Empirical Analysis of the Effect of Illustrated Maps Including Visual Guidance Elements on Tourist Behavior

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Abstract. This study verified the effect of guiding tourist behavior using map deformation and scale change as a measure against overtourism. In the Saga-Arashiyama area, we created an illustrated map in which the sense of distance was intentionally deformed and northern tourist spots were emphasized. We distributed this map to 8 subjects and conducted a tourism experiment. The results showed that a guidance effect towards the northern area was confirmed in the initial stage of tourism. The subjects showed a tendency to move around a wider area than the typical range of action of the inbound tourists. This suggests the possibility that visual guidance elements have a certain influence on tourist behavior, and proposes a new direction for map design in future tourism support.

Keywords: Visual guidance · Tourism · Behavior Change.

1 Introduction

Tourism pollution and overtourism have long been problems in popular tourist destinations, such as Kyoto City, which receive high popularity from both domestic and international visitors. When observing tourist behavior patterns, they often plan their activities using tourist guidebooks, tourism information websites, map applications, and SNS as information sources. This tendency accelerates concentration on "popular spots". This concentration creates significant imbalances in congestion levels and results in factors that disrupt the overall balance of the tourist destination. In response to this situation, new approaches are required to achieve both the sustainable operation of tourist spots and the improvement of the quality of the tourism experience.

As conventional means of providing tourism information, digital maps, represented by Google Maps, are widely used. While digital maps offer rich information and navigation functions, a problem is pointed out: it is often difficult

to understand the appeal of tourist spots or event information. Therefore, illustrated tourist maps, which are specialized for specific events and allow tourist spots to be understood at a glance, still play an important role. However, illustrated tourist maps have drawbacks, such as the difficulty in grasping one's current location due to constraints on publishing space, resulting in map deformation and limits on the amount of information.

To address these issues, this study focuses on map deformation and scale change as an information provision method to guide tourist behavior. Unlike conventional map representations that prioritize accuracy, dynamically emphasizing or simplifying information on the map according to conditions such as congestion level is expected to naturally disperse the interest of tourists. Specifically, this study proposes an illustrated map incorporating visual elements that actively influence tourist behavior. We focus on visual guidance elements such as the intentional manipulation of distance scale, devising ways to make tourist spots stand out, selective omission of information, changing how roads are drawn, placing people illustrations, and strategically placing restaurant icons. This approach makes it possible to suppress excessive concentration on specific spots and promote a wider area tourism experience.

This study focuses on the deformation of the sense of distance among the visual guidances created by such map designs. Because illustrated maps are intended to be printed and distributed, all elements must be fitted onto a rectangular sheet of paper. As a result, winding roads are often drawn straight, and distant destinations are often drawn close on the map. We established two hypotheses: (1) More people will visit a spot if they feel the distance is short, and (2) People might think a tourist spot is famous if its illustration is large. We then created an illustrated map that extremely incorporates these elements. The details of the created map will be discussed later, but famous Saga-Arashiyama tourist spots, such as Togetsukyo Bridge and the Bamboo Grove Path, were made inconspicuous. Conversely, slightly distant tourist spots located in the north, such as Daikaku-ji Temple and Adashino Nembutsu-ji Temple Bamboo Grove, were deformed to appear large and close. This map was then distributed to 8 subjects, and a tourism experiment was conducted on March 17, 2025.

The experimental area was the Sagano-Arashiyama area in Kyoto City. An illustrated map designed with intentional deformation and visual emphasis was distributed to eight subjects who were unfamiliar with the area, and a free tourism experiment was conducted. During the experiment, tourist movement trajectories were recorded using GPS data collected via smartphones.

The results showed that, in the early stage of the tour, subjects tended to spend more time in the northern area that had been visually emphasized on the map, suggesting that map deformation influenced their perception of distance and guided their movement. Although visits to highly popular spots increased in the later stage, participants exhibited a slightly wider range of activity compared with typical tourists and visited locations with generally lower visitation rates.

Post-experiment interviews indicated that visual emphasis and the placement of information, such as restaurant icons, affected route selection and destination

Table 1: Various maps for tourism

	Digital map	Illustrated maps	Digital illustrated maps
Information Amount	Very good	Low	High
Information Update	Regular	Event-specific	Event-specific
Navigation	Very good	No	No
Own Position	Yes	No	Yes
Tourism Specialization	No	Yes	Yes
Deformation	No (Accurate map)	Yes	Yes
Behavior Guidance	Advertisement	Illustration	Illustration + Digital
Map Data	Map Company	Illustrator	Illustrator

choice. At the same time, issues such as discrepancies between map representation and actual spatial impressions were identified. Overall, these findings suggest that illustrated maps incorporating visual guidance elements can partially influence tourist behavior and contribute to the dispersion of visitor flows.

2   Related work

2.1   About Illustrated Maps and Digital Illustrated Maps

Table 1 summarizes the characteristics of various maps used in tourism. Digital maps, represented by Google Maps, contain vast amounts of information—not only tourist spots but also restaurants, hotels, and transportation-and enable navigation, thus being used by many tourists. However, information such as the location of tourist spots, which spots are famous, what kind of spots they are, and what events are accompanying them is often unclear. For this reason, illustrated tourist maps are almost always prepared. Illustrated tourist maps are specialized maps for specific events, with the advantage that tourist spots are obvious at a glance. Because they must fit onto a fixed-size flyer, maps with distorted aspects ratios are drawn by illustrators. The drawbacks of these maps are that it is difficult to know one's current location and that additional information (such as business hours or spot episodes) cannot be obtained. Stroly is developing digital illustrated maps that solve these problems. More than 10,000 illustrated maps have already been incorporated, and they are used in large-scale events such as the Kyoto Gion Festival, Hakata Yamakasa, and SXSW overseas.

Our proposal aims to encourage changes in tourist behavior by including the visual guidance element of distance deformation in these digital illustrated maps. For this experiment, an illustrator drew the illustrated map. However, we plan to dynamically change the degree of deformation in the future based on congestion levels, and the drawing of illustrated maps using generative AI is also being considered.

2.2   About Tourist Behavior Guidance

  Spatial and temporal dispersion of tourists is positioned as a fundamental and effective measure for mitigating overtourism. Specifically, guidance to surrounding underdeveloped areas in addition to conventional tourist spots, and promotions to encourage visits during the off-season (slack season) are conducted[7]. Such measures aim to reduce the over-concentration of tourism and support sustainable regional development.

  In recent years, smart tourism initiatives utilizing ICT and big data have also been expanding. The introduction of applications that visualize congestion in real-time to encourage the dispersion of tourists, and the planning of predictive measures based on the analysis of tourist behavior are being promoted[1]. This is expected to achieve both the optimization of tourist spot management and user satisfaction. Isoda et al. proposed a method to encourage on-site decision-making by providing information that considers visit timeliness[3]. Hidaka et al. proposed an information provision method tailored to individual tourists by feeding personal preference information into such on-site tourism guidance[2]. Kawanaka et al. and Matsuda et al. proposed methods to guide tourist behavior and manipulate the amount of information collected from tourists by using game elements (gamification)[5, 6].

  Regarding behavior guidance through visual intervention, the use of signage and maps has been practiced in several cities. For example, in Barcelona, digital signage displaying real-time congestion information has been introduced to avoid excessive concentration of tourists[8]. This type of information provision contributes to load distribution among tourist spots by adjusting tourist movement behavior and enabling path selection that avoids congestion. Similarly, in Amsterdam, the redesign of tourist movement routes is being performed through visual signposts and maps, functioning as a strategy to guide the flow of tourists in urban space[4]. These examples show that visual information affects tourist decision-making and can be an effective means of urban tourism management. However, as far as the authors investigated, the only example of incorporating behavior guidance into illustrated maps distributed at tourist information centers was the "Saga-Arashiyama Touring Guide" designed by Stroly.

3   Illustrated Map Including Visual Guidance Elements

In this study, we go one step further from conventional map representation based on accurate scale, and propose an illustrated map incorporating visual elements that actively influence tourist behavior. This technique functions not merely as aesthetic expression but as a method for manipulating spatial awareness to intentionally guide tourist behavior. Figure 1 shows the illustrated map including visual guidance elements used in the experiment. In creating this map, we first adjusted the psychological impression of the space by intentionally manipulating the distance scale. Specifically, the scale of the northern area was compressed, while the foreground representation was maintained close to the actual size. This aims to reduce the psychological barrier to accessing the northern area and

Fig. 1: Illustrated Maps Including Visual Guidance Elements

stimulate the desire to visit. This is expected to increase tourist circulation and guide them to the northern area, which traditionally had low visiting frequency. Next, we devised ways to make tourist spots stand out, taking care to guide tourists' attention toward specific directions. For example, Daikaku-ji Temple was drawn relatively large, while Togetsukyo Bridge and the Ryuzenji Bamboo Grove Path were drawn small. This design ensures that the focus of attention naturally shifts to specific spots. Furthermore, by emphasizing the bamboo grove of Adashino Nembutsu-ji Temple, we aimed for the effect of attracting interest to cultural resources that tended to be overlooked. Additionally, selective omission of information was intentionally incorporated. By purposely omitting text information regarding Togetsukyo Bridge and the Ryuzenji Bamboo Grove Path, we expected the effect of reducing cognitive load caused by excessive information while relatively increasing attention to other spots. Moreover, we added innovations to the way roads are drawn. By changing the texture of the stone pavement, line thickness, and color density, the map expression naturally indicates routes we want tourists to walk. These visual differences are thought to unconsciously influence route selection. We also devised the placement of people illustrations, placing many in the right-side area to create an atmosphere of liveliness. This utilizes the crowd psychology, where "people want to go where others are gathered," aiming for a natural guidance effect. Finally, eye-catching information, such as restaurant icons, was strategically placed around Daikaku-ji
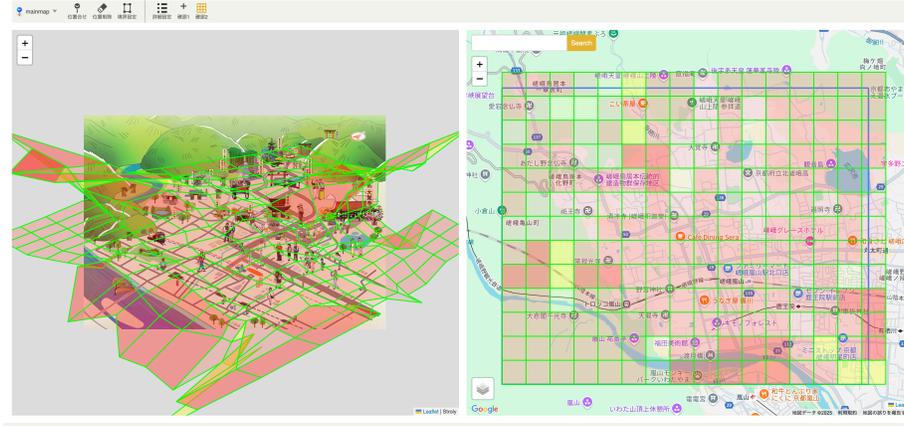
Fig. 2: The degree of deformation in distances on the created illustrated map

Temple, Seiryo-ji Temple, and Atago Nembutsu-ji Temple. This aimed to extend the tourists' length of stay and promote consumption activities, such as eating and drinking. By applying a combination of these visual innovations, the goal is to intentionally transform the tourists' spatial awareness. Figure 2 visualizes the degree of distance deformation in the created map. The map shown on the right is a distance-accurate map. The visualization result is based on aligning approximately 120 locations on both maps. It is possible to grasp how much distortion occurred by looking at the size and distortion of the green rectangles on the map on the left. Notably, the rectangle near Daikaku-ji Temple (center right) on the left map is small, indicating that the distance was deformed to feel shorter.

4   Subject Experiment in Kyoto Arashiyama

The subjects were a total of 8 people: 7 undergraduate and graduate students from Kyushu University, and 1 undergraduate student from Kyoto Tachibana University. The authors also participated but were not included in these 8 subjects. Since the experiment required subjects to view the map, subjects unfamiliar with the Arashiyama area were considered preferable. For this reason, Kyushu University students were intentionally selected as subjects. The attributes of the subjects, based on a questionnaire conducted the day before the experiment, are summarized below.

4.1   Visiting Experience

Among the participants, 5 people were visiting Arashiyama for the first time, 3 people had visited 2 to 3 times, and 3 people had visited more than that. Regarding the experience of visiting Kyoto overall, 4 people had visited 2 to 3

times, and 5 people had visited more than that. While participants had some familiarity with Kyoto as a tourist destination, many were first-time visitors to Arashiyama, matching the expected subject group.

4.2   Experiment Outline

The experimental area was the Sagano-Arashiyama area (Kyoto City, Kyoto Prefecture), which is the same scope as the illustrated map created in this paper (Figure 1). The departure and arrival point was standardized as "JR Saga-Arashiyama Station" for all subjects. Groups were a maximum of 2 people, and the maximum touring time was about 6 hours (10:00 to 16:00). Subjects were primarily asked to tour freely based on the information obtained from the printed illustrated map. However, the use of smartphones for map search and web search was permitted if necessary. To analyze the tourist behavior taken by the subjects, a GPS logger application was installed on each subject's smartphone.

5   Analysis Results of Tourist Behavior

In this study, we conducted a quantitative analysis of tourist behavior based on the GPS logs of experiment participants. The purpose of the analysis is to clarify the influence of the deformed illustrated map on the tourists' range of movement and selection of destinations. Specifically, the effect of the map design's visual elements on spatial dispersion and circulation within the tourist spot is verified from various perspectives. Below, we analyze from three perspectives: (1) temporal changes in tourist behavior by group, (2) comparison with dynamic statistics of inbound foreign tourists, and (3) comparison with users of the illustrated map "Saga-Arashiyama Touring Guide" for overtourism measures. Based on this, we discuss the relationship between information presentation methods and behavior guidance in tourist destinations.

5.1   Analysis Result 1: Visualization of Tourist Behavior by Group

Figure 3 shows the trajectories of the tourist behavior of each group (A to D) over approximately 6 hours, visualized as heatmaps divided into four sections of 1.5 hours each. This allows visual capture of differences in movement and staying tendencies, including temporal changes for each group. The intensity of color in each figure indicates the length of stay or high frequency of visits in the corresponding area.

An interesting tendency observed was that in the initial stage of tourist behavior (0.0–1.5h) in all groups, subjects stayed longer in the northern area that was intentionally deformed and emphasized, rather than in conventional main tourist spots (e.g., Togetsukyo Bridge or the Bamboo Grove Path). This suggests that the illustrated map designed in this study influenced the tourists' spatial awareness and exerted a certain degree of effect in guiding circulation behavior northward. On the other hand, in the final stage of the tour (4.5–6.0h),
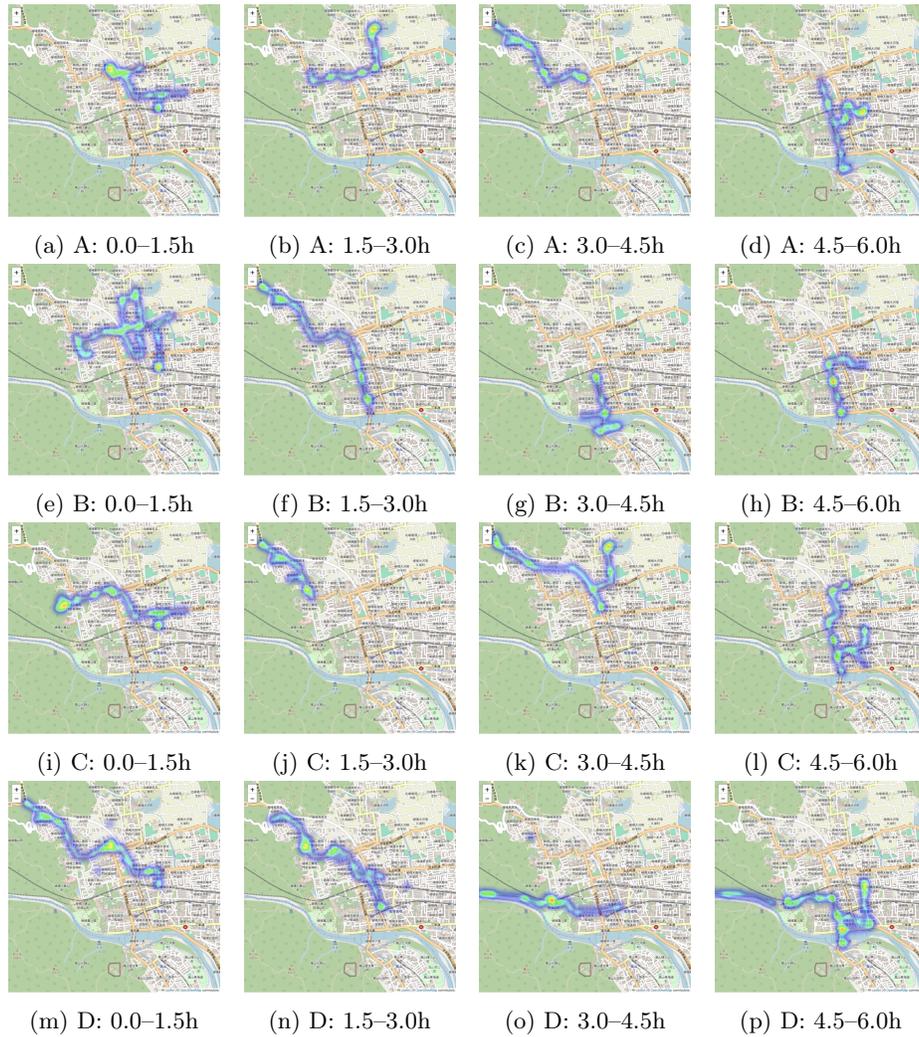
(a) A: 0.0–1.5h	(b) A: 1.5–3.0h	(c) A: 3.0–4.5h	(d) A: 4.5–6.0h
(e) B: 0.0–1.5h	(f) B: 1.5–3.0h	(g) B: 3.0–4.5h	(h) B: 4.5–6.0h
(i) C: 0.0–1.5h	(j) C: 1.5–3.0h	(k) C: 3.0–4.5h	(l) C: 4.5–6.0h
(m) D: 0.0–1.5h	(n) D: 1.5–3.0h	(o) D: 3.0–4.5h	(p) D: 4.5–6.0h

Fig. 3: The results of visualizing the stay patterns as a heatmap by dividing each group's tourism activities into approximately 1.5-hour segments

movement gradually tended to concentrate on central tourist destinations highly popular among inbound foreign tourists, such as the area around Togetsukyo Bridge and Saga-Arashiyama Station. This suggests the possibility that while the promotion of circulation through visual guidance achieved a certain success, a regressive behavior toward "standard spots" exists in the latter half of the tour.
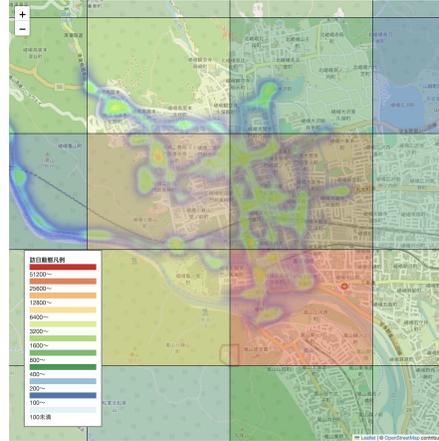
Fig. 4: Visualization results overlaying the tourism behavior logs of all experiment participants with the movement statistics of foreign visitors to Japan based on mobile spatial statistics

5.2 Analysis Result 2: Comparison with Overall Trend and Inbound Foreign Tourist Dynamics

Figure 4 is a heatmap integrating the tourist behavior logs of all subjects. Furthermore, dynamic statistics of inbound foreign tourists were obtained from Mobile Spatial Statistics of NTT Docomo[9] and visualized overlaid on the map. In this study, only the 1km mesh corresponding to the current experimental area was extracted, and data aggregated monthly from March 2024 to October 2024 were used.

The visualization results confirmed a common high-density visiting tendency for both experiment participants and inbound foreign tourists around Togetsukyo Bridge and the Bamboo Grove Path. On the other hand, the movement trajectory of the experiment participants extended to the northern area (e.g., around Daikaku-ji Temple and Atago Nembutsu-ji Temple). It appeared that the distribution was somewhat wider compared to the overall dynamics of inbound foreign tourists. It is noteworthy that experiment participants stopped by areas where remarkable visits were not confirmed in the statistical data of inbound foreign tourists. This suggests the possibility that distance deformation and visual guidance elements, as shown in Figure 2, had a certain influence on the selection of tourist routes. Such results indicate that the introduction of the illustrated map had a certain effect in arousing interest in areas previously not frequently visited and encouraging the expansion of the range of action. This suggests possibilities for future tourism space design.
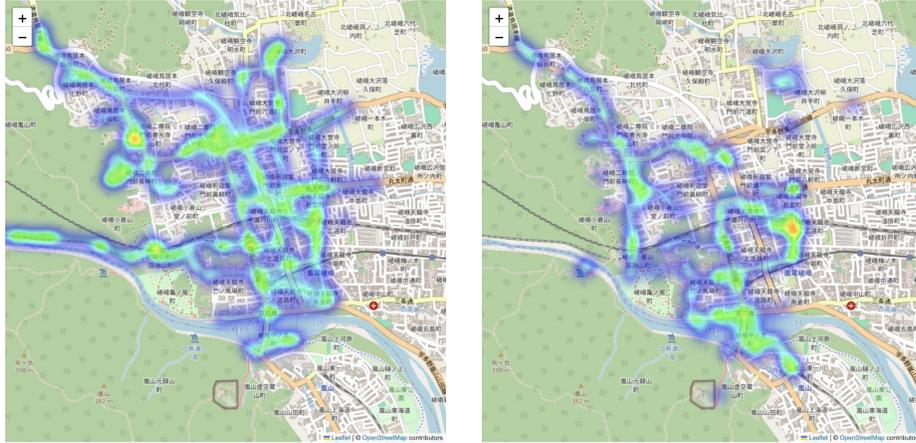
(a) Travel Logs of Deformed Map Users in this Experiment

(b) Travel Logs of Saga Arashiyama Tour Guide Users

Fig. 5: Comparison of Travel Patterns

5.3   Analysis Result 3: Comparative Analysis with Users of the Digital Illustrated Map "Saga-Arashiyama Touring Guide"

We analyzed the movement tendency of users of the digital illustrated map "Saga-Arashiyama Touring Guide," using GPS logs provided by Stroly Inc. during the same time period as this experiment, and compared them with the participants of this experiment. For this analysis, 100 users were randomly sampled from the total users, and their behavior logs were targeted.

The "Saga-Arashiyama Touring Guide" is a digital illustrated map for tourism support, designed with the intention of dispersing tourist behavior. It features the emphasis of hidden spots and stamp rally functions. As shown in Figure 5, experiment participants (Figure 5 (a)) showed a tendency to visit tourist spots located in the upper part of the map, such as Daikaku-ji Temple, more often compared to Stroly users (Figure 5 (b)). This is thought to be partly due to the visual emphasis on the northern area in the deformed map used in this experiment. Conversely, Stroly users showed a prominent tendency to concentrate around Togetsukyo Bridge and the Arashiyama shopping street, located in the lower part of the map, which are highly popular among inbound tourists. This difference is thought to be partly because Tenryu-ji Temple and Kameyama Park were not relatively emphasized on the deformed map used in this experiment. In other words, this result shows that map design and presented information can influence tourist movement behavior, suggesting the importance of interface design for mitigating congestion and guiding behavior in tourist destinations.

6 Participant Evaluation of Illustrated Maps and Design Implications

After the tour, post-experiment interviews and a group workshop were conducted with participants to collect opinions on the effects and issues of the illustrated map by reviewing their usage experience. This section organizes the influence of the illustrated map on tourist behavior based on participants' subjective evaluations and the contents of the group discussion.

In the interviews, free-form answers were obtained regarding the map and their tourist behavior. The following trends were observed:

- **Cognitive Gap:** Participants noted a gap between the deformed map and actual space (e.g., "I thought it was a river, but it broke off halfway," "The road was compressed"), hindering intuitive comprehension.
- **Visual Guidance:** Visual emphasis (colored backgrounds, large icons) influenced route decisions (e.g., "I chose the route where the background was colored").
- **Restaurant Information:** Restaurant depictions directly led to destination selection (e.g., "I went there because only one spot suitable for lunch stood out").
- **Oversight of Inconspicuous Places:** Low visibility caused participants to overlook spots (e.g., "I did not visit Tenryu-ji because it was drawn small on the map").
- **Need for Supplementary Information:** Participants requested more details, e.g., "It was difficult to understand how to get out of the station" or "I wish bus stops had been included".
- **Discouraging Representation:** Map representations sometimes suppressed behavior (e.g., "I passed through because it looked like a residential area").

In the workshop, participants confirmed that the distance manipulation (between Seiryo-ji and Daikaku-ji) might have encouraged circulation and that road textures acted as guideposts. Conversely, the simplified depiction of Saga-Arashiyama Station caused initial confusion, and the deviation from actual distances was noted as a problem. Furthermore, the limitation of static paper (lacking dynamic information, such as business hours and congestion status) was shared. This led to suggestions for hybrid maps, improving the visibility of landmarks, and presenting model courses.

7 Conclusion

In tourist maps provided by local governments, expressions such as listing only specific restaurants or highlighting only specific tourist spots are often restricted due to fairness considerations. It is difficult to directly use illustrated maps including visual guidance elements, like the one created in this study, as public tourism guidance.

However, the findings show that map representations—such as emphasis, omission, and configuration—significantly influence tourist routes and destination selection. Issues arising from insufficient information and the gap with actual geography were also revealed. This suggests that deformed illustrated maps can function not only as guidance but also as a "tool" to design the entire tourist experience. Design that influences behavioral aspects, such as the sequence of movement, length of stay, and stimulating the desire to visit, will be an important perspective in future tourism support.

In the future, we plan to study flexible information design that balances this public nature with guidance, tailored to users' cognitive characteristics. We also plan to explore hybrid information provision, such as interactive map representations linked with digital media, and the potential for maps personalized for each visitor.

Disclosure of Interests. The authors declare no competing interests.

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