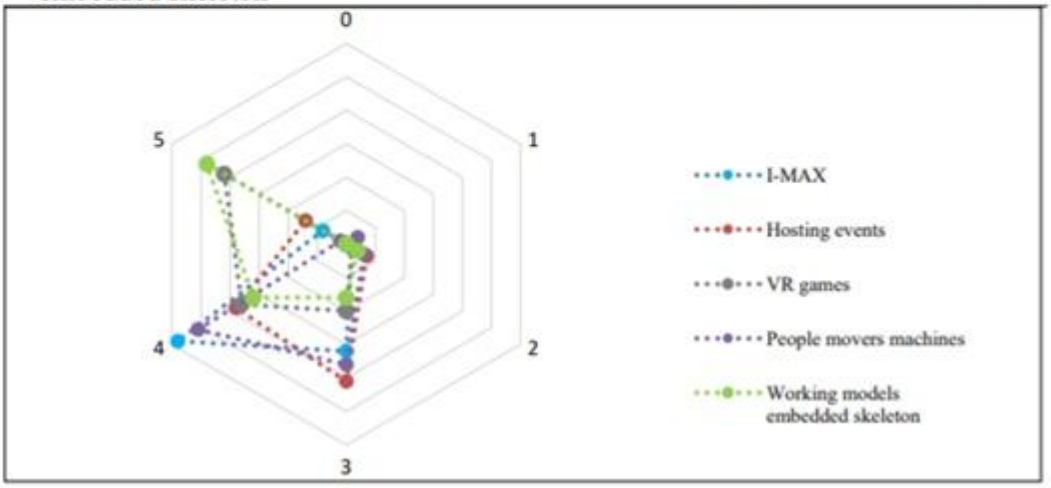

Figure (8) Section C – Three Dimensional Display Technique Results

Audio-visual and interactive Display Techniques	0	1	2	3	4	5
Audio systems	0%	2%	32%	55%	11%	0%
Sound and light	0%	0%	2%	18%	58%	22%
Skin and bones	0%	0%	0%	10%	38%	52%
Talking head costume model	0%	0%	8%	43%	37%	12%
Animatronics	0%	0%	0%	10%	43%	47%
Hologram	0%	0%	4%	18%	51%	27%
Peppers ghost	0%	0%	8%	47%	33%	12%

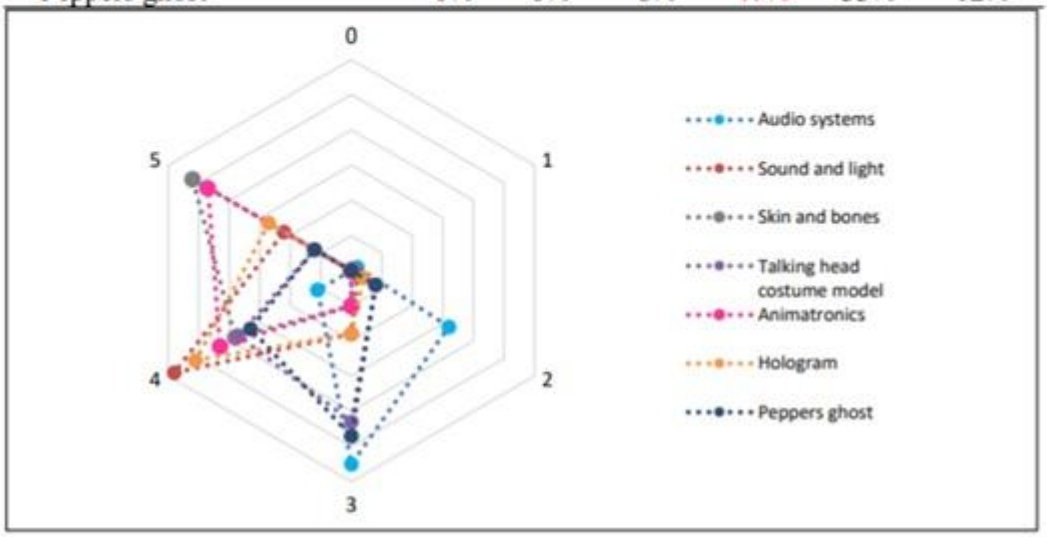

Figure (9) Section D – Audio-visual and interactive Display Technique Results

4.3 Museum exhibition design framework model

34 architects responded to these set of questions resulting as 53% of them were female architects and 47% male. Their age range varies where the majority are 17-20 years 47%, 38% 20-25 years, 3% 25-40 years, 9% 40-50 years and 3% above 50 years. The percentages of respondents indicated that they had architectural knowledge as their current architectural positions as 9% professors, 6% associate professors, 9% assistant lecturers, 23% teaching assistants and 53% architectural students. The prototype evaluation tool is used as a museum exhibition design framework model that can be used as a prototype evaluation tool between museum visitors' experiences and learning behaviour and museum display techniques, to transform museum visitors from passive consumers in a collection focused 'static exhibition' to active participants in a visitor centred 'interactive technology exhibition.' The results are shown in Figure 10.

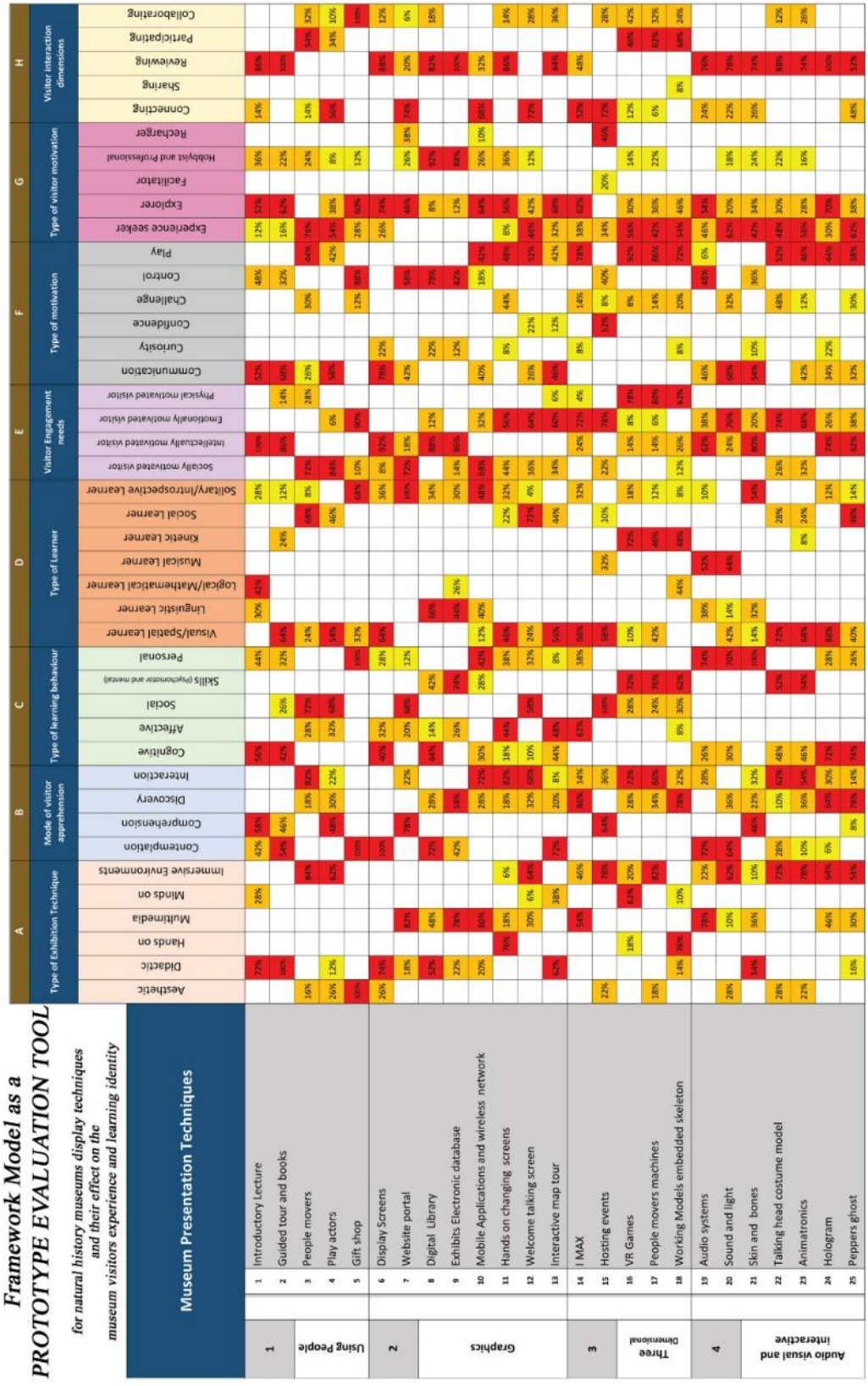

Figure (10) Museum exhibition framework model results

Display techniques effect on museum visitors experience and learning behaviour.

5. DISCUSSION

The identification of issues of public buildings scholars and experts' perspectives views towards planning a direction for developing public building such as museum exhibitions for public learning. Many researchers alert that public building such as museums are used as a key tool of broader learning and knowledge institution for the society [24], [25]. Linking user centred design and museum studies will highlight how museums can address their need to better understanding for their visitor experiences. As a framework, user centred design combines theories and methods from various disciplines including cultural theory, design psychology, design philosophy and social science.

Most of studies concerning museum exhibition design have mainly concentrated on their functional design, however, only a few numbers of studies have analysed impact of these display techniques on museum visitors learning identity and behaviour each time they visit and revisit the museum. The main aim of this research is the combination of these two approaches to formulate design strategy throughout a prototype evaluation tool which submit a minimal stander level, and also the paper will deal with analytical tools for stating the impact and the degree of validity to determine the effect of different display techniques on museum visitors learning identity and behaviour. In defining museum in a changing world museum display techniques use only ordinary presentation techniques to display the museum exhibits without the interaction of staff, visitors, spaces, and exhibition environment. Museums have been forced by the pressure of change to switch practices to transform museum visitors from passive consumers in a collection focused 'static exhibition' to active participants in a visitor centred 'interactive technology exhibition', to enhance the museum visitor's experience of the exhibits collection by providing a wide range of activities, programs and technologies that reinforce the communication of the museum exhibits core message. Therefore, the research highlights the role of museum exhibition designers while designing and redesigning the museum exhibits focusing on the visitor's role in the museum sustainability for visitors experience and re-experience within the museum, in an attempt to encourage our authorities, decision makers and designers to try to use these concepts in the formulation of the display techniques that can be applied to help achieve sustainability goals.

The Prototype evaluation tool provides a new way for designers and researchers to investigate different exhibition environments from a visitor-centred perspective. The instrument is simple to administer and sufficiently brief to be able to be used in conjunction with other measures of interest. As it offers a way of relating observed physical characteristics of an exhibition gallery to what visitors notice and find salient about the environment. This can help inform and improve exhibition design by helping focus refurbishments and improvements in those areas that are most likely to have an impact on the visitor experience. The prototype may also be useful for evaluating alternative layouts within exhibition existing museum galleries or design a new museum gallery. Therefore, the evaluation tool offers a contribution to the shared language that has been called for by exhibition planners. It represents tangible properties of an exhibition space that exhibition planners can aim for and provide a means by which these properties can be discussed during the design process. Furthermore, unlike other concepts that have been proposed to inform a shared language, ss it has been shown to be a predictor of both affective and cognitive engagement, and it helps build the case that creating a sense of activity in a space. This helps close the loop between what a designer sets out to achieve and what the visitor experiences.

The prototype can be used as both a planning and evaluation tool. During the planning stages, different exhibition environments could be mapped in terms of what the desirable combinations depending on the type of experience. As well as giving cues as to what design properties might lead to these outcomes, the resulting environments could be assessed as a form of subsequent evaluation and ongoing refinement. Such an approach could also be used to ensure there is an appropriate balance of environments across a whole

museum. The prototype evaluation tool can be used as guide for museum designers to design the museum exhibit in an interactive way that can transform museum visitors from passive consumers in a collection focused 'static exhibition' to active participants in a visitor centred 'interactive technology exhibition', Determination of museum visitor's public participation level to motivate museum visitors learning behaviour, ensuring visitors satisfaction which is directly related to the museum visitors learning experience, discovery, interaction and involvement.

The following evaluation is an example of how to use the prototype tool while designing the museum design exhibits. A designer was asked to propose a well-designed strategic development plan for a new museum exhibit or developing an existing museum integrating between the museum and technology may be used as a solution to create a space with positive response to visitors providing the best understanding and knowledge to educate people in an interactive way affecting their way of learning. Transforming museum visitors from passive consumers in a collection focused 'static exhibition' to active participants in a visitor centred 'interactive technology exhibition', to enhance the museum visitor's experience of the exhibits collection by providing a wide range of activities, programs and technologies that reinforce the communication of the museum exhibits core message. As the museums entered a time zone of transform, it is required to adapt in the museum the following criteria:

- Type of learner: Visual/spatial learner
- Visitor engagement needs: Socially motivated visitor
- Type of motivation: Play

(4) Start using the prototype evaluation tool (see figure …)

(5) Search for the required criteria within the (x-axis):

(Type of learner, Visitor engagement needs and Type of motivation)

(6) For each category, search for the required subcategory:

(Type of learner 'visual/spatial learner', Visitor engagement needs 'socially motivated visitor' and Type of motivation 'play')

(7) Highlight the required columns, for each required item there is a percentage will be shown for each display technique, check the display techniques that are active in all items in the criteria required (y-axis).

- People movers
- Play actors
- Mobile applications and wireless network
- Hands on changing screens
- Welcome talking screen
- Interactive map tour
- Talking head costume model
- Animatronics

(8) If you want to arrange the display techniques according to their priority, add the percentages indicated for each display techniques within the three requirements.

- People movers (A 24% + B 72% + C 44%) / 3 = 140 / 3 = 47%
- Play actors (A 54% + B 84% + C 42%) / 3 = 180 / 3 = 60%
- Mobile applications and wireless network (A 12% + B 68% + C 42%) / 3 = 122 / 3 = 41%
- Hands on changing screens (A 46% + B 44% + C 48%) / 3 = 138 / 3 = 46%
- Welcome talking screen (A 24% + B 36% + C 52%) / 3 = 112 / 3 = 37%
- Interactive map tour (A 56% + B 34% + C 42%) / 3 = 132 / 3 = 44%
- Talking head costume model (A 72% + B 26% + C 52%) / 3 = 150 / 3 = 50%
- Animatronics (A 68% + B 32% + C 46%) / 3 = 146 / 3 = 49%

For the requirements given, the following display techniques can be applied to increase museum visitors experience and address their learning behaviour:

(1) Play actors
(2) Talking head costume model
(3) Animatronics
(4) People movers
(5) Hands on changing screens
(6) Interactive map tour
(7) Mobile applications and wireless network
(8) Welcome talking screen

For future empirical work, Confirm the findings of the present study with samples of larger sizes and achieving a greater degree of representativeness confidence. Combine close-ended questions and open-ended questions or complement survey questionnaires with several in-depth interviews for a deeper understanding of perceptions and opinions about vertical greening. Future studies may relate to a greater variety of visitor outcomes, either as self-report measures or observable behaviours. Visitor behaviour was only explored in a limited sense in this study, and more sensitive measures of observable visitor behaviour and attention could be applied.

Future research should aim to how to implement and install the display techniques on the case study and make a comparison that will identify how different exhibit types may influence atmospheric perceptions. Furthermore, comparison of spaces of the cases study chosen anticipated to have different combinations of display techniques and museum visitor experience and learning behaviour.

The Prototype evaluation tool can be refined by further research, as it can be transformed into a digitalized data base framework model that can be used within all types of museums for creating and evaluating museum visitors experience and learning behaviour and which display technique can be used.

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