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Exploring Sentiment Analysis and Visitor Satisfaction along Urban Liner Trails: A Case of the Seoul Trail, South Korea

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Abstract: Increasing public health awareness has stressed the significance of the mental and physical benefits of outdoor activities. Government involvement and support for urban redevelopment projects in Korea, such as Seoul Dulle-gil, connected previously disconnected green spaces. Despite the ecological and cultural importance of urban spaces, their impact on residents and tourists and their role in exploring the city's dynamic remains limited. This study aims to evaluate how green space activities engage in sustainable land management and offer insights into surrounding communities. A quantitative big data research method was employed, analyzing 3995 online blog post reviews using Python code, and sentiment analysis conducted with pandas and KoNLPy's Okt library. The results indicated that sentiment scores were generally higher in sections located south of the Han River. Among the eight trail courses, courses 6, 3, 4, and 5, located south of the Han River, exhibited higher sentiment scores compared to courses 7, 8, 2, and 1, located north of the Han River, which showed lower satisfaction levels. Among the 16 characteristics influencing visitor satisfaction, the study emphasized the importance of potential space maintenance to enhance trail user safety and community well-being, contributing to sustainable land management.

Keywords: trail; urban development; visitor satisfaction; sentiment analysis; sustainable management

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1. Introduction

Walking is a universally recognized physical activity. Trails offer significant benefits within surrounding community landscapes [1]. In modern society, pathways have developed into routes for recreation and leisure [2]. This evolution reflects a growing interest in tourism experiences that blend physical engagement with cultural and environmental exploration [3,4]. There is an evident shift from the traditional approach of developing isolated tourist destinations to linear leisure activities [5–7]. Local governments and public health initiatives are adding value to establishing linear tourism routes that connect these destinations.

Globally, several nations have established wide trail networks, each designed to promote outdoor leisure activities and preserve natural landscapes. The French Randonnée Association produces brochures about these trails. The French trail system, managed by FFRandonnée, emphasizes the promotion of community life by encouraging the mixing of populations and generations. It supports sports, tourism, and leisure activities while focusing on the protection of biodiversity and urban environments. This approach aims to bolster regional development and preserve community well-being [8]. In the United States, the National Trail System (NTS) was established under the National Trail System Act [9]. The National Trail System Act, established in 1968, mandates federal involvement in the designation, management, and protection of national trails. This legislation aims to provide diverse outdoor experiences for all, ranging from short outings to extended expeditions. The Act reflects a commitment to making America's natural landscapes

accessible and enjoyable for everyone [10]. This system is collaboratively managed by the federal government, state governments, and private organizations, each assigned specific roles over defined periods. The NTS comprises three main trails—National Scenic Trails, National Historic Trails, and National Recreation Trails. New Zealand features a network of safe, pedestrian-oriented paths in suburban areas known as Walkways, established under the New Zealand Walkways Act [11]. Through the Walkways Act (1990), New Zealand has expanded walking tracks across both public and private lands. This Act ensures safe and unobstructed access to the outdoors, promoting physical recreation, enjoyment of natural and pastoral beauty, and appreciation of historical and cultural features along the trails [12]. The Department of Conservation (DOC) plans these Walkways based on the Act's guidelines and categorizes them into four types based on user characteristics. In Japan, the Long-Distance Nature Trails span approximately 22,000 km and were established by the Japanese Ministry of the Environment, with local governments responsible for maintenance and management [13]. The Japanese Ministry of the Environment oversees ten Long Distance Nature Trails, designed to offer safe experiences of seasonal nature, scenic landscapes, and local history. These trails promote well-being through natural surroundings while fostering environmental conservation awareness [14]. These selected countries highlight a range of approaches and philosophies in trail management and visitor experiences. The main criteria involve geographical diversity, cultural significance, recognition, and the variety of terrain associated. Each country's trail system embodies a unique mission that aligns with broader goals of promoting physical activity, cultural appreciation, and environmental stewardship globally. The South Korean government developed the Seoul Trail, known as the Seoul Dulle-gil, to address the increasing interest in walking activities [15]. This linear spatial landscape surrounding Seoul consists of eight distinct courses. Each course comprises 21 sections strategically planned to cater to individuals with different levels of physical ability and specific recreational purposes [16].

Urban green spaces connect natural habitats, which is related to biodiversity [17]. Trails, with their linear nature, provide opportunities to link with neighborhoods, contributing to positive changes in the physical health of residents [18]. Previous studies on sustainable trail management have reviewed trail resource sustainability and the design of trail networks to better accommodate visitors [19]. These studies highlight that sustainable trail management focuses on protecting natural resources while allowing increased visitor access. It also emphasizes ensuring inclusive and safe visitor experiences and providing economic benefits for protected areas and local communities. Also, trail characteristics and user behavior significantly impact overall trail usage and the perceived quality of the trail. Trail visitors are likely to visit a trail more frequently if they perceive it to be closer to their residence [20–22]. Hence, within the context of land ownership, governance networks play a crucial role in effective management. These networks can significantly influence the institutional capacity needed to support the ecological aspects of the system [23,24]. Moreover, to remain viable in the long term, sustainable resource management must account for changes in demand, supply, and other external factors [25].

However, there is currently a gap in the tourism literature regarding the examination of destination satisfaction levels on linear trail courses and the provision of visitor sentiment analysis. The main purpose of this study is to provide insights into urban development and evaluate trail usage by understanding the relationship between visitor experiences and the surrounding environment. The research question aims to answer the positive, negative, and neutral standards of emotional levels of the trail visitors, as well as how trail-specific characteristics influence visitor satisfaction. Hence, the current study aims to fill the gap in the existing literature in three key ways: (1) to utilize advanced text mining techniques to measure sentiment on recreation experiences, (2) to offer detailed content analysis of visitor text reviews shared on online blogs, and (3) to provide an empirical analysis of trail-specific visitor satisfaction. This paper seeks to review and describe the existing international literature related to managerial and resource sustainability to better inform trail managers and other stakeholders. A common objective is the design,

construction, and management of trail networks that can accommodate visitation and provide high-quality recreational experiences while minimizing detrimental impacts on natural, historic, and cultural resources. By addressing these objectives, the study intends to offer insights into urban development and evaluate trail usage by understanding the relationship between visitor experiences and the enhancement of linear recreational settings in an urban environment.

2. Literature Review

2.1. Sustainable Trail Management

Sustainability is directly associated with trail activities. Health benefits through trail walking is one of the most studied subjects. Previous studies have stressed its physical health benefits [21,26–28], such as on quality of life [29]. Health researchers have supported the view that walking is a form of exercise that improves people's health [30]. For instance, those who were more health-motivated were more frequent trail users [30,31]. Furthermore, man-made trails can encourage physical activity within communities [32,33]. The creation of linear trails has resulted in significant improvements in public health and daily well-being [34]. Active participation from residents and relevant government authorities is crucial for effective trail management [35]. In practice, Seoul city's government focused on uplifting public health [36]. They developed and connected trails throughout the city's nature streams and communities. This initiative is part of the municipal project aimed at creating scenic, neighborhood, and eco-friendly walking environments across the city. Over a decade after opening the trail, successful results have been noted.

At the regional level, socio-economic value can increase through urbanizing spaces [37]. This can be directly related to the monetary value of increasing the regional price. Consequently, a spillover effect for revitalizing the local economy, such as on local restaurants and shops, can occur [38]. However, this economic diversity has negatively impacted the natural environment [39]. Education programs rely significantly on the proactive role of land managers in ensuring effectiveness. Therefore, land quality managers must have an updated view of changing demographics and take proactive steps to disseminate best practices [40].

2.2. Trail Characteristics and User Behavior

Apart from the health benefits of trail walking, there is a focus on exploring leisure-based trail experiences [20,41]. This emphasizes the need to understand user behavior, perception, and preferences in different trail environments [21]. The concept of linear tourism involves developing and promoting a travel route or itinerary that includes multiple destinations and attractions. Consequently, there is a growing recognition of the importance of considering specific trail contexts when studying user experiences and motivations. Research highlights the diversity among trails, with each offering unique conditions that significantly influence user motivations and preferences [42]. Specifically, trail characteristics are important in influencing walking behavior. In natural riverside environments, people experience more positive emotions [43] because the trail users are likely to prefer open and high scenic spaces in a linear-routed condition [4]. Other conditions include safety from traffic and crime, a suitable trail surface, accessibility for wheelchairs, scenic views, trailside facilities, and regular maintenance [44]. In the context of leisure and trails, beautiful scenery, natural environment, and accessibility have been identified as strong participation motivators [45]. However, unpredictable weather conditions and climate change in an outdoor activity setting can significantly influence experiences [40,46]. In general, all these characteristics create walking trails that are approachable, convenient, and attractive to people [47,48].

2.3. Previous Research on Sentiment Analysis

Sentiment analysis, also known as opinion mining, uses analytical methods to evaluate and interpret sentiments, opinions, attitudes, and assessments expressed in natural

language texts [49]. Sentiment analysis has diverse applications, such as refining business strategies, predicting elections, monitoring disease outbreaks, raising data security awareness, and improving disaster response. This means that sentiment analysis plays a crucial role in grasping public opinions and aiding decision-making [50]. There are eight fundamental and prototypical emotions: joy, sadness, anger, fear, trust, disgust, surprise, and anticipation [51]. In contrast, sentiment analysis refers to the process of using computer technology to categorize text based on these emotional states.

In tourism research, sentiment analysis involves determining tourists' attitudes toward tourism products or attractions by categorizing textual data into sentiment categories: positive, negative, or neutral [52]. While emotions represent individual feelings, sentiment analysis involves systematically classifying text according to the emotional content it conveys, using automated methods to identify and categorize these feelings [53]. Primary data can identify the demographic segmentation of trail visitors, but it fails to capture changes in sentiment or behavior over longer periods [54]. Additionally, recreation activities, such as visiting trails, are voluntary actions [55]. This voluntary nature means that the data collected can reflect a more genuine and engaged perspective [4], compared to survey-based research, which often captures a limited range of perspectives through a small number of questions. In the context of voluntary participation in recreational activities, big data can provide a broader and more nuanced understanding of user experiences and preferences [56]. Hence, sentiment data from blogs reflect genuine opinions, making the results more accurate.

3. Methods

3.1. Data Collection and Analysis Process

First, Information Extraction (IE) is a method used to derive valuable insights from extensive text data [57]. Domestic portal sites with abundant review data from Seoul Trail users were selected. The analysis focused on posts written by users. A web crawler was developed using Python's Selenium and Beautiful Soup libraries to collect data. Beautiful Soup is a Python library designed to extract data from HTML and XML documents [58]. IE systems collect specific attributes and entities from documents and determine their relationships. After the extraction process, the collected data are stored in a database for information retrieval purposes [59].

Second, Natural Language Processing (NLP) aims to develop text mining techniques that accurately extract information from literal vocabulary or texts [60,61]. The collected text data were processed using natural language processing techniques. Since the data were written in Korean, the Konlpy package (a Python library) was used to analyze only the necessary words [62]. In this study, words not registered in the emotional dictionary were assigned a value of 0 points. The sentiment analysis was performed on 3995 reviews by repeatedly applying this process. Using Python code, sentiment analysis was conducted using pandas and KoNLPy's Okt library [62]. In this research, big data sentiment analysis and text frequency analysis were adopted to examine visitor satisfaction on Seoul Trail courses one through eight. Big data, particularly data extracted from online blogs, offers significant advantages over traditional research methods such as quantitative surveys and qualitative interviews. One of the main benefits is the ability to acquire dynamic data.

3.2. Sentiment Analysis

Based on the KNU Korean Sentiment Dictionary, sentiment analysis was conducted on user posts from online blogs for each course of the Seoul Trail. The KNU Korean emotional dictionary comprises 12,853 emotional words, including 4872 positive words, 9828 negative words, and 154 neutral words [63]. This dictionary encompasses idioms, abbreviations, emoticons, and other elements. Each word is assigned a sentiment value on a scale of five emotional levels—strongly positive (+2), positive (+1), neutral (0), negative (−1), and strongly negative (−2) [64]. The code analyzed the frequency of positive, negative, and neutral expressions based on word polarity [65]. Furthermore, the length of each document

was calculated, and the corresponding results were noted. In order to conduct sentiment analysis, the data were organized by the eight courses of the Seoul Trail. Sentiment scores were extracted for each course, identifying the top 4 courses with the highest sentiment scores and the bottom 4 courses with the lowest sentiment scores.

3.3. Instrument Development and Frequency Analysis

To identify the specific characteristics that influence visitor satisfaction regarding the eight courses of the Seoul Trail, online blog content was selected for big data analysis. Originating from the "2021 Walking Travel Survey" [66] (Table 1), 16 selected items of destination image were measured. In this research, the high and low satisfaction of Seoul Trail visitors were compared. We conducted a sentiment analysis on the eight courses, focusing on the top four courses with high satisfaction and the bottom four courses with low satisfaction. This enabled a detailed examination of the distinctive traits and preferences observed within specific courses.

Table 1. Trail satisfaction items.

Rank	Items	Ratio		
		Average	Top 3	Bottom 3
1	Scenery	6.13	92.1	1.2
2	Circumference	5.42	91.3	1.5
3	Safety	5.86	88.7	2.2
4	Difficulty grade	5.84	89.1	2.6
5	Management	5.82	87.8	2.0
6	Accessibility	5.74	86.0	3.4
7	Guidance	5.72	86.8	2.8
8	Attractions	5.71	85.1	2.4
9	Local tourism	5.61	82.2	3.8
10	Accommodation	5.58	80.9	3.8
11	Cost/expenses	5.56	80.8	3.9
12	Facilities	5.55	81.1	4.6
13	Culture	5.42	76.4	3.2
14	F&B	5.40	75.8	5.5
15	Events	5.14	65.2	7.2
16	Shopping	5.14	64.3	9.1

Note: Top 3 resources from the [66]. This Table displays the factors considered most important when selecting a walking trail. The "Average" section represents the mean rating for each item. The "Top 3" section indicates the cumulative percentage of responses categorized as "Somewhat Important", "Important", or "Very Important". The "Bottom 3" section reflects the cumulative percentage of responses categorized as "Not Important at All", "Not Important", or "Slightly Important" [66].

Frequency analysis is one of the most intuitive and widely used methods for visualizing the frequency of terms that appear in documents from various perspectives, and it is a fundamental technique for identifying frequently used words within an entire document [67,68]. In this paper, a frequency analysis was conducted to determine which characteristics of the eight courses of Seoul Dulle-gil had high or low satisfaction levels and explore the reasons behind varying sentiment scores for each segment. In previous research, characteristics of the trails were analyzed simply through frequency analysis without establishing specific criteria [69]. This approach may have limitations, as frequency analysis alone might not fully capture the complexities of the trail characteristics.

4. Results

4.1. Results of Sentiment Analysis

In Table 2, the eight courses are distinguished. Document refers to the number of words collected for each segment, while document length shows the average number of words per document for each course. Sentiment words are categorized into four levels, strongly positive, positive, strongly negative, and negative, with scores of +2, +1, −2, and −1 assigned according to the intensity of the sentiment. Also, positive count indicates the number of words with positive sentiment and provides the proportion of these words relative to the total number of words. Similarly, negative count refers to the number of words with negative sentiment and includes their proportion compared to the total word count.

Table 2. Result of sentiment analysis.

Course	Document	Document Length	Sentiment Words						
			Strongly Positive (+2)	Positive (+1)	Strongly Negative (−2)	Negative (−1)	Positive Count (%)	Negative Count (%)	Senti Score
1	324	896.21	2270	2572	1300	2024	4842 (59.3)	3324 (40.70)	1764
2	312	896.21	2270	2407	1207	1819	4516 (58.88)	3026 (40.12)	1780
3	525	979.08	5039	5543	2272	3280	10,582 (65.59)	5552 (34.41)	3589
4	570	958.4	4207	4962	2427	3189	9169 (62.01)	5616 (37.98)	3571
5	530	934.13	3999	4908	2158	3428	89.07 (61.46)	5586 (38.54)	3492
6	591	906.93	6300	6913	2499	3507	13,213 (68.75)	6006 (31.25)	3800
7	656	921.28	4547	5516	2788	3738	10,063 (60.67)	6524 (39.33)	3150
8	479	937.35	3503	3949	1892	2174	7452 (64.70)	4066 (36.30)	3115
Total Average	498.375	917.433	3996.75	4596.25	2067.875	2894.625	68,744 (63.4)	39,700 (36.60)	3032.625

Note: Document length refers to the average number of words in a document by course. The Table provides details on various courses, including document length and sentiment analysis. The "Document Length" section represents the average number of words in documents by course. The "Sentiment Words" section breaks down the sentiment analysis into counts of different sentiment categories: "Strongly Positive (+2)", "Positive (+1)", "Strongly Negative (−2)", and "Negative (−1)". "Positive Count (%)" and "Negative Count (%)" represent the percentage of positive and negative words, respectively. The "Sentiment Score" is the net sentiment score derived from these sentiments.

Course 6, as indicated in Table 2 had the highest sentiment score at 3800 points, followed by courses 3 (3589 points), 4 (3571 points), 5 (3492 points), 7 (3150 points), 8 (3115 points), 2 (1780 points), and 1 (1764 points). Regarding the vocabulary analyzed, 64% of the blogs expressed positive words about all the courses, while 37% of the blogs expressed negative sentiments. This result indicates that the frequency of positive sentiment words was roughly twice that of negative sentiment words. These findings suggest that users generally hold a positive perception of the Seoul Trail.

4.2. Sentiment Characteristic Proportion

The ratio of text content showing positive, negative, and neutral emotional polarity values for online blog posts by courses of the Seoul Trail is presented in Table 3. Although

there are subtle differences in each course, generally, the proportion of blog posts with positive content was higher than negative posts.

Table 3. Proportion of document's sentiment characteristic.

Course	Text Number	Positive (+)	Negative (−)	Neutral
		Proportion (%)		
1	8166	55.521	38.114	6.363
2	7542	56.232	37.678	6.088
3	16,134	56.055	37.129	6.814
4	14,785	55.739	37.387	6.873
5	14,493	56.211	36.91	6.878
6	19,219	56.155	37.42	6.423
7	16,587	55.136	39.033	5.829
8	11,518	56.424	36.844	6.731

Note: Proportion refers to a part considered in comparative relation to a whole value; sentiment analysis refers to the total word count. The Table presents sentiment analysis for various courses. The "Text Number" section indicates the total number of texts analyzed for each course. The "Positive (+)" and "Negative (−)" sections show the proportions of positive and negative sentiments as percentages. The "Neutral" section reflects the percentage of neutral sentiments. Each entry provides a comprehensive overview of sentiment distribution across different courses.

Additionally, the neutral polarity value constitutes approximately 6% in each course. This implies that when calculating the emotional polarity of text from blogs, certain words may not be included in the emotional dictionary. Alternatively, the presence of both positive and negative words can lead to a neutral emotional score (0) due to conflicting sentiments.

4.3. High-Satisfaction Trail Courses

Scenery was measured based on the natural attractions [70] around the Seoul Trail, with course 5 scoring the highest at 42, followed by courses 3 (36), 4 (24), and 6 (21). Circumference was the measure of satisfaction with the length of the Seoul Trail course. Course 6 recorded the highest score of 290, followed by courses 3 (270), 4 (256), and 5 (237). Safety was measured to assess the level of risk [71] along the Seoul Trail; however, it was not prominently mentioned in most sections, with only two mentions in course 3. Difficulty grade measured perceived challenges in each course, considering factors, such as steep slopes or numerous stairs. Courses 6 and 5 received the highest score (111), followed by courses 4 (105) and 3 (102).

Regarding management, such as supervision and trail operation, courses 4 (15), 5 (14), 3 (14), and 6 (13) had similar results. Accessibility was evaluated to determine whether the Seoul Trail was conveniently located for easy access [72,73]; however, this item has not been discussed in any section. Guidance referred to the effectiveness and infrastructure of signboards and directions, being indicated only five times in course 3 and twice in course 4. Additionally, three of the following items on attractions, local tourism, and accommodation were not mentioned for any course. Cost and expenses was the amount spent at each course for travel to arrive at the Seoul Trail. Courses 3 (3), 4 (2), 5 (1), and 6 (0) had similar results. Facilities related to convenience were measured by the presence of amenities, such as toilets and rest areas. Course 6 was mentioned 28 times, followed by courses 4 (19), 3 (10), and 5 (10).

As projected in Table 4, culture, which encompassed the history and cultural resources of the Seoul Trail, was mentioned majorly in course 5 (15), followed by courses 4 (11), 3 (6), and 6 (5). F&B measured the variety of food available along the course. It was mentioned in all courses, with courses 6 (15), 3 (13), 4 (11), and 5 (10) having the highest scores. Events referred to festivals that could be enjoyed on the Seoul Trail and were mentioned only in course 6 four times. Shopping measured the availability of items for purchase while

walking the Seoul Trail. The results were mentioned 29 times each in courses 3 and 5, 28 times in course 4, and 26 times in course 6.

Table 4. Higher-satisfaction trail courses.

Items	Course 3	Course 4	Course 5	Course 6
Scenery	36	24	42	21
Circumference	270	256	237	290
Safety	2	0	0	0
Difficulty grade	102	105	111	121
Management	14	15	14	13
Accessibility	0	0	0	0
Guidance	5	2	2	0
Attractions	0	0	0	0
Local Tourism	0	0	0	0
Accommodation	0	0	0	0
Cost/Expenses	3	2	1	0
Facilities	10	19	10	28
Culture	6	11	15	5
F&B	13	11	10	15
Events	0	0	0	4
Shopping	29	28	29	26
Total	490	473	471	523

Note: The 'Items' refer to the factors considered most important when selecting a walking trail. Courses 3, 4, 5, and 6 are the trails with the higher satisfaction rating.

4.4. Low-Satisfaction Trail Courses

In contrast to higher-satisfaction courses, the remaining four courses had low satisfaction levels (Table 5). This result highlighted that scenery on course 7 had the highest value of 21, followed by courses 8 (15), 1 (12), and 2 (10). Circumference was mentioned most often in course 7 (324), followed by courses 8 (236), 1 (149), and 2 (135). Safety was only mentioned once in course 2. Difficulty grade was mentioned 110 times in course 7, followed by courses 8 (93), 1 (83), and 2 (54). Management had the highest occurrence result of 17 in course 7, followed by courses 8 (93), 1 (83), and 2 (54). Accessibility, local tourism, and accommodation were not mentioned in any course. Attractions was only mentioned thrice in course 7. Cost and expenses was only mentioned thrice in course 8. Facilities was mentioned in courses 7 (11), 8 (9), 1 (7), and 2 (6). Culture was highest in course 2 (8), with 6 mentions in courses 1, 7, and 8. Events was mentioned once in courses 1 and 8 (1) and 0 times in courses 2 and 7. Shopping was mentioned most often in course 7 (32), followed by courses 8 (26), 1 (15), and 2 (14).

According to Table 5, sentiment scores were higher in courses located south of the Han River, specifically in courses 6, 3, 4, and 5. This finding is consistent with the results in Table 4, which indicated high satisfaction levels for these courses. Conversely, courses 7, 8, 2, and 1, situated north of the Han River, exhibited lower sentiment scores, similar to Table 2. Drawing on these results, we developed a visual map to illustrate the identified relationships and patterns (Figure 1).

Table 5. Lower-satisfaction trail courses.

Items	Course 1	Course 2	Course 7	Course 8
Scenery	12	10	21	15
Circumference	149	135	324	236
Safety	0	1	0	0
Difficulty grade	83	54	110	93
Management	11	10	17	9
Accessibility	0	0	0	0
Guidance	0	0	1	0
Attractions	0	0	3	0
Local tourism	0	0	0	0
Accommodation	0	0	0	0
Cost/expenses	0	0	0	3
Facilities	7	6	11	9
Culture	6	8	6	6
F&B	10	4	8	7
Events	1	0	0	1
Shopping	15	14	32	26
Total	264	242	533	405

Note: Courses 1, 2, 7 and 8 are the trails with lower satisfaction ratings.

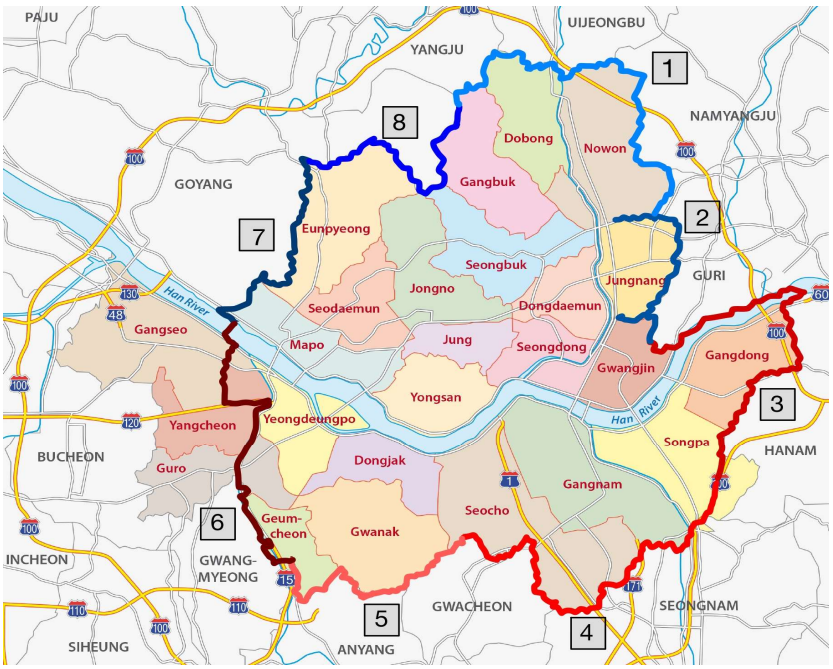

Figure 1. Satisfaction for each course of the Seoul Trail based on sentiment scores. Note: Red color illustrates high sentiment scores with high satisfaction and blue color identifies low sentiment scores with low satisfaction. 1: Course 1 through Su-raksan and Buramsan, 2: Course 2 through Yongmasan and Achasan, 3: Course 3 through Godeol and Iljasan, 4: Course 4 through Daemosan and Umyeonsan, 5: Course 5 through Gwanaksan Moun-tain, 6: Course 6 through the Anyangcheon stream, 7: Course 7 through Bongsan and Aengbongsan and 8: Course 8 through Bukansan. Source, Authors' recreation.

Figure 1 presents a physical map of Seoul, with each course divided into sections and color-coded according to the high and low sentiment scores. There is a difference in sentiment scores based on the Han River. Courses 1, 2, 7, and 8 are located in the upper Han River area, with sentiment scores ranging from 1764 to 3150. The higher the score, the darker the blue color; hence, course 8 scored the highest, followed by courses 7, 2, and 1. Downstream from the Han River are courses 3, 4, 5, and 6, with sentiment scores ranging from 3492 to 3800. The lower the score, the darker the red color; hence, course 6 had the highest score, followed by courses 3, 2, and 5.

5. Discussions

Based on the comprehensive analysis of trail user satisfaction and sentiment, several key conclusions can be drawn. The study underscores the significant role of urban linear trails, such as the Seoul Trail, in enhancing public health and well-being through outdoor recreational activities. These trails promote physical exercise and contribute positively to mental health by providing natural and scenic environments. The findings indicate that trail user satisfaction varies significantly across different courses. Areas south of the Han River exhibited higher sentiment scores and satisfaction levels compared to those situated north of the river. This highlights the importance of geographical location and its impact on visitor experiences and perceptions [43]. Amenities and infrastructure play a crucial role in enhancing trail user satisfaction. Key amenities, such as rest areas, scenic viewpoints, and facilities, such as benches and vending machines, were identified as critical factors influencing visitor enjoyment and safety along the trail.

With regard to circumference, when visitors perceive a trail as closer and safer, it enhances their overall experience and makes the trail seem more approachable [22]. Key amenities, such as rest areas, scenic viewpoints, and facilities, such as benches and vending machines, were identified as critical factors, which is supported in the related literature [43,74]. In order to influence visitor enjoyment and assure them of their safety along the trail, facilities must be available along the trail, which is supported by the literature [22,75]. Moreover, management is important to increase visitor satisfaction and sustainable development, as mentioned in previous research [74]. On the other hand, accessibility did not emerge as a prominent issue since the Seoul Trail is located in a densely clustered area of the city [43].

Geographically, Seoul Dulle-gil's course 3 intersects with the Songpa Trail, and feedback praised the quality of the signboard information. Course 3 demonstrated safety and guidance, and positive evaluations highlighted the well-maintained stairs on hilly sections. Most trail users noted the presence of coir matting along course 3 to prevent slipping due to adverse weather conditions [40,46]. Additionally, directional signs at the entrance of the Han River Park provided clear instructions for visitors. The facilities and F&B offerings of course 6 played a significant role in the trail visitor experience. Additionally, there were several resting places and restaurants along the trail. Course 6 has gained a reputation for its convenience due to its proximity to restaurants and cafés, particularly along the Yangjaecheon streamside [36]. The visitors shared their experiences in online reviews, generating numerous posts about the area. After reviewing statements, such as "It was great that the exercise, convenience, and rest facilities were well-maintained," we confirmed the accuracy of the findings. The reviews align with our observations that convenient accessibility and diverse facility options significantly contributed to the high satisfaction levels for course 6.

5.1. Theoretical Implications

This research revealed nature scenery, F&B options, convenient facilities, and guidance as important elements for user satisfaction evaluation across each course. The broad applicability of these keywords in highly prioritized courses underscores their importance. The analysis of lower-satisfaction courses reveals fewer mentions of scenery, facilities, and F&B. Online blog reviews highlighted several comments expressing difficulties with

course 1 due to the absence of convenience stores and snack bars. This aligns with the study's findings that courses 1 and 2 had significantly fewer mentions of F&B compared to courses with higher satisfaction. Facilities were mentioned least frequently across all eight courses, which suggests that leisure participants value nature [44], amenities, and food consumption. Additionally, there has been an increase in mentions of management issues. For example, in course 8, located at the intersection of Bukhan Mountain Trail, there was an inadequate number of signboards directing visitors to the Seoul Trail. Instead, visitors had to rely on Bukhan Mountain Trail signages. This inconvenience is related to the facilities and trail management and guidance systems. Thus, these issues contribute to lower satisfaction levels.

Regarding sentiment analysis, the differences in sentiment scores among the higher-scoring sections were relatively minor. Notable variations were observed when considering the entire section. These findings highlight that users' preferences for each course are distinct. This supports previous studies that projected that user preferences are different in every trail [42]. The sentiment analysis of the Seoul Trail revealed that approximately 64% of derived words expressed positive sentiments, while about 37% expressed negative sentiments. Positive sentiment words were twice as frequent as negative ones, indicating an overall positive user perception. To understand differences in user satisfaction across the eight courses, keywords, such as scenery, facilities, F&B, and guidance, were analyzed. High-satisfaction courses (courses 6, 3, 4, and 5) frequently mentioned these aspects, particularly F&B and facilities. Moreover, users highlighted scenery, enjoying natural settings and beautiful nature [4,43,45], and engaging with historical and cultural sites along the trail [3,4]. Therefore, this finding suggests that user experiences at facilities and engagement with cultural elements contribute significantly to satisfaction levels on the Seoul Trail.

5.2. Practical Implications

There is a pressing need to enhance public awareness about the Seoul Trail. Currently, the trail lacks sufficient events to attract individuals who may not be interested in outdoor activities. For example, a nature-oriented program integrated into daily life could be offered free of charge, providing incentives for participants who do not complete the entire course. Moreover, with a growing emphasis on environmental stewardship, plogging programs along the Seoul Trail could engage people in positive environmental behaviors [76]. It is essential to provide facilities near the trail and maintain the connecting roads. This should be consistent with visitors' participation.

A dominant practical approach to enhance user experience would be to ensure that future trail management and maintenance efforts include designated photo spots for optimal scenic views and resting facilities. Additionally, improving accessibility for all types of users is crucial [45]. For instance, considering entertainment programs and events tailored for pet owners, given the high number of dog owners in Seoul, would increase positive experiences. Providing pet waste disposal areas along the trail would contribute to a pleasant and convenient walking experience for non-pet owners as well. To enhance the overall experience and safety of the Seoul Trail, it is essential to establish a comprehensive road safety management system, such as providing caution information around the trails [40]. It is crucial to consider outdoor education programs and trail etiquette. Also, as one of the effective ways to minimize traffic dispersion, sustainable trails should have smoother and drier treads than adjacent areas, and obstacles like rocks or logs can be installed off-trail to prevent visitors from bypassing drainage features and steps [77]. This could prevent crimes or injuries and help handle incident reporting quickly, increasing trail user safety and security.

5.3. Limitations and Future Research

The data collected in this study did not include demographic information. Since data on blog posts were collected annually, detailed information, such as the authors' gender,

age, and country of origin, could not be obtained. Therefore, only the original content of the posts was used for analysis. To address this limitation, quantitative research, such as survey-based methodology, could be employed to gather demographic information. While there has been research measuring how different ethnicities engage with green pathways [78], Seoul has been experiencing high inbound tourism. Besides ethnicity, it would be feasible to compare emotions and satisfaction levels of individuals aged 15–79 years. This information and data can be crawled based on the "2021 Walking Travel Survey" [66]. It was assumed that all online posts represented honest opinions. While the primary objective was to classify advertising and promotional posts, during the classification process, posts, such as simple trail introductions, might have been included without proper categorization. To ensure more reliable results, a refined approach could involve classifying and analyzing posts that convey emotions only. Future research should consider conducting big data studies focusing on trails across the country. This broader scope would provide a comprehensive understanding of trail usage and user experiences nationwide.

6. Conclusions

This study emphasizes the need for the continuous maintenance and management of trail resources. Courses with well-maintained infrastructure and clear signage received more positive feedback, suggesting that effective management practices are essential for optimizing visitor experiences. Furthermore, the application of sentiment analysis using big data techniques provided valuable insights into visitor sentiments and preferences. While analyzing online blog posts, the study quantified and visualized visitor sentiments, thereby identifying areas for improvement and development. Policy implications derived from the study suggest that urban planners and policymakers should prioritize sustainable land management and ongoing investment in trail infrastructure. This approach supports tourism development and ensures the long-term viability and attractiveness of urban green spaces. Based on the frequency analysis of 16 items from the 2021 Walking Trail Survey [67], it was found that sections with more food and convenience facilities tended to receive higher satisfaction ratings. In contrast, courses lacking these amenities were reported as less satisfactory. Many visitors expressed concerns about the inconvenience of these areas. To address this issue, it is essential to provide rest areas, such as benches, and vending machines for hydration, particularly on more challenging sections of the trails. This approach could enhance comfort along the routes and encourage visitors to return in the near future. Moreover, a robust safety management system for the trails is necessary. Recent reports have highlighted that criminal activities occurring along some trails may contribute to their perception of trails as unsafe areas [79]. To prevent these negative social issues, installing video surveillance technology and ensuring accessible emergency contact numbers linked to nearby police stations are essential measures. By creating a safer atmosphere, visitors will be able to enjoy their time on the trails more comfortably and for longer periods.

In conclusion, this research contributes to the literature by filling a significant gap in understanding visitor satisfaction along urban linear trails. By integrating sentiment analysis with traditional satisfaction metrics, this study offers a nuanced perspective on how recreational spaces, such as the Seoul Trail, contribute to urban livability and tourism attractiveness. Future studies are recommended to research the socio-economic impacts of trail development and explore how different user demographics perceive and utilize urban trail systems. Such research will be instrumental in shaping urban planning and leisure infrastructure development strategies. Overall, the findings underscore the Seoul Trail's role as a valuable asset in promoting sustainable urban tourism and enhancing the overall quality of life for residents and visitors.

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