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Design Principle for Public Transportation Infographic

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***Abstract*—Infographics is a visual representation of data. Today, people learn faster and remember things more efficiently and effectively through the use of text and visuals than using the conventional textual method alone. Infographics can be used in visualization to enhance data interpretation and knowledge discovery. Many businesses use infographic elements that are hard to digest and understand. Visualization can be insufficient or ineffective, thus messages can be transferred well or they can be wrongly transferred. Businesses with lack of graphical representation skills usually meet with this kind of challenge. Preliminary study has found that transportation companies may not follow any design principle to design infographics. This can cause data to be poorly defined with uninteresting graphics which eventually do not trigger target audiences' interest or unable to engage them. Besides, this process can affect the businesses' revenues and customers' satisfaction. A qualitative method was applied in this study. A design principle for public transportation infographic was developed based on three main principles which were Gestalt theory, components of infographics and components of public transportation. Gestalt theory introduces the theory of similarity, figure-ground, proximity, common region, focal point, closure, and continuity. Components of infographic include visual element, content element, and knowledge. Components of public transportation are unit of carriage, transportation terminals, travel directions and durations, safety, accessibility, reliability, and fares. A qualitative methodology was applied to evaluate the proposed principles. Five experts in infographics and visualization were assigned to evaluate the reliability of both the questionnaire and the infographic design principles. Findings from the expert's review show the content validity index 0.95 for questionnaire and 0.89 for the design principle Infographic. Therefore, the result is acceptable. It is hoped that the developed design principle in public transportation will give good impacts in developing and enhancing infographics.**

***Keywords*—Infographic, public transportation, design principle, visualization**

I. INTRODUCTION

Infographics is a visual representation of data, information or event that provides information in a specific and practical way. Learning through text and visuals is more effectively than the regular textual method alone [1]. Infographics intrigue elements include the usage of colors, charts, maps, logos, and other textual elements to deliver content in the least amount of space. Infographics in businesses today have become a popular way to relay complex data and messages using visual elements [2].

Infographics helps to avoid distortion and ambiguity in a message or communication [3]. It can be used in information visualization to enhance data interpretation and knowledge discovery in disciplines ranging from computer science, business intelligence, and humanities. The current wave of infographics usage is gaining momentum in business; thus, it has been used in governmental response, activity performance, and planning. The term infographics can be associated with the thoughts of using graphics and images to communicate action, plan or status [4]. The instruments for data visualization are infographics which targets to enhance knowledge transfer as well as communication process and to overcome the limitations of space and time [5, 6].

The main concept of using Infographics is to simplify messages using visual graphics. Infographics designer often uses charts, pictograms, signs, and illustration, including photography, lines, and charts to visualize the information. According to [1], Infographics element reduces barriers and overloaded information and is directly useful for decision-making purposes. Different studies show that some infographic designs are always outperforming as sometimes it is time consuming for the target audience to get into details, to understand and to digest information using visual elements [7] [8].

Infographic visualizes idea and data from intricate information to something that is easier for the viewer to absorb [9]. Sometime infographics are implemented insufficiently [10] with infographic elements that are hard to understand [11]. Having too little information in an infographics or off topic illustration can be a problem, as well as poorly defined data which cannot be translated too well. Businesses are finding their ways into these common challenges. They use poorly defined data with uninteresting graphics which eventually do not interest or engage the target audience. Some infographics have great visualization elements but do not deliver a concise message or compelling storytelling.

Infographics is a powerful tool for illustrating vast, complex information with very little text [6]. It is commonly used as a visual communication tool in various fields such as marketing, education, healthcare, transportation, and others [12], [13] . Infographics may be created improperly, putting in too much information, using inappropriate types for the information provided as well as wrong and insufficient use of the visual elements. So, people may not properly get involved with them. Therefore, businesses have started to overlook the usage of visuals to enhance infographic for effective business communication. For example, in education virtual literacy and infographic skills play significant roles in the digital-age instructors' toolbox [14]. Moreover, in public health, infographics is a powerful digital tool that enables patients to have the required knowledge to understand information on specific diseases, procedures, and trending health-care topics [15]. Transportation has a deciding impact on other branches of the global economy including tourism through its role in the transportation of goods and people [16], according to an initial investigation, the findings have proven that there is a need to develop an infographic design principle to be followed in public transportation business. This design principle is useful to assist infographic designers in making infographics for public transportation and students to enhance their learning experience. In this article has two objectives:

a) To develop infographic design principle for public transportation.
b) To evaluate the developed design principle for public transportation.

This article is organized into several sections. The immediate section provides background information on infographic and design principles which clarify the needs to design principle for public transportation. Section III presents the methodology employed in the development of the design principle. Section IV presents the discussion on the findings. Finally, Section V presents the conclusion of this study by summarizing the contribution, limitation, and recommendation for future research.

II. LITERATURE REVIEW

Krum has defined infographics as the usage of visual cues to communicate information [8]. Siricharoen have argued that infographics is a visual presentation that is intended to communicate complex information [17]. Information Graphic is defined as the tool and technique involved in the graphical representation of data [1]. Infographics is great tool in telling story with data to a broad, and non-expert audience [18]. A well-designed infographics can be used to generate a lot of inbound connections in online marketing. When a market product is paired with an image or a graphic, it makes the content more digestible [19]. Businesses all over the world have begun to use infographics and data visualization as tools for marketing and sharing information [20]. Marketing companies mostly use infographics to get their point across to their target customers or audience. Meaning that a well-executed infographic connects with the audience by providing them with useful information. Infographics have been explored in nearly any field including marketing, finance, operational management and finance, government, and online social media [21]. A well-designed infographics can assist to strengthen business sales performance and pull top on Search Engine Optimization (SEO) ranking. Infographics is fun and engaging when it is done right and can foster great business connection between customers and companies' brands [22].

Despite infographics that has been used in many sectors, it is still inappropriately used. Many businesses yet to get it right in designing compelling infographics that will help the audience to retain the visual information. There is a lack of generally acceptable frameworks or models that can help in the delivery of value creation infographics [23]. According to [23], there are no associated conventional methods for creating an "aggregate infographics" that engages the opinion of large audience.

Dr. Catherine Stones and Dr. Mike Gent have introduced a new set of evidence-based principle to help the production and commissioning of health infographics for use with the general public. These are 1-Get to know your Audience, 2-Restrict Color, 3-Align Elements, 4-Priorities Parts, 5-Highlight the Heading, 6-Invest in Imagery (wisely), 7-Choose Charts Carefully [24].

According to [25], three important problems must be overcome to create successful infographics. There are strategies to be followed in order to design infographics that will make a difference in education which are:

a) Determine clearly which quantitative, chronological, physical communication will be used.
b) Plan the information as a whole with a consistent design should include more than all parts (drawings, plans, diagrams) in the design.
c) Select the appropriate environment for the topic (interactive, static or moving).

In addition, ten strategies have been laid out in designing successful infographics [25]. These are organizing information, making the information visible, creating content, simplifying content, adding multiple emphasis, showing cause-and-effect relationship, making comparison, creating multiple dimensions, and integration [25]. It can be said that a successful infographics can be designed in four steps when the important conditions and methods mentioned are included in the account which are [14]:

a) Make a plan,
b) Start designing
c) Check
d) Finish

III. METHODOLOGY

This study applies a qualitative research methodology. A set of questionnaires was distributed to five experts for the evaluation of the proposed design principle. As shown in

Fig. *1*, the development of the design principle was based on Gestalt theory. The elements of this theory employed were similarity, figure-ground, proximity, common region, focal point, closure, and continuity. For the components of infographics employed they were integrate visual elements, content elements, and knowledge. Meanwhile the components of public transportation used were unit of carriage, transportation terminals, travel directions and durations, safety, accessibility, reliability, and fares [26], [27].

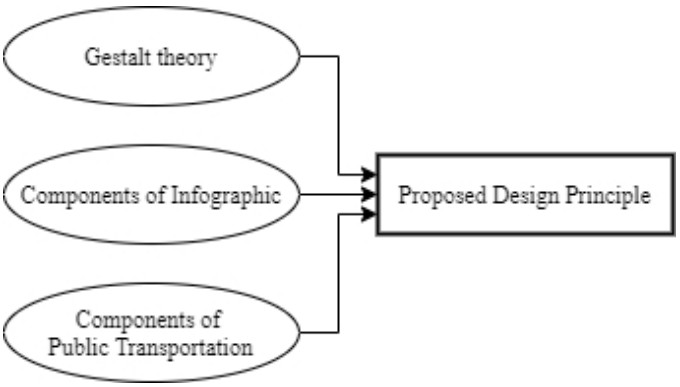

Fig. 1. Design Principle Development

A. Respondents

As suggested by Nielsen, three to five evaluators are enough to avoid more problems [25]. In this study five experts were selected to participate in the validation and evaluation of the proposed design principle. The experts were senior lecturers in a public university and an expert from public transportation industry. The experts were chosen based on their expertise.

B. Research Instruments

Fig. 2 shows that there are two types of instrument used in this study; they were a design principle and a questionnaire. The design principle had undergone one phase of validation which was the content validity. Meanwhile, the questionnaire had undergone two phases of validation which were face validity and content validity. Two different participants were involved in the validation and evaluation process. Five respondents were selected to participate in the face validity phase in which they were asked to validate whether the questionnaire could be understood or otherwise. Five experts were selected to participate in the content validity assessment of both the questionnaire and the principle infographic. The changes in the content on questionnaire and the design principle were made according to their evaluation and validation. The Likert scale of between strongly disagree and strongly agree was used to measure the acceptance of the design principle.

To develop an infographic of the design principle, a data presentation and visualization tool was used. In this study, Visme, a free online tool that can create various types of infographic was used to design the design principle infographic.

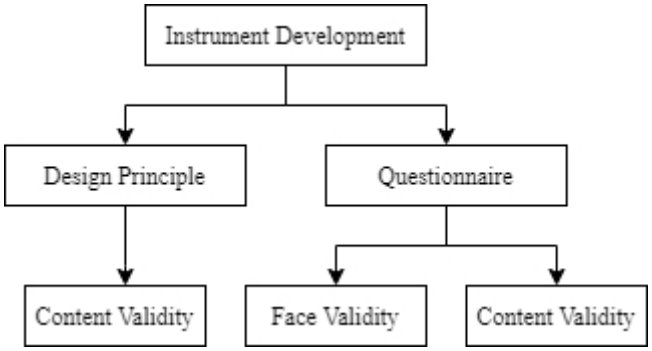

Fig. 2. Instrument for design principle infographic

The proposed design principles consist of 10 principles as depicted in TABLE 1. They are grouped into three categories which are the components of infographic and components of public transportation were used in the principle infographic. Questionnaire and design principle infographics are the instruments used to evaluate the design principle. TABLE 2 represents the items in the design principle questionnaire.

TABLE 1. Proposed design principle

No	Design Principle	Components of infographic	Components of public transportation
1	Visual Hierarchy	Visual elements	1) Unit of carriage 2) Transportation Terminals 3) Travel directions & durations 4) Safety 5) Accessibility 6) Reliability 7) Fares
2	Negative Space (Gestalt theory: Focal point or Figure-ground)		
3	Leading Lines (Gestalt theory: Continuity or Line, Closure)		
4	Color and Contrast		
5	Proximity (Gestalt theory: Proximity)		
6	Create a focal point		
7	Tell a story (Gestalt theory: Similarity, Common region)	Content elements	
8	Send one key message		
9	Accurate and well-researched		
10	Choose the right chart	Knowledge	

TABLE 2. Questionnaire evaluation

Item	Question	Rating (1,2,3,4)
Visual Hierarchy		
1	Make the Titles bold and in the largest font size.	
2	Instructions not necessarily is in textual form; visuals such as shapes or arrows can also be used.	
3	Use a slightly different font for interactive text such as URLs, it is smaller but not too small so that it is readable.	
4	Notes and sources are probably the smallest typeface. Create unity by making them as same as other element.	
Negative Space		
5	Build some negative space into your design, condense everything into several words to make it more appealing and easier to be read and followed through.	
Leading Lines		
6	Create movement in the form of leading lines to grab and direct viewers' attention.	
7	Use lines and visual cues like arrows to visualize the direction in space and time.	
Color and Contrast		
8	Use colors in contrast to make the Infographic stands out and draws attention.	
9	Colors should not be overloaded in Infographic; it may distract viewers' eyes from making sense of the whole Infographic. Use not more than five colors in a single design.	
10	To stand out text, headers and objects, visualize them in different color from other objects and avoid using busy or textured backgrounds.	
Proximity		
11	Place the elements in close proximity in a clear and comprehensive order so that viewers should be able to figure out the connection of information in the design.	
Create A Focal Point		
12	To create Focal Point, make the size of the object bigger compared to the rest.	
13	To create Focal Point, create contrast by using color over a muted background.	
14	To create Focal Point, place one or more elements in front of another element in order to create the illusion of depth.	
Tell A Story		
15	Good Infographic follows a simple three-part story format: Introduction, key message and conclusion; Identify key facts in data and tie them together into an easy to understand story format.	
Send 1 Key Message		
16	Concentrate on one key message only.	
17	If it is a complex information, break Infographic down into sections and each section contains specific message.	
Accurate and Well-Researched		
18	Define the objective of the Infographic and make sure the content brings values to viewers and give them the understanding or the awareness that they need.	
19	Handle information responsibly and make sure you do not provide inaccurate or incomplete information.	
Choose the right chart		
20	To visualize comparison use Bar chart, Tables and Line chart.	
21	To visualize composition use Pie chart, Stacked area and Bar chart.	
22	To visualize distribution use Scatter, Bubble charts and Butterfly charts	
23	To visualize relationship, use Scatter plot and Bar Histogram.	

TABLE 3 represents the items in the questionnaire used in the evaluation of the visual of the design principle. According to the results gained from the questionnaire, the respondents consented on all questions asked.

TABLE 3 Design Principle evaluation

Item	Question	Rating (1,2,3,4)
1	The type of text used is acceptable and suitable for Infographic designers.	
2	The colors used are acceptable and suitable for Infographic designers.	
3	The pictures and the text are appropriate.	
4	The principle presents a complete, clear, well-formed message and is logically structured.	
5	The visual of the design principle is interactive and interesting.	
6	The design principle is easy to understand and follow.	
7	The principle enables me to improve my knowledge on designing Infographic in public transportation	

C. Research Procedures

Before the design principle can be employed, evaluation processes must be conducted first. Fig. 3 shows the flowchart of the evaluation of the design principle.

The process started with proposing a design principle. The design principle was evaluated by employing face validity and content validity tests. Face validity was used to identify whether the terms and sentences used could be easily understood. The content validity was used to validate the content of the design principle in terms of graphics and elements that were included in the design principle. Once the design principle is approved, it can be used [28]. Otherwise, it has to be revised and improvised. The revised design principle will then repeat the evaluation process until it gets approved and appropriate to be used.

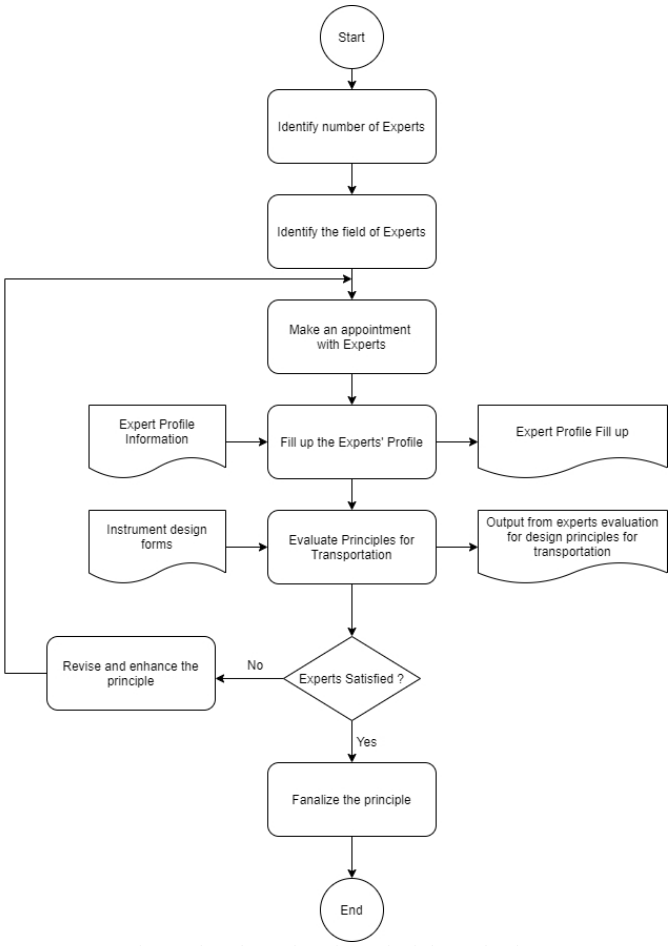

Fig. 3. Flowchart of Design Principle Evaluation

IV. FINDINGS

Based on the expert evaluation and validation, Table 4 provides the list of comments made by the experts.

TABLE 4 Expert's comments on content validity

No	Experts	Comments and Suggestions
1	Expert 1	Design principle is not process model, it is part of the process model, have to understand the principle of developing Infographic as the base and combine it with the transportation.
2	Expert 2	a) Rephrase a few questions then add the evaluation format - Likert or yes or no; guide the respondent to answer your question b) Rephrase some of the questions.
3	Expert 3	a) If you can provide the principles first before the questionnaires will be more helpful. b) some of the questions are poor and need to be overlooked.
4	Expert 4	In my opinion, the questionnaire sentences not easy to understand by the audience. and also the structure content elements of the questions are mixed. Recommendation: Better to design the questionnaire into 3 major part: a) Visual elements – colours, graphics, signs, icons, maps, etc. b) Content elements –facts, statistics, texts, references, time frames, etc. c) Knowledge –conclusion to express the stories or messages
5	Expert 5	Change some Infographics

In order to evaluate the expert result on content validity of the questionnaire, the Content Validity Index (CVI) was used in this study. Content validity is the degree to which an instrument has an appropriate sample of items for the construct being measured and is an important procedure in scale development. CVI is the most widely used index in quantitative evaluation [29]. A CVI value can be computed for each question on a scale which refers to I-CVI, and the overall scale which refers to S-CVI. In this study, the experts were asked to rate the relevance of each item, on a 4-point scale. The scale used in this study was 1=Not Relevant, 2=Somewhat Relevant, 3=Relevant, 4=Highly Relevant. Number of agreements is calculated based on number of experts rated 3 or 4 [29]. Researchers recommend that a scale with excellent content validity should be composed of I-CVIs of 0.78 or higher and S-CVI/UA and S-CVI/Ave of 0.8 and 0.9 or higher, respectively. The results of the CVI are depicted in Table 5.

Table 5 show the results of Content Validity Index. The computed result of S/CVI was 0.95. This proved that the revised questionnaire was accepted to be used.

TABLE 5 Content Validity Index (CVI)

Question	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	No. of Agreement	I/CVI
Q1	3	3	3	3	3	5	1
Q2	3	3	4	4	4	5	1
Q3	3	4	4	2	4	4	0.8
Q4	3	3	4	3	3	5	1
Q5	3	3	4	3	4	5	1
Q6	3	3	3	3	2	4	0.8
Q7	3	4	3	3	4	5	1
Q8	3	4	3	3	4	5	1
Q9	3	3	4	4	4	5	1
Q10	2	3	4	3	4	4	0.8
Q11	3	3	3	3	4	5	1
Q12	3	3	3	4	4	5	1
Q13	3	3	3	3	3	5	1
Q14	3	3	2	3	4	4	0.8

Question	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	No. of Agreement	I/CVI
Q15	3	4	3	3	4	5	1
Q16	3	2	3	4	3	4	0.8
Q17	3	3	3	3	4	5	1
Q18	3	3	3	3	4	5	1
Q19	3	4	4	3	4	5	1
Q20	3	3	4	3	3	5	1
Q21	3	3	3	3	3	5	1
Q22	3	3	3	2	4	4	0.8
Q23	3	3	3	3	3	5	1
						S/CVI	0.95

Based on the experts' review, the infographic design principles needed to be revised so that the audience could gain better understanding. The title, picture, font size and terms were the elements that needed to be revised. The results of the principles pre and post revision are depicted in

Fig. and

Fig. .

From the principle (before revised) the title from "How to develop beautiful and astonishing Infographic" was changed to "How to create interactive Public Transportation Infographic" (after revised). The low quality pictures were replaced. Lots of texts were replaced with pictures. Font face was updated to a better one to support better printing view. The summary of the changes before and after the design principle infographic was revised is illustrated in TABLE 6.

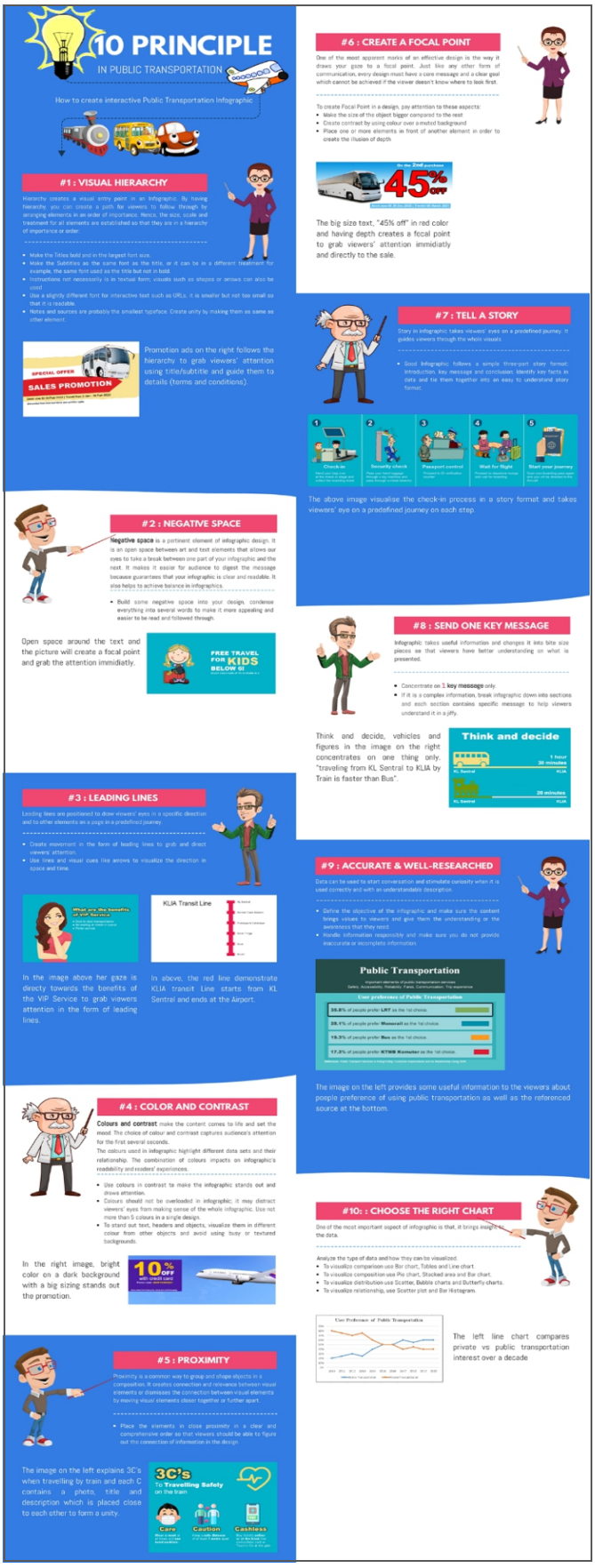

Fig. 4. Infographic Design Principle – before Revised

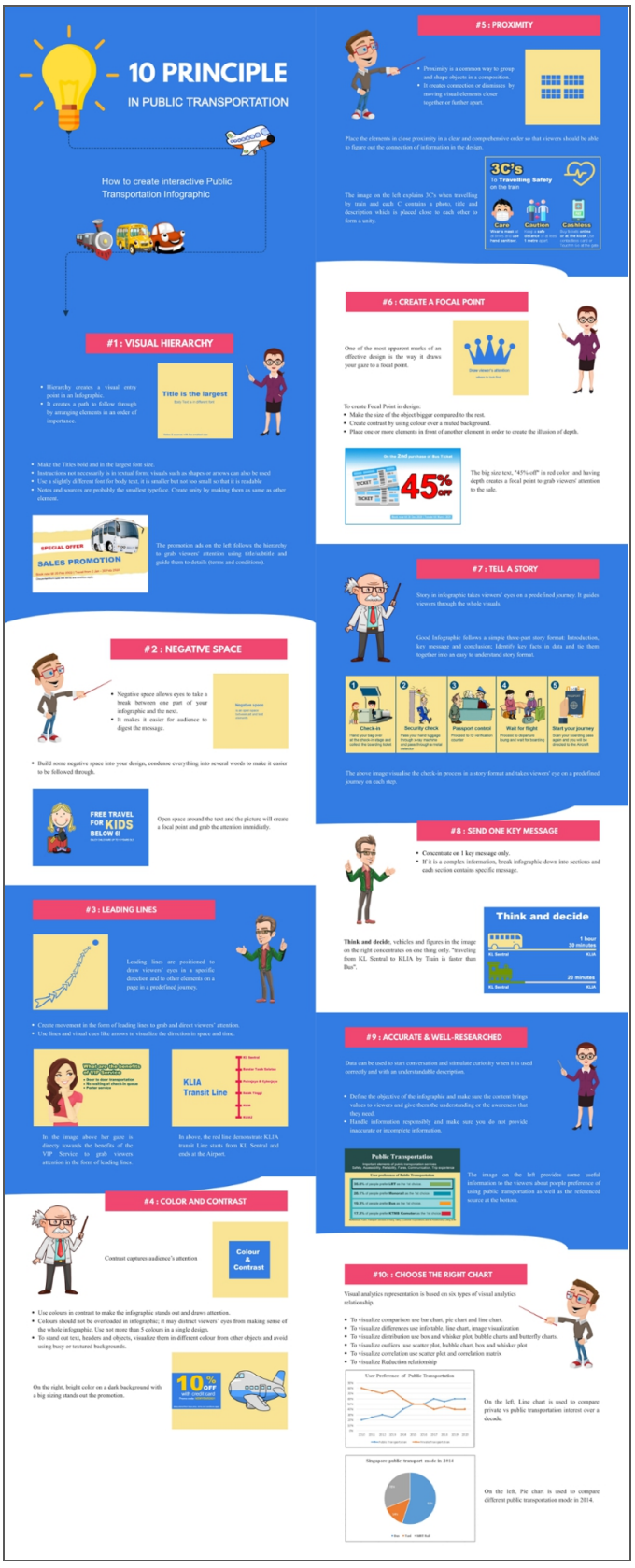

Fig. 5. Infographic Design Principle – after Revised

TABLE 6. Summary of Infographic Design Principle's Changes

No	Item	Before Changes	After Changes
1	Title	Title was "How to develop beautiful and astonishing Infographic"	Changed to "How to create interactive Public Transportation Infographic"
2	Terms	Have lots of text	Reduced and replaced with pictures
3	Pictures	Low quality pictures	The pictures replaced with more relevant and higher quality one
4	Font Size	Hard to read and bad in printing	Font face updated.

V. DISCUSSION AND CONCLUSIONS

The usage of infographics to enhance business communication is inevitable and is also challenging if not created properly [10], [11]. Therefore, businesses have started to overlook the usage of visuals to enhance infographics for effective business communication. For example, in education, todays virtual literacy and infographics skills play a very significant role in the digital-age instructors' toolbox [25]. Infographics in public health are also powerful digital tool that enable patients to have the required knowledge to understand information on specific diseases, procedures and trending health-care topics [30]. According to an initial investigation, the findings have proven that there may be no concrete infographics design principle to be followed in public transportation business. Therefore, a design principle is proposed to assist designers to develop effective infographics for public transportation.

This study proposed an infographic design principle for public transportation. 10 principles were developed based on seven elements of Gestalt theory, three components of infographic and seven elements of public transportation. This design principle is useful to assist designers to develop infographic in public transportation and for students to improve their understanding of infographics and visualization. Face validity and Content validity were used to evaluate the principles. CVI shows the result of 0.95 after experts' reviews.

Time consumption contributes the main limitations of this study. The challenge was to follow up with experts to provide their feedbacks.

The proposed design principle is recommended to be used in various type of businesses, instead of just focusing only on public transportation. The purpose is to create effective infographics to improve the quality of communication. It is also hoped that this study opens more doors for similar research works to be conducted in the future.

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