DIGITAL MAP DESIGN ELEMENTS FOR LOCAL TOURISM: COMPARING USER BASIC CONSCIOUSNESS BETWEEN TAIWAN AND JAPAN

Ming Lun LI*, Ming Shih CHEN**, Kiminobu SATO***

Abstract: This study investigates the influence of nationality, ages, and address systems on the use of digital maps in wayfinding. The examination shows how user—whether they are merely browsing maps or actively trying to find a destination—perceive and interact with their environments. Also, assessing the current problems regarding digital maps. It compares user experiences of participants from different nationalities, age groups, and genders through a questionnaire. The subjects are from Taiwan and Japan, and either in their 20s or above the age of 60. Through a Chi-square test, some significant differences between nationality, age, and sex was revealed. For example, Taiwanese use street names, landmarks, and outward appearances of destinations to help them confirm their own position. When user above the age of 60 try to establish their location, they rely on three aids. In principal component analysis, four factors influence digital map functions: (1) Orientation; (2) Tourism Information; (3) Atmosphere; and (4) Checking Information. In these usability problems, especially three wayfinding aids and the factors of operating map, which means the map should not only be considerate as a tool that all kind of people can understand and how user interact among themselves, map and environment. And the order and wayfinding aids can be set as following the three wayfinding tasks for different kind of groups of users to have a more comfortable and usable map using experience.

Keywords: Digital Tourism Map, Map Design Element, User Basic Consciousness, Cultural Comparison

1. Introduction

According to the 2018 Newzoo Global Mobile Marketing Report (2018.09), approximately 70 million people (55.3%) in Japan and 14.2 million people (60%) in Taiwan use smartphones.[1] In the statistic, 20s and who above the age of 60 have the most distinctive. In Japan, the ratio of 20-29 own smartphone is 88.7%, but in 60-69 is 46.4%, 70-79 is 19.7%, and over 80 is only 46%. Also, in Taiwan, in 20-29 is 100% and above 65 is 64.4%.[2,3] These portable devices have become part of people’s daily lives, and digital maps are now being used more often than paper maps. Digital maps do, however, still present usability difficulties; they target a small range of user, and there is little scope for usage among local people [1].

Taiwan and Japan are as same as belonging east Asia countries, more and more Japanese and Taiwanese go traveling to each other's country. Especially, twice Japanese people came to Taiwan, and 4.5 times Taiwanese people went to Japan in this decade. It shows the tourism map becoming more important than before.

Modern map design relies on two sets of tools and methods; one is thematic cartography, which has regional characteristics, and the other is geo-visualization. However, there are some disadvantages of thematic cartography cause foreigners having difficulties about comprehending the map legend, inaccurate scale, imprecise location indicators, and overloaded information that confuses the user. These problems make them are unable to find what they need.
Conversely, geo-visualization, relies on technology to detect user’s position by Global Positioning System (GPS) and the Geographic Information System (GIS) and updates the data accordingly and instantly. Since the 1950s, technological advances like these have changed how people read maps [4]. Nowadays, people tend to use the maps on their phones or electronic devices rather than paper maps and be able to update more information instantly by producer and user.

In Taiwan, the “Road Number System” uses street names to help people identify their locations. In contrast, the “Block Number System” in Japan divides the district and codes of every building in the block.

![Figure 1. Taiwanese and Japanese Address System](image)

2. Literature Review

2.1. Wayfinding and Environment Cognition

A city is composed of five elements, which are also used in wayfinding and cognitive mapping [5]. Lawton and Kallai believe that there are two kinds of wayfinding processes: (1) orientation/survey strategy and (2) route strategy. The orientation/survey strategy can obtain information from different resources (i.e., integrating the information between different nodes) and create a more flexible cognitive map. Moreover, route strategy refers to a series of instructions, such as landmarks being the main reference in a wayfinding strategy when subjects move from one location to another [6-8]. These two strategies exhibit two kinds of map user: one needs some additional information between the nodes along the route, and the other needs a landmark to create a route plan. The first strategy is primarily used by men, and the second one is used primarily by woman.

Nori and Giusberti indicate the wayfinding have three types of group which are (1) landmark task, this type of people mainly rely on photo and figure; (2) route task, they more use sequence, map description, right–left discrimination, and 2D rotation to make sure the destination or orientation; and (3) survey task, in this group, they use path, 3D rotation, and sum and straighten which more likes bird’s-eye viewpoint of an object-centered reference system [9]. And these studies show that women may use route strategy/task more, but in Nori and Giusberti’s study shows other two tasks still have around 20% of people in each. Therefore, it may relate to other socio-demographic not only just gender. However, there are no study that shows whether culture or nationality have a significant effect on wayfinding strategies. This study specifically analyzes the difference of nationality.

When creating a cognitive map, people interact with their environment, using all five senses to absorb all kinds of information. They then combine their knowledge and memory to form a unique mind map [5,10].

2.2. Digital Map Design

The origin of maps can be traced back to around B.C. 500, when people used these maps to indicate to locate food or water. Thus, to read maps, people should understand space and semiotics. Humans have developed language and semiotics to help place information in maps and develop cartography to make user easy to understand the information form in map. The map revolution started with the 1950s’ quantitative revolution, followed by the 1960s’ communication model, the 1970s’ cognition theory, and then the 1990s’ geo-visualization, which improved map design and legibility. Wakabayashi Yoshiki has elaborated on the difference between paper and digital maps [11].

According to Mentello et al. (1999), the performance of a map depends not only on its visual appeal but also on its words and graphic [12]. Meanwhile, the digital map has changed the performance differs from each one and the way how map interacts with user. Users choose their own accuracy to clarify the information and make the difference of their recognition for each user. The interface will influence usability and impact on wayfinding. Digital maps, such as Google map and Apple map, has changed peoples’ behaviors. These maps try to combine a user’s previous information and the interactive functions to make it more real time.

Digital maps can show and output any scale and range. They can also easily connect with satellite images, aerial photos, or other information from databases to enhance user’ recognition of geographic information. Moreover, processes involved in map design should be integrated with GIS, remote sensing (RS), and GPS as databases [13]. The 3D outward appearance of landmark shows easier to
understand from 18.33% to 81.67% [14]. And the street name is also acting a critical role in the wayfinding in tourism map in Macau [15]. It shows that if who have the same address system idea can be easier to understand the map information which may provide a new thinking in map design to guide user to adopt different system of map.

2.3. User Spatial Experience

User experience research seeks to understand a user’s need, expectations, and operating error [16,17]. People use paper or digital maps to identify a map’s most and least important functions. They then combine these functions with their experiences in the wayfinding process. Some external stimuli, such as haptic and visual material, provide information that helps the brain realize space [18-20]. The color which are around us will become the daily experience, which will help us understand and move through space [16,21].

Some theories explain how user experience is applied in the design and construction of spaces. These theories are related to people’s behaviors and how they are guided by a building’s features. Fogg’s model believes that people are coercive, but this concept is only applicable in specific situations [22]. Moreover, Rahimi’s model tends to believe that a user is influenced by his or her own sociocultural experience [23,24]. Lastly, Kuntson et al.’s model includes the following seven factors: orderly, benefit, accessibility, convenience, utility, incentive, trust, and environment. This model also divides user experience into different levels to analyze how people participate in common activities [25]. Based on these three theories, this study aims to find the important elements of map usage that help users to have a pleasant wayfinding experience. And Figuring out the demographic what affects by the interaction between user and environment. By the differences, even the same functions show different meaning for user’s operation. It may show when people use the same tools, but the meanings can be variable.

3. Case Study

For this study, five digital maps were analyzed to identify their various functions and elements: Google Maps, Apple Maps, Taipei Historical Maps, what3words, and Drink Store TW. The results of this case study were then used to design the questionnaire. The aim of the survey was to determine which of these functions’ participants used or known before. Besides the type also choose them by the amounts of downloading.

Google Maps and Apple Maps have created the most extensive digital maps, and the other three maps are based on these designs because they allow user to pinpoint their position and access information. Google Maps, for example, uses instant GIS to update the traffic status (e.g., show peak traffic sections or suggest an alternative route) based on a user’s position. Apple Maps does not give instant updates. The case study shows that Google covers more functions than the other four maps, but many of these—such as Shop and Spot or Street View—need to be updated. Furthermore, Google Maps of smaller, tourist-oriented areas can update very slowly or not at all.

Taipei Historical Maps collects 10 maps from different eras and integrates them into present-day Taipei. Tourists

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<th>Table 1: Figures of map</th>
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<tr>
<td><strong>Function</strong></td>
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<td>Main target</td>
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<td>Base map</td>
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<td>GPS</td>
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can use these maps to find ancient monuments or use street view to experience what streets or places might have looked like in earlier times. Conversely, the what3words map does not rely on traditional coordinate reference systems; instead, the design team divides all areas into a grid of 3m × 3m squares and assigns a unique three-word address to each, e.g. “heave.skate.belonging”. Also, it can be used as Google Maps, just put in the name of destination. The final application is Toilet Map helping users in Japan to find their nearest toilet. The app also allows them to access the place and open time, type of toilet and so on. The most important, this application can interact with user by editing the information of toilet.

The table gives an overview of the functions these five maps have to offer. The findings from the case study emphasizes the preciseness and accuracy of digital maps such as Google Maps and Apple Maps. Therefore, designers or engineers with a limited budget would profit from using these two maps as bases to create smaller local tourism maps.

### 4. Questionnaire

To determine the usability and user experience of paper and digital maps, the questionnaire was divided into three sections: demographic, experience, and perception. The demographic section is included questions on nationality, age, gender, career, and education level. This information includes some significant disparities to set up principle. The second section of the questionnaire focused on user experience: how frequently they used their maps, the problems of using map (Incomprehensible of illegible, Font size too small, Unclear user’s directions, Information overload, Outdated information), and what wayfinding aids (Street name, Other shop, Landmark, Outward appearance of destination, Signage, Asking other people, Instinct) they used. And type (plane and bird eye’s view of hand drawing, simplified), media (paper or digital) of map they preferred.

There are lots of wayfinding abilities and strategies with demographic such as gender, culture, age and so on [6-9,23-25], and some researches of age related are more focus on learn environmental layout, real vs. virtual test, and big scale map using. [26-28]. Hence, this study focuses on the age distinction with map information.

A total of 183 people (93 Taiwanese and 90 Japanese) participated in this re-search project. Of these, 113 people were in their 20s, and 70 were above the age of 60. To reveal what the dissimilarities are, this study uses principal components analysis to categorize the functions of digital map (such as Google Maps or Apple Maps, some apps are more used in daily life and understood which are built up into a new map app) when the user are in two situations: 1. Decided destination, and 2. Undecided destination. In the final section of questionnaire, and the question is based on when user is using a new digital map app with 5 points Likert scale 1 (the least important) to 5 (the most important). The result is collected online by google sheet.

### 5. Analysis and Results

A total of 183 people (93 Taiwanese and 90 Japanese) participated in this research project. Of these, 113 people were in their 20s, and 70 were above the age of 60. A chi-squared test revealed significant dissimilarities in how participants who are from different nationalities, age, and genders groups in using and experiencing digital maps when in their traveling.

#### 5.1. Differences in Nationality

The data indicates that Japanese participants (F (1, 4) =30.562; p <.001) use paper maps more often than Taiwanese participants (F (1, 4) =29.8793; p <.001), also who prefer digital maps. The reason should be more studies to confirm the reason relating to socio-demographic, policy, or other reasons. Regarding nationality, bout the main usability difficulties, the results indicated that Taiwanese participants have: First, Unclear user’s direction (F (1, 1) =6.673; p < .01), about this problem, Google maps and Apple maps both suggest user to return wi-fi, recalibrate phone or check the setting of app. There are still no proof can explain why Taiwanese will have more this difficulty more. The second one, incomprehensible of illegible (F (1, 1) =11.998, p <.001) which is may the digital map use words to replace the illegible (more research needs to be done on this). Outdated information (F (1, 1) =13.268; p <.001), this distinction might be because Taiwanese participants think it is unlikely that a digital map will give outdated information. Japanese user has problem with Font size too small (F (1, 1) =4.562, p <.05), it could be the illegibility between traditional Chinese and Japanese which required minimum size are 8pt and 10.5pt. Therefore, for Japanese user they may need a bigger font size than Taiwanese [29, 31].

As Table 2 shows, participants from both nationalities use Other shop, Signage, Asking people, and Instinct as wayfinding aids. However, Taiwanese subjects make significantly more use of Street names (F (1,1)=7.722; p < .01) which indicates that the address system does support
people identify the spatial information (like orientation, the use of egocentric coordinates and so on). Landmarks (F (1,1)=41.741; p<.001) and there are some studies show that demo-graphic (such as, gender or age) has significant difference in wayfinding task or strategy [6-9, 30], and the outward appearance of their destination (F (1,1) =7.323; p <.001). In Taiwan, the street name can easily be obtained from the country’s address system; in Japan, however, streets (especially those in residential areas) are not named.

5.2. Difference in Age

Table 2 shows that the participants above the age of 60 (F (1,4) =34.65; p<.001) are more likely than those in their 20s to use paper maps, and the younger group prefers digital maps (F (1,4) =79.443; p<.001). It may be affected by the smart phone holding ratio, in Japan the age between 60-69 is 46.4%, 70-79 is 19.7%, and over 80 is only 46%. But in 20-29, the holding ratio is 88.7% [2]. Also, in Taiwan, in 20-29 is 100% and above 65 is 64.4% [3]. The further research may confirm the smart phone operation ability will have influence on or not. The results further indicate that participants from all age groups experience issues with two parts, first one is usability problems with Font size too small (F (1,1) =29.225; p <.001). It should be noted that the preferred size of traditional Chinese text for optimal reading speed and comfort is 16pt>12pt>8pt and 16pt>12pt>8pt, respectively. The error ratio is 8pt>12pt>16pt [31]. Research also shows that the elderly can decipher a minimum font size of 8pt, but, especially in Japanese, their performance declines when they read anything smaller than 10.5pt [29]. Unclear user’s direction (F (1,1) =7.994; p<.01), 20s has this difficulty than who above 60, the reason still is unclear now which should need more evidence to prove. And the third Outdated information (F (1,1) 11.027; p <.001), also 20s feel this problem than above 60, it may relate with the usage frequency. 20s relies on digital map than above 60 which when the data is outdated or has not been updated frequently.

And the second part is wayfinding aids with Landmark (F (1,1) =20.59; p <.001), Outward appearance of their destination (F (1,1) =6.485; p <.05), Signage (F (1,1) =8.207; p <.01) , and Instinct (F (1,1) =8.358; p <.005). Furthermore, those in their 20s use landmarks and their instinct more often than the older group of participants, who rely on the outward appearance of their destination, signage and asking people for directions.

Asking other people for directions (F (1,1) =18.013; p <.001) which is the only one those above the age of 60 higher than 20s, and according to some of the participants, those in their 20s are not as comfortable talking to strangers as those above the age of 60. Because they prefer relying on asking people, it may reduce them to use other aids to
distinguish the direction or orientation. After all, asking local people can get the information instead of thinking through the whole process of wayfinding easier. Although the aim is different the result still shows some different in age which means age is one of the critical demographics which will influence how people recognize, process and integrate the information between map and environment [26-28].

5.3. Difference in Gender

In terms of gender, the data suggest two areas in which men and women’s user experiences and wayfinding strategies differ: women have difficulty with unclear user’s direction (F (1,1) =7.116; p<.01), and use signage (F (1,1) =8.327; p<.001) as an aid. According the Nori & Giusberti (2006) indicates the women use they imply a linear spatial organization and right–left discrimination ability, which are good predictors of the use of egocentric coordinates to help them find the route and call this type of people as route task[9]. Other research supports the finding that women find it more challenging to figure out directions. [32-36].

5.4. Basic Consciousness of Functions with Decided and Undecided Destination

In the result of all participants, KMO is 0.685, Bartlett’s Test of Sphericity is 815.946, and cumulative 68.02% of variance. The analysis points to four factors that influence map function: (1) Orientation (giving direction where a user wants to go); (2) Tourist Information (switching layers about type of place and searching for information to shop or spot); (3) Atmosphere (attracting a user who does not have a destination in mind); and (4) Checking Information (helping a user to confirm a destination). Orientation guides the user and is the most important factor, because all user (whether they have a place in mind or not) need to confirm their destination. Tourist information is unique to digital maps. This kind of information is also provided regardless of whether a tourist has decided on a destination or not. Regarding 3rd and 4th factor, the results show that the outward appearance and street view of a building or place are used as wayfinding aids if the user has decided on a destination; when the destination is unclear, these two factors can attract tourists to a particular place. This section can base on demographic (such as, age, gender nationality, and so on) to confirm it will be affected or not.

6. Conclusion

This study aims to identify the types of maps, map functions, and information of local tourist areas that are acceptable for most user. Instead of updating every 2–3 years like world maps, local tourism maps are designed with specific areas and people in mind; therefore, they have unique features. The address systems can be considered as one of the factors influencing how user process information and wayfinding. However, more be research should be done to confirm if there are any significant differences between an individual using different strategies or tasks.

The results show significant differences in how people from different nationalities, age groups, and genders use and experience maps. This study shows that map design should more focus on people how user use map and interact with environment. For this reason, these features need to be taken into account when designers create maps for local tourism. For example, a digital map would be more functional and appealing if it allows a user of a specific age,

<table>
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<th>Table 3: Four factors of map functions</th>
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<td>Orientation</td>
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<td>Direction (U)</td>
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<td>Direction (D)</td>
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<td>Navigation (D)</td>
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<td>Navigation (U)</td>
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<td>Multilayer (D)</td>
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<td>Information (D)</td>
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<td>Multilayer (U)</td>
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<td>Information (U)</td>
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<td>Outward appearance (U)</td>
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<tr>
<td>Street View (U)</td>
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<tr>
<td>Street View (D)</td>
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<tr>
<td>Outward appearance (D)</td>
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*D = decided, U = undecided
background, or gender to choose the functions and aid(s) with which he/she is most comfortable.

Furthermore, the results show that the purpose of a function determines how much importance a user attaches to it. For example, participants in this study valued a map’s orientation function (whether they had decided on their destination or not). However, the data also shows that the Street View function and the Outward Appearance of a destination impact on different factors. When users have decided on their destination, they use these two functions to check the spatial information, i.e., confirming their position or how the surrounding looks like. However, when the destination is undecided, the atmosphere factor comes into play to attract tourists to a spot.

Combining with the results in wayfinding strategies/tasks, demographic and decided/undecided destination, which can design a better map using process and fitting variable groups. The map can be designed into different types of user, through a preceding test and following by the demographic to setting three types mainly wayfinding tasks to confirm that they can have an easier and comfortable local tourism map operating experience [9,23-25,33]. For further research, making a map app to make the orders and critical elements by the three wayfinding tasks or two strategies to investigate prototype of digital map which order of showing wayfinding aids and those functions will fit each taskstrategy.

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