Graphic Design Methods of a Science Museum Exhibition for Children

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ABSTRACT

The graphic design is essential for the science museum exhibition affecting the perception and motivation of children to learn and discover a science experience. The research aims to study the graphic design methods of science museum exhibition for children, to propose the new approach of the graphic design which the most efficient expression to motivate learning of children from age 6 to 9 years old, and to design the graphics module within the temporary exhibition space. This article is the 1st phase to observe the graphic design methods of the science museum exhibition by using the fieldwork case study analysing of literature by selected 27 exhibits from the United Kingdom, Japan, and Thailand to compare. Also, interviews the 7 experts who are a stakeholder with the research. The result indicated that the graphic design approach of all exhibitions with the consistent. However, the mood and tone vary depending on the exhibit presented, and the role of graphics is different because of the socio-cultural context of each country. The conclusion can be drawn that the study result can be the guide or sources inspiration of further artistic creation and design that is attracting children the further stage of development.

Keywords: *graphic design, science museum exhibition, children learning*

INTRODUCTION

A science museum exhibition is designed to give children the opportunity to learn and to discover a new science experience apart from learning within the school. Graphics are essential for the exhibition affecting the perception and motivation of children. They are always used in the exhibition to communicate the visual to visitors by synthesising images and complex texts that visitors can quickly recognise, understand easily, and have also worked with other elements to draw child attention to focus on various objects in the exhibition.

The case of an exhibition, the designer must consider both visual images and texts in the area that the visitor stood to watch. All elements which in the large area of the exhibition have affected recognition and reading whether models, VDO, diorama, distances of panels or graphics boards, movement of multimedia, lighting, etc.

In the same way, the ability of the graphics has affected to the visitor recognition. For example, “Eat and Be Eaten” the exhibition of Liberty Science Center, the United States of America. The Jury of Society for Experiential Graphic Design

(SEGD, 2006) commented "A wonderful exhibit of live animals housed in hexagonal structures with large-scale interpretive graphics allows the visitors to engage fully with the animals and their habitats. Visitors can navigate by the four different colors used within the signage and graphic displays. The use of large-scale photography and up-close shots of the animals engages the visitor." Another example is "What is in Sneeze?" the exhibition of Science Museum of Minnesota, the United States of America. The graphic lures visitors to open a small door over the young girl's face. When they do, a sound and a spritz cause them to jump back as they get sprayed. This an experiential, interactive graphic that is funny, surprising and causes a physical response (Polly McKenna-Cress and Janet A. Kamien, 2013: 96).

Figure 1. "Eat and Be Eaten" exhibition of Liberty Science Center, New Jersey, USA. (Source: https://segd.org/content/eat-and-be-eaten downloaded 29 March 2015)

Figure 2. "What is in Sneeze?" exhibition of Science Museum of Minnesota, USA. (Source: Polly McKenna-Cress and Janet A. Kamien. (2013). Creating Exhibition: Collaboration in the Planning, Development, and Design of Innovative Experiences. New Jersey: Wiley & Sons, p 96.)

When referring to the children visitors who are just starting to a school-age, they will have the opportunity to acquire knowledge and experience from the exhibition in the science museum. However, children are thinking and experience to recognize different from adults. Even between young children and older children, their ideas are not the same. George E. Hein (1998: 143) states that to classify all young visitors simply as "children," meaning the glossing over vast developmental differences as Jean Piaget's major stages of development all occur within the population labeled as "children." Obviously, the youngest visitors still unable to read are developmentally different than older, elementary school visitors. But these latter, in turn, are quite different from teenagers.

Also, Pam Locker (2011: 47, 121) suggested that children will require a hierarchy of information that is of interest to a range of age groups and learning abilities. Their exhibitions will require specialist design decisions regarding height, size, colour, and use of materials. The age group will dictate their literacy levels and will influence how they engage intellectually. Children require the use of appropriate language, font choices, and images, and tend to respond positively to interactive environments. Similarly, the use of graphics in children's exhibitions, including interactive and object labels, will need to consider literacy level, child-friendly typefaces, and content as well as engaging imagery.

With the background and significance of the preceding, the researcher has the objective to study the graphic design that encapsulating the content to communicate the visitors to interact with space and also allow visitors to learn and experience something back. So, this study observes the graphic design methods of a science museum exhibition for children, serving as guide or sources inspiration of further artistic creation and design that attracting children further stage of development.

METHODS

The conceptual research framework involved three main issues, including graphic design, exhibition design, and children learning.

This study divided into three phases. The first phase, exploring fieldwork case studies and interview the experts to study the concept design and themes. The second phase, experimental procedure and testing the samples to find the graphic design methods, and the last phase, design of the graphics module of the exhibition for children within a temporary exhibition space.

This report describes the study on the first phase to observe directly to obtain accurate information and reliability. The researcher involved in some events and activities to test the presentation and explained certain behaviours manually, along with in-depth interviewed with experts who are the key informants and stakeholder in this research by using the interview schedule, documents, field notes, and taking photos.

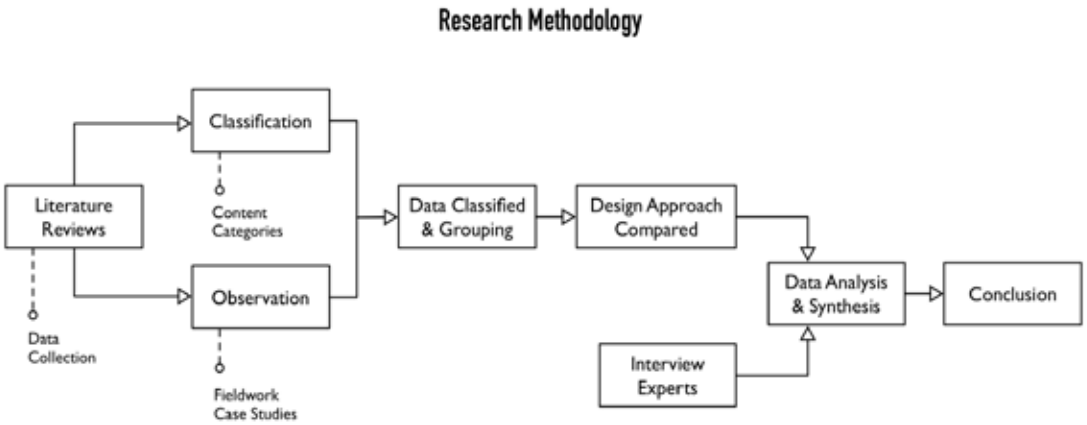

Figure 3. Diagram of the research methodology.

1. Criteria

The selection criteria of the science museum exhibitions as follows: first, the researcher analysed to classify the categories of the science learning course for Thai students in the elementary school grade one, two, and three according to the Basic Education Core Curriculum A.D. 2008 (Bureau of Academic Affairs and Educational Standards, 2008). As a result, science learning is divided into five categories including Animal & Plant Life, Earth & Environment, Human Life, Science & Technology, and Space & Universe.

After that, the researcher used fieldwork case study analysing of literature by selected twenty-seven exhibitions from three countries in different regions and cultures include the United Kingdom, Japan, and Thailand both a permanent exhibition and a temporary exhibition that are exhibited during the years 2015-2016. Those are an exhibition for education about science and nature for children and people. The following is a list of science museum exhibitions:

1. Natural History Museum, London, the United Kingdom; 4 exhibitions are as follows: 1) Dinosaurs, 2) Ecology, 3) Human Biology, and 4) Sensational Butterflies
2. Science Museum London, the United Kingdom; 6 exhibitions are as follows: 1) Atmosphere, 2) Cravings: Can your food control you?, 3) Exploring Space, 4) Launchpad, 5) Pattern Pod, and 6) Who am I?
3. National Museum of Nature and Science (Kahaku), Tokyo, Japan; 4 exhibitions are as follows: 1) ComPaSS, 2) Investigation Technology for the Earth, 3) Navigators on the History of Earth, and 4) Origins of Biodiversity
4. National Museum of Emerging Science and Innovation (Miraikan), Tokyo, Japan; 5 exhibitions are as follows: 1) Curiosity Field, 2) Earth Environment and Me, 3) Songs of Anagura, 4) Stories of One, Everyone, and You, and 5) This is ISS, go ahead
5. Children's Discovery Museum, Bangkok, Thailand; 4 exhibitions are as follows:
   1) Creative Science, 2) Dino Detective, 3) Incredible Me, and 4) Miracle of Life
6. Science Center for Education, Bangkok, Thailand; 4 exhibitions are as follows: 1) The Blue Planet, 2) Inspired by Astronomy, 3) Kid City, and 4) The Secret of Life

The selection of exhibitions is consistent with the categories of the science learning that used the selecting specific methods. The selected exhibition is designed for young visitors can visit and also be a popular exhibit for children. The information is provided by the curators and studying the documents.

2. Analysis

Review of twenty-seven selected exhibitions into five science learning content categories classified as follows:

1. **Animal & Plant Life:** 1) Dinosaurs, 2) Sensational Butterflies, 3) Pattern Pod, 4) ComPaSS, 5) Origins of Biodiversity, 6) Dino Detective, 7) The Secret of Life

2. **Earth & Environment:** 8) Ecology, 9) Atmosphere, 10) Navigators on the History of Earth, 11) Earth Environment and Me, 12) The Blue Planet, 13) Kid City
3. **Human Life:** 14) Human Biology, 15) Cravings: Can your food control you?, 16) Who am I?, 17) Curiosity Field, 18) Stories of One, Everyone, and You, 19) Incredible Me, 20) Miracle of Life
4. **Science & Technology:** 21) Launchpad, 22) Investigation Technology for the Earth, 23) Songs of Anagura, 24) Creative Science
5. **Space & Universe:** 25) Exploring Space, 26) This is ISS, go ahead, and 27) Inspired by Astronomy

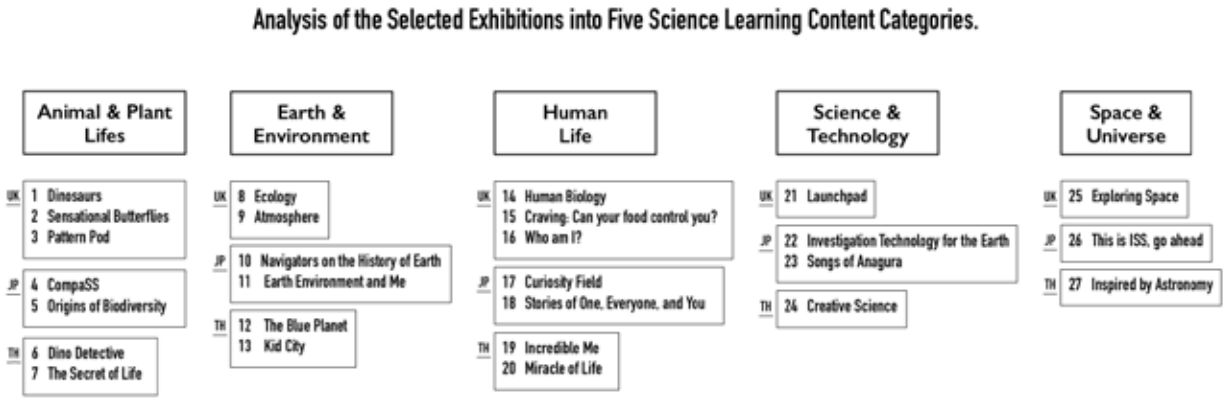

Figure 4. Analysis of the selected exhibitions into five science learning content categories.

The research was conducted by studying the graphic design principles and exhibition design approach to compare in eleven topics: 1) site and space 2) visual image 3) text 4) layout 5) colour 6) lighting 7) material 8) interactive 9) model 10) sensory perception and 11) mood and tone. The analysis methods have been clarified in the table, and descriptive summary already was given.

3. Interview

Furthermore, the researcher interviews the experts in three fields namely science museum, exhibition production, and children learning. Everyone is a stakeholder with this research. The total number of seven people from three organisations including the Science Center for Education, Children Discovery Museum, and National Science Museum, Thailand.

RESULTS

The research results can be concluded as follows:

1. Site and space

The exhibition separated into three sizes, namely a small-size is less than 200 square metres, a medium-size is 201-500 square metres, and a large-size is more than 500 square metres. The exhibition spaces are in various forms. They are exhibited in rectangular area shape and may be constructed in different ways depending on the exhibits presented. In the same way, they used various devising

paths, mostly the areas of affinity that allow visitors to make immediate visual connections between exhibits, compare them directly and follow a thread of exploration from one artefact to another, and secondary is star exhibits that visitors enliven the areas around them, and also tend to draw visitors through a gallery and create a sense of expectation throughout the journey.

2. Visual image

The stroke and style of visual images or illustrations; all exhibitions usually used an image representation, a silhouette and contour drawing comes as the second. However, a pictograph, exhibitions of the United Kingdom and Japan more used than Thailand. Experts agreed that a representation image should be applied to children while some experts thought different that a silhouette is suitable for children because it helps them to build imagination and creativity. Moreover, mostly exhibitions used cartoons and diagrams to be the visual symbols, consistent with the opinion of experts that a cartoon will be able to attract children attention and a diagram should be the picture chart more than showing only text.

The gestalt principle, mostly exhibitions used the similarity rule that meaning is a similar colour, shape, or size for grouping images. It is consistent with Amy E. Arntson (2007: 80-84) states that "When people see things that are similar, they naturally group them. Grouping by similarity occurs when they see a similar shape, size, colour, spatial location (proximity), angle, or value. All things are in some respects and different in others. In a group of similar shapes and angles, they will notice a dissimilar shape or angle." Also, Rudolf Arnheim (2004: 79) cites that "The same sensible attitude prevails in perception. Comparisons, connections, and separations will not be made between unrelated things, but only when the setup as a whole suggests a sufficient basis. The similarity is a prerequisite for the noticing of differences."

Besides, the core of the image transformation of three countries is the cropping especially a photo. The difference between the British and Thai exhibitions used the image exaggeration. In the Japanese case, they did not use the same technique.

3. Text

The result of using text, all exhibitions used the sans-serif typeface with the English language. In the case that English is not the national language, they will use the bilingual both the national language and English. In the case of Thailand, exhibitions mainly used Thai language and the serif typeface with headlines and body texts. The experts agreed that friendly fonts to Thai children should be serif typefaces. Conventionally correct Thai character writing is required have a head, and then children are familiar with the character's head when they learned in the school. Besides, the exhibition for children is popularity to use handwriting fonts for the title and section or zone that will make for young sense and casual.

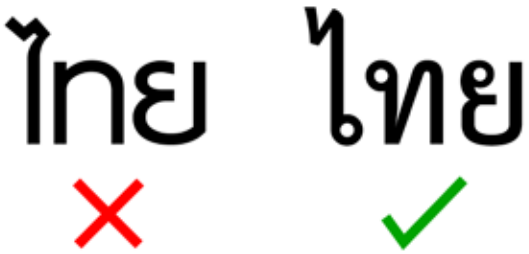

Figure 5. The example of the correct Thai character's writing.

Types of character, all exhibitions used a regular and bold character, while some of them also used an extra bold character to highlight the distinct texts on the title label and section or group label. Moreover, the British and Japanese exhibitions mainly used one or two typefaces In the case of the Thai exhibitions, and several typefaces are usage. The issue typeface structure, exhibitions mostly arranged horizontally, but the Japanese exhibitions arranged their quote text vertically.

4. Layout

Labels, panels, and signs; all exhibitions have installed the title label and mainly have had the introductory or orientation label and identification text. In the case that the exhibition separated the section or zone, the section or group label will be used. The difference is several Thai exhibitions have installed prohibitive signs and some temporary prohibitive signs made by curators, while the other countries are quite less to appear. Experts are the further opinion that Thai children behaviours especially young children who visited with their parents. Some hands-on objects in the exhibition were damaged quickly as the result of their parents did not provide them with cognitive before to play objects. So, it was the cause that museum stuck prohibitive signs at various points. It became to the echoes of some parents that the museum blocked their children's learning.

The observation of text levels referred to the principle of Jacqueline Tang (cited in Barry Lord and Maria Piacente, 2014: 317) explains that "In general, there are four levels of text a graphic designer considers in a hierarchy. The characteristics of each are project-specific, but here is how they used: Level 1 is used for first levels exhibition content such as titles, headlines, quotations, and introductory text to the whole exhibition. Level 2 is secondary to Level 1 and is used for general overviews on introduction panels to specific themes or sections of the exhibition and primary introduction or information panels on a tertiary level. Level 3 is used for most general exhibit content as well as primary text on labels and multimedia or interactive devices where necessary, and Level 4 is used for the lowest level of exhibition content – label and caption text. It is detailed and explanatory and pertains to specific artefacts, works of art, or specimens, and to images reproduced in the exhibition."

The study found that exhibitions mainly used four levels of text hierarchically, and the exhibition for children used two levels of text. In spite of the Thai exhibitions used four levels of text, but each level used many typefaces and font sizes. However, the exhibition that designed primarily for children still used two or three levels of text and did not be several fonts. The experts' opinion is that the text for children should limit to two to three levels and should have it on title and section or group label only because children do not read any message.

About the graphic layouts, Alex W. White (2011: 81) states that the asymmetrical or informal, balance attracts attention and is dynamic. Thus, all exhibitions usually used the asymmetry composition similarly because this method makes them look casual. Also, the scale relationships between text and images on a label and a panel found that the proportional of images rather than text, but it depends on the amount of content.

5. Colour

The colour of the graphic elements namely a text, image, background, and pattern; the study found that the text in the exhibition was mainly in light or dark colour but images were in vivid colour. Backgrounds were in light, dark, and vivid colour and they also were in contrast to the text. Each exhibition used the different colour of patterns but rather less to appear. According to the experts' opinion, a visual image is suitable for children should have with vivid colour. The exhibition needs the light text colour in dark or vivid background or reversal.

6. Lighting

All closed exhibition spaces installed lightings including the spotlight, wall-wash lighting, contour spotlight, and ambient lighting that to build an atmosphere and illuminated an object, label, and panel, some of them installed the coloured lighting. In contrast, open exhibition space is used a natural lighting.

7. Material

All exhibitions used the graphics on ink-jet printed to mount on panels and labels are made of the plastic, acrylic, plywood, and fibreboard. Experts stated that due to the cost of ink-jet printed is the lowest other materials and can be easily adjusted, suitable especially for the temporary exhibition. In the Thai case, permanent exhibitions mainly used the ink-jet printed mounted on plywoods or fibreboards but several damaged. The original idea exhibition is supported to be temporary because budget limited and new coming exhibition is not possible. And another one, the material qualities have a new coming because of the budget was the problems. The other one of the problem, material deteriorated. So exhibitions were necessary to extend the exhibit indefinitely became to be the permanent exhibition finally. It has defected because of the long term use.

8. Interactive

All exhibitions are a hands-on type; visitors could explore experience by touching and used the interactive media namely touch-screen computer, VDO, and electro-mechanical to interact with them. It is consistent with the experts' opinion the

exhibitions are designed for children mainly to encourage children the new experiment. And also they used the device function as the instruction media replacing the static text on panels because children need not read the message but those media will cause to gain knowledge and fun at the same time.

9. Model

Touchable model is the most popular be usage in exhibitions, and the naturalistic model comes as the second. The current experts' opinion is that a visitor can touch on explores the model closely, the old fashion of "please don't touch" is outdated. This method is effective for children that can attract the attention of children as well because they like to touch objects. The significant, safety precaution for visitors must be considered whether the objects on display, experimental player, interactive media, interior design, and decoration, etc. These must be safe and do not any harm to visitors.

10. Sensory perception

The perceptions of visitors to the exhibition, the visual, hearing, and touching senses were usage, some case a visitor could use the smell sense to perceive but the taste sense did not be usage. Also, the experts' opinion is that the exhibition would avoid the exposure of children to taste because to the concern health problem possible impression.

11. Mood and tone

Referring to the Colour Image Scale theory of Shigenobu Kobayashi (1990: 2, 12) that "The classification of colours based on images is the key to understanding the way in which colour combinations are perceived, a common feeling runs through the images that people hold of colours. By research linking adjectives associated with these images and colour, he has developed the Key Word Image Scale. The keywords in the warm-soft area of the scale have an intimate feeling, and convey a casual image, while those in the warm-hard section have a dynamic character. The keywords in the cool-soft section have a clear feeling and suggest a good sense of colour, while those in the cool-hard section conveys an image of reliability and formality."

Thus, this theory can be applied to classify overall mood and tone of the exhibition. The result found that each exhibition had been the different mood and tone depending on its content. The British exhibitions mainly have been warm-soft mood and tone to make an enjoyable casual image. The Japanese exhibitions used several mood and tone such as warm-soft to make an enjoyable casual image, cool-soft to make a youthful cool-casual image, and cool-soft to make an artistic-tasteful chic image. While the Thai exhibitions mainly have been warm-hard to make a vigorous dynamic image, and warm-soft to make an enjoyable casual image comes as the second. In the case of the exhibitions were designed for children only found that the core of mood and tone have been warm-soft to make an enjoyable casual image corresponding all countries and according to the experts' opinion as well.

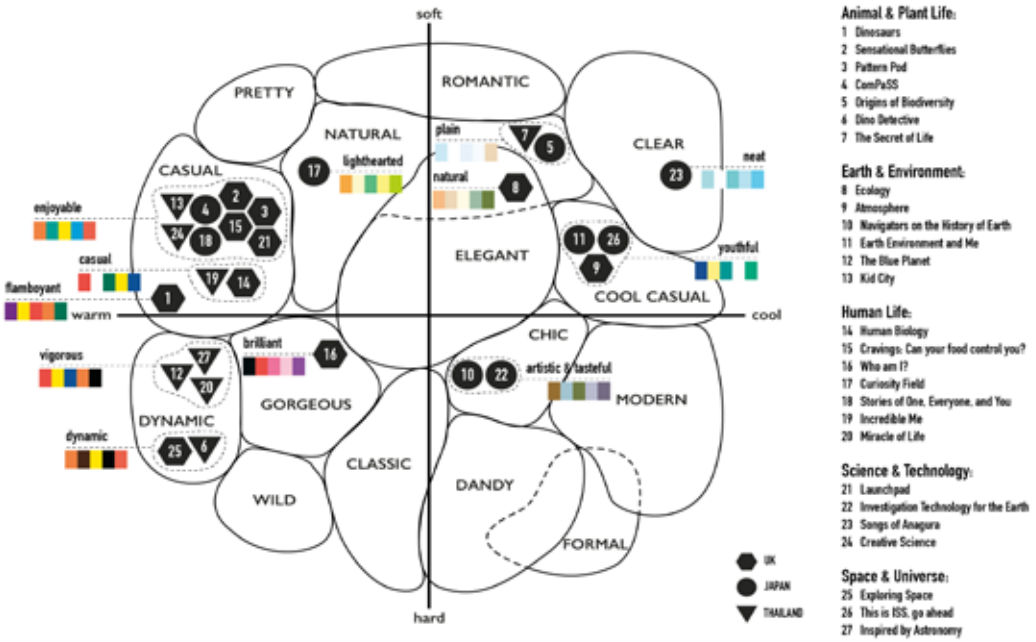

Figure 6. Analyse overall mood and tone of the exhibitions.

DISCUSSION

The researcher analysed more than some of the issues below:

The role of graphics for the exhibition in the case of the United Kingdom, graphics are served as the information to communicate the content of the object to display such as a history, a scientific principle, etc. On the other hand, in the case of Japan, graphics are served as the narrative and the exhibition would have a story theme. Graphics would be used as a media to visualise the story and to build the atmosphere which surrounded visitors. Nonetheless, in the case of Thailand, graphics are also served as the information, but they could not communicate well enough because of many contents on the panel.

Figure 7. The role of graphics for the exhibition.

The experts' opinion is that the contents of the exhibition would be defined by the scholar which to be many data usually that is consistent with the Thai education culture. Kritsada Reungareerath (cited to Arphawan Sopontammarak, 2015) agreed that the Thai education system forced many educational contents to children. Moreover, Thai children have lacked the freedom to learn because the education system has emphasized memorization rather than critical thinking and creativity. Preecha Methawasspark (cited to ASTV Manager Online, 2014) agreed that teaching of the Thai education system nowadays, the courses focused on contents and theories rather than to apply knowledge to everyday life. Thus, the Thai exhibition presented has been full of educational materials likely due to the primary education of Thailand highlighted with the knowledge memorization.

The results of the study found the difference between British and Japanese children that are freedom to learn more than Thai children. The British education system is designed to support children learning freely such as a course has the homeroom class offered to them that need to learn anything. Meanwhile, the Japanese education system has focused on the creative learning such as a folding art is called "Origami" to be a subject in the course that children required learning, it has pushed them can be analysed brilliantly, intelligent and creative. So, both the British and Japanese exhibitions are designed to encourage children learning independently, and they have the learning media stimulate a child's creativity.

The issue of art and design culture, the United Kingdom is a country with the concept of modern art. The exhibition designer focuses on design regard to the corporate identity. Notice the use of typefaces in the exhibition is consistent with the organization's logo. The mention of Japan, a country with a highly nationalistic and also highly progress in science and technology. Various designs have reflected the Japanese style. They are proficient in creating that conscious about saving space. Thus, the exhibition is organized mainly in a small-size and medium-size space used the creativity to present the content to quickly understanding in a short time and could maintain their Japanese style as well which is evident from the Japanese is the primary language in the presentation of the exhibition.

The contrast, Thailand has given the cultural influence of Western countries and international cultural leaders of Asia such as Japan and Korea. The graphic design of the exhibition usually uses a cute cartoon character and internationalization could appeal to children better. Simultaneously, showing the national identity could be done because the Thai language is the national language which Thai people use essentially, so the exhibition is also required to present the contents in Thai. In term of the exhibition for Thai children should design such as a title label and section or group label with a few texts in large-size typeface and may show description with a cartoon character and picture diagram on the advice of experts.

The study found that science museum exhibitions mainly have been focusing on the school-age target. However, their purposes allow children to experience by

playing, while adults such as teacher and parent still need to read messages on the label and panel for suggesting children learn and know how to play. Children are not interested in the detail of contents on the label and panel. They are only interested in playing everything which can be touch.

The design concept of the exhibition for children is touching and safety. The exhibition should be installed with the object, mechanic, and interactive media that focus on the visitor's experience and also be considered the safety. Exhibition graphics served as the information and narrative. Especially, the graphic design should make visitors perceive the sense of touch and safety feel such as use the bright and vivid colour visual to stimulate imagination and creativity, the rounded typeface to make the safety feel, etc. At the same time, graphics should be able to create a learning atmosphere with mood and tone to illustrate comfortable, informal, and colourful images to motivate imagination and creativity for children.

CONCLUSION

The study results indicated that the graphic design of the exhibition in all countries with the consistent in several items such as illustration styles, visual symbols, gestalt, graphic layouts, character types, and graphics colours. Among the various parameters discussed, the mood and tone vary depending on the exhibit presented, and the role of the graphic is different because of the socio-cultural context of each country. Moreover, graphics should be illustrated by the informal, enjoyable, and colourful to stimulate imagination and creativity to children.

The good exhibition design that includes: The content is appropriate for the visitor's learning ability. Learning materials such as real model, simulated model, and interactive media for the visitor can learn from exposure experiments. Beautiful graphics and engaging content to help viewers get to know and understand quickly. The text is a concise thematic material with the national language by the character and placement of the correct language. Construction and decoration exhibition tones create an atmosphere for the material presented. The objects are positioning and devising paths viewers learn the content in its entirety and meet the objective of the presentation. Inclusive lighting lit with a message on the panel and backlight to create an atmosphere to the place.

The graphic design of an exhibition for children, the designer, needs to know what the different artistic style between children and adults, studies the physical and intellectual development of children, learning behaviour, and their satisfaction. The designer must act to transform these data into easily visual communication to make children understanding and motivating them to learn.

The conclusion could be drawn that the study result is serving as a guide or sources inspiration of further artistic creation and design that attracting children the further stage of development. Finally, the further studies on the theme of children's favourite will benefit to create a prototype of the graphic design for an exhibition that the most efficient. So, the next phase, the research will be the experimental procedure and test the samples to find the graphic design methods that suitable for children from age 6 to 9 years old. Then, the researcher will design the graphics module in the temporary exhibition space in the final phase.

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