

Applications of AI Large Language Models in Citizen Participatory Urban Planning

: Using GPT-4o and Prompt Engineering

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Abstract

Can artificial intelligence (AI) represent citizens in urban planning? Owing to the continuous development of large language models (LLMs) such as ChatGPT, LLMs are expected to represent the thoughts of citizens. However, urban planning involves not only spatial particularities but also the intertwined interests of various stakeholders, where both efficiency and equity are pursued. Hence, a citizen-participatory urban-planning model that utilizes LLMs to represent the diverse opinions of citizens must be developed. This study aims to investigate the applicability and potential of LLMs for citizen-participatory urban planning and identify future tasks. The methodology involves using LLM prompt engineering to conduct discussions between citizens and urban-planning officials in a specific community. The discussions focus on living service facilities, which is a subfield of urban planning, and the prompt-engineering approach is categorized into four levels. This classification reflects the principle that the more specific the prompt is, the more detailed the response is. Through discussions spanning various fields and prompts, this study analyzes the representation of citizen opinions based on the field and prompt composition, based on which relevant implications are derived. The prompt-engineering results are analyzed, and the degree of prompt implementation is evaluated. Two key findings are identified from the analysis. First, LLMs are shown to effectively represent citizens of a specific area during urban planning. Second, this study presents a methodology for effectively addressing local-community issues in urban planning using AI agents. These findings are crucial as they suggest an approach that can efficiently reflect diverse citizen opinions regarding urban planning by leveraging LLMs.

Keywords Artificial Intelligence, Large Language Model, GPT-4o, Prompt Engineering, Public Participation

주제어 인공지능, 대규모 언어 모델, GPT-4o, 프롬프트 엔지니어링, 시민참여

I. Introduction

1. Background and Purposes

Urban planning refers to a series of processes for establish-

ing a desirable future image of a city and implementing it (Ministry of Land, Infrastructure and Transport, 2024). Since urban planning secures rationality and fairness through expert opinions and deliberation, hearing opinions from related organizations, and reflecting residents' opinions

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during the establishment process, citizen participation is an essential element of urban planning (Lee, 2009). However, urban planning in Korea is often limited to unidirectional transmission of planning information or limited opinion collection (Lee and Kim, 2012). In addition, traditional urban planning, centered on experts, has been criticized for having limitations in reflecting citizens' demands or local characteristics. In addition, the urban planning resident participation system has a stiff and closed structure that does not sufficiently reflect social needs, and it also leads to social conflicts because it fails to consider the region and its residents (Lee et al., 2022). In this context, the need for establishing plans through citizen participation is being discussed, and the 2030 Seoul Master Plan, which emphasizes citizen participation in the early stage of urban planning, was established. However, since the citizens who participated in the process did not sufficiently understand the technical and legal aspects of urban planning, questions were raised regarding the quality of the opinions presented, and there was a problem that the opinions of a small group of participants were over-represented (Kim, 2014). In addition, problems occurred in the process of inducing citizen participation such as the complexity in analyzing opinions and reflecting them to policies, cost incurred, and temporal and spatial constraints. Therefore, it is necessary to find effective ways to address these problems and maximize the benefits of citizen participation.

To solve these problems, Large Language Models (LLMs), which have recently been attracting attention with the development of artificial intelligence (AI), can be used. Based on their natural language processing capabilities, LLMs can understand and generate various types of text, and through this, they can quickly process and analyze complex information. Since the introduction of ChatGPT, a conversational AI developed by OpenAI in 2022, LLMs have been utilized in various fields (Park et al., 2023). Recently developed LLMs can perform tasks at levels similar to human levels, so they can quickly perform a wide range of tasks such as translation, free Q&A, essay writing, and computer programming (Kasneci et al., 2023). In particular, LLM agents that have independence and perform tasks according to specific purposes can be created and utilized in various fields such as work and research. Recently, various studies have demonstrated that LLM agents can be developed and

utilized to replace the role of actual humans in urban planning, traffic management, and voting preference verification (Fu et al., 2024; Yang et al., 2024; Zhang et al., 2024). Accordingly, various approaches utilizing AI LLMs are being proposed to promote citizen participation and improve efficiency in urban planning, and it is becoming possible to overcome existing limitations and collect and reflect the opinions of more citizens (Wang et al., 2023; Gao et al., 2024). The utilization of LLMs offers the potential to enhance the transparency and participation of urban planning, thus enabling the implementation of a democratic and open urban planning process through real-time data analysis and feedback. However, there are several limitations and problems in the introduction of this new technology. For example, there are biases that may occur in the process of collecting opinions using LLMs, data quality issues, and uncertainty about how various stakeholders including citizens will accept AI. Therefore, it is a critical research task to clearly analyze the possibilities and limitations of citizen-participatory urban planning using an LLM.

2. Research Purposes

The present study has the following purposes. First, this study seeks methods of applying an LLM more effectively to derive opinions on urban planning from specific citizens living in specific areas using the AI GPT-4o model and prompt engineering. In particular, this study aims to develop prompts that can be reflected in urban planning by representing specific citizens in the research area. Second, various prompt composition methods are compared through prompt engineering techniques, and the impact of each composition method on the agent's discussion content is evaluated. Finally, the limitations that may arise in the opinion derivation process using an LLM are analyzed, and based on that, directions for how AI-based citizen-participatory urban planning can be improved are suggested.

Accordingly, the main research questions to be addressed in this study are as follows. First, "Can an LLM be used to generate results that represent the discussion process during citizen participation in urban planning?" Second, "Can an LLM actually represent residents of a specific area and derive the right conclusion based on appropriate knowledge?" and "How do differences in prompts through prompt engineer-

ing affect the LLM results, and how can this be applied to urban planning?” The goal of this study is to answer these questions and ultimately contribute to expanding citizen participation in the urban planning process through prompt engineering, alleviating blind spots in resident-participatory urban planning, and finding better urban planning methods.

II. Literature Review

1. Urban Planning and Citizen Participation

Citizen participation in urban planning is one way citizens can actively participate in the urban planning process, express their opinions, and affect the decision-making process (Haklay et al., 2018). Furthermore, citizen participation can directly influence the government’s policy-making and execution processes and plays a role in monitoring and expanding support for administrative agencies (Lee et al., 2015). This means that citizen participation goes beyond the mere act of participation; it has the institutional significance that it directly influences policy-making processes and serves as an administrative watchdog. In particular, citizen participation increases the rationality and publicness of urban planning and reflects diverse opinions and values in the plan, thereby contributing to sustainable collaborative planning (Kim, 2010). In other words, citizen participation is significant in that it allows urban planning decision-makers to collect a wider range of opinions from diverse citizens and reflect them in policies to produce comprehensive and acceptable results (Shiple and Utz, 2012). In this way, citizen participation in the planning process can contribute to increasing the effectiveness and efficiency of public policies, and therefore requires a careful approach to the design and implementation of the process.

Today, citizen participation in urban planning is carried out in various forms, such as public hearings, surveys, and online platforms (Yang, 2012). The Seoul Metropolitan Government offers a website to publicize the urban planning process and continuously collect citizens’ opinions and operates a participation panel composed of some citizens to monitor and assess the implementation of urban planning. In particular, such citizen participation can be facilitated through visualization and analysis of spatiotemporal data.

Specifically, spatial information technologies such as Public Participation Geographic Information Systems (PPGIS) can be utilized to induce direct participation of citizens in urban planning and demonstrate that citizens’ opinions can be reflected in the urban planning process (Koh, 2006; Haklay et al., 2018).

However, there are still some areas that require improvement in current urban planning. Citizen participation is often limited to a formal procedure to satisfy legal requirements, and it is difficult to exert real influence. Specifically, it has been pointed out that the results of citizen participation are limited to the opinion collection stage and that opinions are not sufficiently reflected in the decision-making stage (Lee et al., 2015). In the process of establishing the 2030 Master Plans for Cheongju, Suwon, and Seoul, the level of citizen participation was lower than the participation plan, and the participation of ordinary citizens was limited (Jeon and Lee, 2016). In particular, since citizen participation of the marginalized is further limited in this process, sufficient citizen participation of various classes needs to be ensured in future urban planning (Mahjabeen et al., 2009). Finally, issues related to the time and costs that are incurred in the process of citizen participation in urban planning have also been continuously raised. As seen in the case of Seoul City’s ‘living area plan,’ a lot of time and resources are required to effectively elicit citizen participation, which in turn leads to high costs; therefore, it is necessary to design the future citizen participation process in consideration of these issues (Yang, 2018).

2. Large Language Models (LLMs) and Prompt Engineering

The development of LLMs began with language models. Language models predict the position of words in a sentence by probabilistically calculating how natural a sentence is, and natural language processing and analysis using the models began to draw attention (Jones, 1994). However, traditional language models have had difficulties in identifying words with low frequency or first appearance as well as overfitting issues and challenges in capturing complex language (Rosenfeld, 2000; Brown, 2020). To overcome these problems, LLMs, which are advanced language models that apply AI-based structures, have emerged (Chang et al., 2024; Hadi et al., 2023). LLMs are effective in identifying the rele-

vance and context of all words in a sentence by learning patterns and relationships between words, phrases, and sentences through large text data sets. Accordingly, LLMs have begun to be utilized in various fields while overcoming the limitations of conventional models used for natural language processing, and their usability has recently been attracting more attention with the emergence of generative artificial intelligence (GAI). Specifically, GAI is capable of analyzing and generating various forms of data, such as text, images, and voice, based on prompts directly entered by the user (Brühl, 2023).

In this context, 'prompt engineering' has emerged as a process for using GAI. This is a process of specifying prompts and optimizing the input prompts to generate the desired response in GAI including LLMs, and it plays an important role in deriving high-level results from GAI systems based on natural language processing and LLMs (Marvin et al., 2023; Fulford and Ng, 2023). It has been proven that the performance of GAI models can be improved through prompt engineering and more realistic and appropriate answers to various problems can be provided, contributing to high-quality question answering (Bsharat et al., 2023; Strobelt et al., 2022; Abukhalaf et al., 2023). Studies have suggested that prompt engineering can maximize the potential of LLMs and propose specific utilization methods specialized in various fields.

3. LLM-based Urban Planning and Design

LLMs trained with reinforcement learning via human feedback can consistently generate human-like outputs (Kalla et al., 2023; Tessler et al., 2024). They also have flexible characteristics to perform various tasks, so they can be used for high-level tasks such as answering questions or making inferences based on the answers (Zhu et al., 2023). Accordingly, the use of LLMs has been increasing in recent urban planning and design studies.

A study using ChatGPT, which enables LLM-based chat, evaluated the quality of 50 urban plans being implemented in the United States through prompt engineering and compared the results with the evaluations actually conducted by humans. The results showed that the evaluation by ChatGPT was consistent with the traditional content analysis approach by 68% (Fu et al., 2023). Furthermore, a

study was conducted that combined prompt engineering and geo-knowledge to recognize geographic location descriptions in social media data and utilize them for disaster response and control (Hu et al., 2023). The study demonstrated that this method outperformed the existing named entity recognition method by more than 40%. Furthermore, a spatio-temporal LLM (ST-LLM) called UrbanGPT was recently proposed by combining an LLM and spatio-temporal data (Li et al., 2024). The model exhibited generalized performance in various urban environments and showed high prediction accuracy even in areas that were not used for model training. In this way, LLMs have been applied and utilized in various fields of urban planning and facilitate not only the evaluation of existing urban plans but also spatial analysis and data structuring (Zhu et al., 2024; Quan and Lee, 2025). In summary, LLMs can provide higher efficiency and accuracy in planning and data collection in the field of urban planning. In particular, there are implications in that the use of LLMs can increase the consistency and objectivity of evaluation and reduce the time and cost of the data collection process compared to existing methods.

Recently, the use of LLM-based agents is drawing attention, because they are capable of providing an environment for real-time response and problem solving, especially in dynamic and complex urban environments (Ruan et al., 2023; Ni et al., 2024; Masterman et al., 2024). Specifically, LLM-based agents can be utilized to perform roles on behalf of real humans. A study conducted on a method for generating personal mobility data using an LLM-based agent demonstrated that agent-based generated data can reflect real spatiotemporal activity patterns at a high level compared to real mobility data (Wang et al., 2024). The agents can replace the discussion process by configuring a multi-agent through multiple combinations. In a study that built a multi-agent-based resident collaboration framework for Beijing, it was found that the land use plan generated through the framework received higher scores than plans prepared by actual human experts in terms of resident satisfaction, inclusiveness indicators, and service accessibility (Zhou et al., 2024).

4. Uniqueness of Present Study

The uniqueness of this study is that, unlike the existing

methodologies for promoting citizen participation in the urban planning process, it focuses on prompt engineering using an LLM. In particular, this study proposes a more efficient and comprehensive citizen opinion collection method utilizing an LLM capable of digitizing and automating offline-based opinion collection methods such as surveys, public hearings, and interviews. Specifically, this study utilizes the GPT-4o model, which has proven excellent performance as the latest LLM. It is expected that the model can represent citizens with various characteristics so that it can reflect various citizen opinions regardless of time and place. In particular, LLMs such as GPT-4o can remember previous chats and generate answers based on previous content when a user asks a follow-up question (Barua, 2024). The use of an agent based on this will enable new content to be derived more effectively and meaningfully based on previous content.

In addition, while previous studies have used AI merely as a data analysis tool or only generated fragmentary content, this study is different in that it demonstrates that AI can be directly used for discussions representing citizens. This allows for the derivation of various perspectives and interests related to urban planning in a specific region and enables more in-depth analysis. Specifically, the discussion-type prompts presented by the GPT-4o model are expected to directly influence urban planning decision-making by helping local residents organize and express their thoughts more easily by representing their opinions, and furthermore, by systematically analyzing their opinions.

Lastly, this study is unique in the sense that it presents specific ways to utilize an LLM by analyzing how the interactions between agents within an LLM occur, through various prompt engineering practices. This will contribute to presenting a new methodology for sustainable urban planning by combining three important elements: AI, urban planning, and citizen participation.

III. Methodology

This study aims to develop a discussion prompt that derives urban planning opinions of specific citizens by utilizing GPT-4o among LLMs. The GPT-4o model employed in this study shows better performance than other models in language understanding and reasoning

ability (White et al., 2024). In particular, despite being an English-based language model, it shows excellent performance in using Korean. Specifically, it showed better performance than other LLMs such as Claude3 and Gemma2 and Korean-based LLMs such as CLOVA X and EXAONE3 in terms of fluency, up-to-dateness, and factuality, while considering various fields such as language, culture, law, and society (Seo et al., 2024).

Thereafter, regional data were used, and prompt engineering was carried out to derive specific answers from the model. Through this, an agent that represents citizens and conducts a discussion process was set up and utilized. First, input data collection is the process of gathering basic data to impart local characteristics to the GPT-4o model, which is a pre-trained model. The data collection process mainly included news crawling data and the background data on workshops for local residents in the area selected as a research area. Thereafter, data summary and data preprocessing stages were carried out to process the data into a form that can be input to GPT, and the data was input to generate responses. Next, the results were comparatively analyzed according to the degree of prompt specificity between the Zero-Shot GPT model without data input and the GPT model with data input. The overall analysis process of this study is illustrated in <Figure 1>.

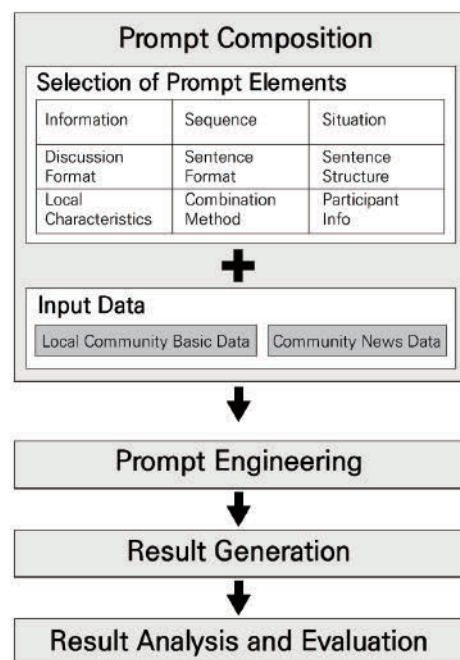


Figure 1. Research framework

1. Research Scope and Data

The spatial scope of this study was set to the Wangsimni-Haengdang area in Seongdong-gu, Seoul, which is in the Northeast Zone 1 designated by the 2030 Seoul Living Area Plan. Seongdong-gu is a composite space where residential areas, commercial areas, and public facilities are densely located (Cho and Chi, 2020). In line with these spatial characteristics, the Seoul Metropolitan Government is implementing policies such as improving the residential environment, creating jobs and economic vitality, encouraging youth entrepreneurship, and consulting small business owners (Seoul Metropolitan Government, 2014; Seoul Metropolitan Government, 2015). In particular, various facilities within the Wangsimni-Haengdang living area are closely related to the daily living of residents; thus, the area was selected as the target area of the study. This study is based on a spatial unit to reflect the opinions of residents at the scale of the local living area rather than a higher-level urban plan on a broad scale. In this context, this study set the Wangsimni-Haengdang living area, a small-scale local living area, in the Northeast Zone, as the research scope based on the '2030 Seoul Living Area Plan.' The 2030 Seoul Living Area Plan is a follow-up plan to the Urban Master Plan, and it presents the direction of living area development and urban management concept by reflecting the characteristics of the living area and the opinions of residents. This plan is divided into zones and local living areas, and this study focuses on local living areas.

Next, GPT-Knowledge was built by utilizing local news crawling data and basic living area data to input information through prompt engineering and induce context-based responses. GPT-Knowledge is a pre-training input interface that helps to input structured and unstructured data into the GPT-4o model in a structured form, and it is useful for increasing the model's information accessibility and understandability (Yang et al., 2022). GPT-Knowledge was used to analyze the difference from the Zero-shot model in which responses are derived without prior information. Specifically, the local news data used in this study was from April 2023 to September 2024, after the lifting of the indoor and public transportation mask-wearing obligation due to COVID-19. This was set to exclude the impact of the epidemic and to consider the daily living standards of ordi-

nary citizens. To collect the content, data crawling was conducted with 'Wangsimni-Haengdang Living Facility' as a keyword, and the data was organized in the order of date, news organization, headline, and short text under the title. Finally, out of the 881 total pieces of news data collected, 125 pieces of news crawling data were used after excluding redundant items. For the basic living area data, the content corresponding to the local resident participation workshop of the '2030 Seoul Living Area Plan' and the content corresponding to the Wangsimni-Haengdang local living area were converted to text to be used in the study (Seoul Metropolitan Government, 2018). The news and basic living area data were processed into JSON files. The files include structured data that the LLM model can effectively understand and are composed in the form of key-value pairs (Bsharat et al., 2023). An example of the JSON file used in this study is attached in the <Appendix>.

2. Experimental Design

This study was designed to analyze the effect of the components of the prompt on the quality of the results in the process of deriving LLM-based resident-participatory urban planning. First, this study conducted discussions using an AI agent, set a prompt representing the opinions of actual citizens as an agent, and designed the experiment by specifying three conditions for the agent:

- (1) Whether the age, status, and number of agents are considered
- (2) Whether specific facilities in the area are considered
- (3) Whether news data on the actual local living area is used in training and reflected

Through this process, this study analyzes the qualitative differences in the results of LLM-based urban planning and derives conditions under which the most effective and realistic urban planning is derived.

3. Prompt Engineering

1) Character prompt

In this study, 10 agents were set up using the focus group technique. This is a qualitative research method that collects in-depth opinions on a specific topic through a small group

with similar backgrounds or interests (Jin and Guo, 2024). This study employed this method to represent the opinions of various citizens. First, to evenly collect opinions by different age groups, the age of the agents was set from teens to seventies so that each age group could reflect the various needs and interests in urban planning. In addition, occupations were set for each group to confirm the conditions of the experimental design. Furthermore, each agent was assumed to be a person who had received education on the living area plan and the role of the participation panel to set the characteristics of the actual resident participation panel, so that the agent could present opinions based on the actual resident participation experience. The character information prompts used in the prompt engineering are shown below.

"Compose the resident participation panel with 10 people as follows.

① a middle school student in their 10s, ② a college students in their 20s, ③ an unemployed person in their 20s, ④ an office worker in their 30s, ⑤ a businessperson in their 30s, ⑥ a professional in their 40s, ⑦ a homemaker in their 40s, ⑧ a self-employed person in their 50s, ⑨ a landlord in their 60s, and ⑩ a senior citizen living alone in their 70s.

Assume that the resident participation panel had received training on the living area plan and the role of the participation panel before exploring local problems and improvement measures."

① An agent in their 10s: A middle school student

Currently, the educational conditions in Seongdong-gu need to be improved due to the lack of middle schools in the new downtown areas and the unequal distribution of small schools in the old downtown areas. In this situation, middle schools such as Dongma Middle School, Haengdang Middle School, and Tonghap Middle School are densely located. The agent in their 10s was set up to speak for the students and present the perspectives on housing and living facilities.

② An agent in their 20s: A college student

Seongdong-gu has a large college district centered on Hanyang University, and a large proportion of college students live and study in Seongdong-gu. In particular, Seongdong-gu actively operates employment and start-up support programs for young people. Therefore, an agent

who is a college student was set up to reflect the needs of various housing and living infrastructure that young people demand in urban planning.

③ An agent in their 20s: An unemployed person

According to the annual employment trend in 2020, the unemployment rate in 2020 increased in the 30s, 60s and older, 20s, 40s, and 50s, rising by 0.7%p year-on-year, and the unemployment rate for the age group of 25 to 29 increased by 1.1%p year-on-year (Gyeongin Regional Statistics Office, 2021). In addition, according to the major employment indicators of the regional employment survey by city, county, and district in the second half of 2021, Seongdong-gu's unemployment rate was 5%, which was the 8th highest in Korea (Statistics Korea, 2022). This means that Seongdong-gu has a high youth unemployment rate, and therefore, an agent was set to be an unemployed person in their 20s in order to derive related opinions.

④ An agent in their 30s: An office worker

Seongdong-gu is a region where various industries and companies are concentrated around Seongsu-dong, and office workers and service workers account for a large proportion. The office worker agent was set up to reflect the actual needs of the region, such as transportation, commercial facilities, and work environment.

⑤ An agent in their 30s: A businessperson

The number of businesses in Seongdong-gu increased by approximately 51% from 27,278 in 2017 to 41,306 in 2022 (Seongdong-gu Office, 2019; Seongdong-gu Office, 2024). Among them, the number of businesses operated by the age group between 30 and 39 increased by approximately 90% during the same period, which is a higher growth rate than other age groups. Therefore, an agent was set up to represent the demand for facilities related to business and commerce.

⑥ An agent in their 40s: A professional

According to the Seoul Metropolitan Government Basic Statistics (2025), the number of professional scientific and technical service industry workers in Seongdong-gu increased by about 97% from 11,663 in 2017 to 23,007 in 2023, marking the third highest growth rate among Seoul's

autonomous districts. As of 2023, the number of businesses operated by people in their 40s is the highest as 869 out of a total of about 2,522 (Seongdong-gu Office, 2025). Therefore, it was determined that the spatial aspect of Seongdong-gu requires the intervention of people in their 40s in the relevant industry, and so an agent who is a professional was set up.

⑦ An agent in their 40s: A homemaker

Homemakers are important members in the community, and because they take care of the household and are closely connected with the community, they can react sensitively to various urban issues such as housing, public facilities, transportation, education, and welfare. In particular, they are active in the local community, and through interactions with other local residents, they share various opinions on urban planning and can serve as mediators capable of reflecting these opinions in the urban planning process.

⑧ An agent in their 50s: A self-employed person

According to statistics on the status of business activities in Seoul (by autonomous district), Seongdong-gu showed rapid commercial expansion, with the number of operating stores increasing by about 105% from 11,698 to 23,997 from 2018 to 2022, which is higher than the average growth rate in Seoul (about 85%) (Seoul Metropolitan Government, 2022). In addition, the number of employees increased by about 14% from 4,191 to 4,794 during the same period, which represents the growth pattern of retail and restaurant business. In this context, when comparing the number of wholesale and retail businesses and accommodation and restaurant businesses and their employees in Seongdong-gu in 2023 by age group, those in their 40s were the highest with 4,552 businesses and 15,113 employees, followed by those in their 50s with 3,840 businesses and 15,850 employees (Seongdong-gu Office, 2025). Therefore, it was determined that self-employed people in Seongdong-gu are mainly composed of middle-aged and older people, and thus an agent who is a self-employed person in their 50s was set to reflect the diversity of age.

⑨ An agent in their 60s: A landlord

In Seongdong-gu, the population of single-person households aged 20-35 accounted for about 41% of the total popu-

lation of 48,111 in 2023 (Statistics Korea, 2024). In addition, many policies and administrative programs are being implemented for various stakeholders such as the government, landlords, and tenants due to gentrification issues (Lee and Choi, 2019; Kim and Ko, 2021). Therefore, in this study, a 60-year-old landlord was set as an agent to analyze the possibility of reproducing discussions based on the landlord-tenant relationship and imitating their interests.

⑩ An agent in their 70s: A senior citizen living alone

The number of single-person households aged 70 or older in Seongdong-gu increased by approximately 36% from 2018 to 2023, which is relatively low among the autonomous districts of Seoul. However, regardless of the current state, the number of senior citizens aged 70 or older living alone in Seongdong-gu continues to increase, suggesting that urban planning must take into account the housing stability and social isolation issues of these senior citizens. In particular, Seongdong-gu is no exception to the overall trend of Seoul where single-person households aged 70 or older are increasing in all autonomous districts, and it is essential to reflect the opinions of senior citizens living alone to secure the quality of life of the elderly and the inclusiveness of the local community. Therefore, a senior citizen living alone was set up as an agent.

2) Area set-up prompt

In this study, we designed a prompt centered on the Wangsimni-Haengdang areas of Seongdong-gu and conducted prompt engineering that reflected the characteristics of the area. The Wangsimni-Haengdang area has a composite urban structure with densely located residential, commercial, and public facilities, and there are various facilities closely related to the daily living of the residents in the area. Based on this, this study determined that it was important to include the specific characteristics of the area in the prompt to discuss how local characteristics and facilities within the living area can be reflected in urban planning.

For GPT-4o, data up to September 2023 is included in the model's training process. The training is performed by collecting and learning most of the documents existing on the Internet, so it can be judged that the AI model has been trained also with information about trends in Korea. For example, it was confirmed that when asked about land-

marks in Seongdong-gu, GPT-4o generated actual place names and supplementary explanations, such as Seoul Forest, Ttukseom Hangang Park, Mr. Eungbong, and Seongsu-dong Cafe Street. Based on this, the prompt was designed to include the characteristics of individual areas as components of the prompt, such as living convenience, status of public facility use, transportation accessibility, and layout of commercial facilities that local residents actually experience, in line with the characteristics of each area, to accurately reflect the realistic needs of urban planning. Through this, more specific and substantial results can be derived in discussing unique local challenges as well as development directions of the areas.

3) Data input prompt

In this study, the prompt was designed so that data can be directly input into the interface of GPT-4o to effectively generate results. This approach goes beyond simple question-and-answer and aims to induce the model to understand and interpret structured data related to urban planning. The data input prompt is significant as a data-based decision-making support prompt design. The news crawling data and Wangsimni-Haengdang basic status data were provided to the LLM, and at the same time, the effect of data inclusion on the consistency of the generated results and practical policy proposals was verified according to the presence or absence of a prompt to generate results based on the data. Through this, the effect of the input data composition method on the model's response quality and usability was analyzed, and the methods of applying generative AI were also investigated to contribute to the establishment of a policy design and decision-making support system in the field of urban planning.

4) Final prompt

The final prompt was specified step by step, as shown in <Table 1>. The prompt specification process is critical because the topic of the present study is to reflect the opinions of local residents in urban planning through AI. Therefore, the prompt specification was carried out such that the necessary information was systematically added in each step, and the specific indicators that AI may refer to when deriving answers related to urban planning were enhanced in stages. This is an essential process for obtaining more

Table 1. The process of prompt specification

Category		Prompt specification conditions according to data utilization			
		Not used		Used	
Local characteristics		Not used		Used	
News data		Not used	Used	Not used	Used
Agent information	2 agents	Lv1	Lv4	Lv7	Lv10
	5 agents	Lv2	Lv5	Lv8	Lv11
	10 agents	Lv3	Lv6	Lv9	Lv12

in-depth and accurate responses, and the goal is to sufficiently reflect the diverse opinions and demands of local residents.

The step-by-step specification process was carried out through the flow described below. In the first step, only the general situation setting is provided, and in subsequent steps, specific character information, number of agents, characteristics of each area, and details on the presence or absence of data were gradually added. In the case of Lv1, only the smallest number of character information and minimum data were considered. Accordingly, the Lv1 prompt includes the main content of the discussion, area information, character information for two agents, and the discussion process. On the other hand, the Lv12 prompt, which is the most specified one, utilizes both area characteristics and news data and includes character information for ten agents. In this way, the number of characters and data appropriate for each step were added to the prompt content for each step. This step-by-step addition plays an important role in increasing the depth and consistency of the responses by gradually providing the context and details necessary for the AI to derive the answers.

This study verified various aspects of the diverse personal information and discussion methods presented in 1) of Methodology 3. Through this, various methods were analyzed to find the most suitable combination of prompts, and as a result, the step-by-step method shown in <Table 1> was found to be the most effective. Each item of prompt engineering is shown in <Table 2>.

Table 2. Prompt Engineering item dictionary

Category	Description
General	Overall content description, explanation of the workshop
Agent information	Number of agents, age, occupation, criteria for discussion participation
Discussion format	Number of statements, length of speech, style of discussion
Local characteristics	Consideration of specific characteristics of the Wangsimni-Haengdang area
News data	Criteria in consideration of the data provided through the GPT interface

Lv1 Prompt

- From now on, I'm going to use you to simulate a citizen participation workshop. This workshop consists of a group called the resident participation panel. The panel is an organization that is formed to ensure procedural legitimacy in the process of developing a living area plan and to establish governance, thereby preparing a tailored plan that well reflects the opinions of the local residents who are familiar with the area's characteristics and current conditions. The workshop encourages voluntary and active participation, allowing residents to take the lead in exploring local issues and envisioning the future. Rather than a consulting session for providing answers, the workshop serves as a forum for open discussion in which diverse opinions on urban planning are respected.
- Now, two residents living in the Wangsimni-Haengdang living area will participate in the resident participation panel and discuss the living and service facilities in the living area. The administrative dong included in the Wangsimni-Haengdang living area are Wangsimni Doseon-dong, Wangsimni 2-dong, Haengdang 1-dong, Haengdang 2-dong, and Eungbong-dong.
- The resident participation panel consists of a college student in their 20s and a landlord in their 60s. At this time, we will assume that this resident participation panel has received training on the living area plan and the role of the resident participation panel before exploring local problems and improvement measures.
- The discussion will be conducted in three rounds, and each participant will have three speaking opportunities. The discussion will be conducted in Korean, and each statement will be approximately 300 characters long.

Lv12 Prompt

- From now on, I'm going to use you to simulate a citizen participation workshop. This workshop consists of a group called the resident participation panel. The panel is an organization that is formed to ensure procedural legitimacy in the process of developing a living area plan and to establish governance, thereby prepare a tailored plan that well reflects the opinions of the local residents who are familiar with the

area's characteristics and current conditions. The workshop encourages voluntary and active participation, allowing residents to take the lead in exploring local issues and envisioning the future. Rather than a consulting session for providing answers, the workshop serves as a forum for open discussion in which diverse opinions on urban planning are respected.

- Now, ten residents living in the Wangsimni-Haengdang living area will participate in the resident participation panel and discuss the living and service facilities in the living area. The administrative dong included in the Wangsimni-Haengdang living area are Wangsimni Doseon-dong, Wangsimni 2-dong, Haengdang 1-dong, Haengdang 2-dong, and Eungbong-dong.
- The resident participation panel consists of a middle school student in their 10s, a college student in their 20s, an unemployed person in their 20s, an office worker in their 30s, a businessperson in their 30s, a professional in their 40s, a homemaker in their 40s, a self-employed person in their 50s, a landlord in their 60s, and a senior citizen living alone in their 70s.
- We will assume that this resident participation panel has received training on the living area plan and the role of the resident participation panel before exploring local problems and improvement measures.
- The discussion will be conducted in three rounds, and each participant will have three speaking opportunities. The discussion will be conducted in Korean, and each statement will be approximately 300 characters long.

4. Evaluation of Results

In this study, evaluation indicators were set up for evaluating the results generated through prompt engineering. Existing natural language processing models used consistency, conformity, relevance, and evidence as human evaluation items for evaluating the quality of generated text (Wang et al., 2020; Fabbri et al., 2021). Based on the previous reports, six evaluation indicators were selected in this study to evaluate how well the LLM-generated answers reflect the actual local characteristics, and these were set with a focus on how consistently they operate according to the agent and prompt conditions. Each item is scored out of 10 points, with points deducted based on specific indicators such as accuracy and logical consistency.

1) Logical consistency

In logical consistency, the opinions presented by LLMs are evaluated by how logical the ground of the opinions are. Scores are given based on whether the arguments are presented based on clear and valid grounds, or whether they contain ambiguous or illogical content. The full score is 10

points, and 10 points are given when the answer has clear logical grounds. Points are deducted when the answer is not logical.

2) Accuracy

Accuracy is a factor for evaluating the factual ground of the answers provided by the LLM. It focuses on evaluating whether the LLM reflects the local information well and whether the answers include facilities or information that do not actually exist, due to hallucination. For example, points are deducted for answers that mention facilities that do not exist in the area or include incorrect geographical information. The full score is 10 points, and 10 points are given when accurate information related to facilities that actually exist in the area is provided. Points are deducted when incorrect information is included in the answer.

3) Interactivity

In interactivity, the form in which AI-generated agents share opinions and assert their own opinions during the discussion process is evaluated. Citizen participation deals with issues related to the daily lives of citizens; therefore, it is necessary to promote in-depth discussion and problem solving through interactions with each other rather than simply presenting opinions. Accordingly, the interaction between agents is evaluated based on a full score of 10, and points are deducted when interaction is not evidently exhibited.

4) Persona reflection

How well the agent's characteristics are reflected in the LLM's response is evaluated. Each agent reflects social roles such as age and occupation, and it is evaluated whether the response was well generated based on the social roles and how much the agent's characteristics affected the response generation. A score is given based on whether the opinion presented by an agent is suitable for the agent. The full score is 10 points.

5) Local context reflection

In this evaluation item, how well the generated response reflects the characteristics of the area is evaluated. Different scores are given based on whether the response presents content unrelated to local characteristics or it reflects the

special circumstances of the area well. In addition, how well the response reflects the content included in the data and whether it reflects the local characteristics within the Wangsimni-Haengdang living area are evaluated. The full score is 10 points, and points are deducted when non-existent content is arbitrarily generated or irrelevant content is included. Specifically, 10 points are given for a plan that reflects local characteristics well, and points are deducted when it is a general plan that is also applicable to other areas.

6) Prompt reflection

Evaluation is carried out on how faithfully the LLM followed the discussion conditions stated in the prompt and whether the LLM reflected the prompt to reflect the data provided. In particular, the faithfulness of the agent's performance is evaluated, such as the number of discussion rounds, whether the agent actually participated in the discussion, and the appropriateness of the statement length. Based on a full score of 10, points are deducted when the conditions are not met.

Based on the above-described criteria, the overall performance of the LLM agent-based citizen participation discussion process was evaluated by adding up the scores of individual evaluation items. Accuracy, local context reflection, and logical consistency play an important role in evaluating the reliability of the LLM-generated answers, while interactivity and persona reflection measure how faithfully the agents perform their role in a specific situation. In addition, prompt reflection is an important criterion for determining how faithfully the LLM follows the given constraints.

IV. Analytical Results

1. Evaluation of Prompt Results

In this study, the prompt was specified at a total of 12 levels according to the prompt specification process presented in <Table 1> and then utilized. The prompt result evaluation was conducted based on the results of Lv10, Lv11, and Lv12, the highest specification levels, by varying only the number of agents in a situation where all available data such as news and living areas were included.

First, the summary of the Lv10 prompt results, obtained

by giving specific conditions and setting the number of agents to 2, are shown below, and the full text is attached in the <Appendix>.

Lv10 prompt results – Two agents (a college student in their 20s and a landlord in their 60s)

1) Statement 1 by the college student in their 20s: I am a college student living in Wangsimni 2-dong. I have recently felt that the residential environment of this area has changed a lot. In particular, with the construction of large apartment complexes such as 'Lacervo Prugio Summit,' the area around Wangsimni Station is becoming more and more luxurious, but the problem is that the living convenience facilities are still insufficient. ... (omitted) ... In particular, the cafes concentrated around Hanyang University are too crowded, and it is difficult to find a quiet space for study. As new redevelopment areas increase, I think we need more cultural spaces or resting spaces for college students. ... (omitted) ...

2) Statement 1 by the landlord in their 60s: I am a landlord and have been running a commercial building in Haengdang 2-dong for a long time. I agree with some of the college student's opinions, but I see it from a slightly different perspective. Recently, with the construction of luxury apartments such as 'Lacervo Prugio Summit,' the commercial district around Wangsimni has developed significantly. ... (omitted) ... In the past, small stores mainly targeted students and low-income earners, but now a more diverse range of consumers are coming in. However, I think the issue of study spaces that the college student mentioned is also important. As the area develops, commercial facilities and residential environments are improving, but it is true that there is a lack of public services or small community spaces. ... (omitted) ... I think that customized service facilities that can supplement this are necessary.

3) Statement 2 by the college student in their 20s: As you said, local development certainly has positive aspects, but I feel that the development does not benefit all residents. In particular, I often visit Wangsimni Station and Hanyang University, and I feel that the living service facilities in this area are developing only for commercial purposes. ... (omitted) ... Rather than living-oriented services that existing residents around Haengdang-dong can easily utilize, I feel that there are more high-end facilities targeting people of the high-income class who are new to this area. In addition, although Hanyang University Hospital and medical shopping centers are nearby, accessibility to welfare services such as hospital services and public medical support is still low for low-income families and students. As local development continues, shouldn't we also think about ways to resolve these gaps?

4) Statement 2 by the landlord in their 60s: I completely agree with the college student's opinion. As local commercial districts become more luxurious, I understand the sense of alienation felt by existing residents, younger generations, and especially students. ... (omitted) ... In order to solve this problem, I think local communities and public institutions should work together to enhance public infrastructure. For example, Seoul Metropolitan Government and Seongdong-gu Municipal Government should consider ways to expand public community centers and provide spaces that younger generations and low-income residents can

use at a low cost. In addition, it seems that efforts are needed from the private sector to provide convenient living facilities that can accommodate various classes. ... (omitted) ...

5) Statement 3 by the college student in their 20s: After listening to the landlord, I agree that regional development should not stop at mere commercial development but should also expand public infrastructure so that all residents can benefit fairly. ... (omitted) ... Since the Wangsimni Station area has convenient transportation, there is a great influx of people from outside the area in addition to the local residents. So, shouldn't we create public facilities that more people can use? ... (omitted) ... I hope that development will be carried out such that both the young people who study and live in this area and those who have lived there for a long time can benefit.

6) Statement 3 by the landlord in their 60s: After hearing the college student's opinion, I also had a lot to think about. ... (omitted) ... In the past, there used to be small parks, shelters, and community centers where residents often gathered, but many of them disappeared as redevelopment progressed. This change is also a concern for landlords like me. It is positive that commercial facilities are developing, but I don't think it is desirable for residents who have been living in this area for a long time to be pushed out by high-end facilities, without being able to enjoy the benefits of development together. I think we need to create a balance between the people of the high-income class who are moving into this area and the existing residents. ... (omitted) ...

In 'Statement 1,' the college student agent in their 20s expressed frustration over the lack of study spaces and cultural and resting places for college students. In response, the landlord agent in their 60s in Statement 1 empathized with the college students' sense of the problem and mentioned the need to solve the problem along with the main tasks he thought of. In addition, in subsequent speeches, the agents expressed their opinions based on the personality assigned to each agent for each topic and presented their opinion on the other agent's argument. In particular, in 'Statement 3,' the landlord agent in their 60s generated thoughts about the college student agent's argument in association of the landlord's own problem, thereby deepening the discussion. In the first round, the agents generated their separate opinions on living service facilities. In the second round, the agents mentioned the negative effects of redevelopment and created a discussion on local development that embraces various classes in the area. In the third round, the agents generated the opinion that outsiders should also be taken into consideration, considering that Wangsimni is a transportation hub. Therefore, the results showed that the agents asserted needs based on the positions given to them and developed the discussions

related to living service facilities in consideration of not only the residents in the local community but also outsiders visiting the living area.

Next, in the Lv11 prompt in which the number of agents was increased to five, the interactions were relatively few. A summary of the Lv11 prompt results is show below, and the full text is attached in the <Appendix>.

Lv11 prompt results – Five agents (a college student in their 20s, an office worker in their 30s, a professional in their 40s, a self-employed person in their 50s, and a landlord in their 60s)

1) Statement 1 by the college student in their 20s: I am a college student living in Wangsimni 2-dong. I feel that there is a lack of study spaces and youth-friendly facilities among the living service facilities in this area. ..(omitted).. It is sad that there is little discussion about spaces for young people or convenience facilities for teenagers.

2) Statement 1 by the officer worker in their 30s: I am an office worker living in Haengdang 2-dong. The problem that I feel while commuting to and from work is accessibility to transportation and accessibility to medical facilities. Although transportation is convenient near Wangsimni Station, I think there is a lack of proper medical facilities in the area. ... (continued) ...

3) Statement 1 by the professional in their 40s: I am a professional living in Haengdang 1-dong. People say that this area has a well-developed educational infrastructure, but it seems that more systematic management is needed. For example, there are schools such as Muhak Middle School and Muhak High School, but traffic safety issues between the roads and the schools are serious. ... (omitted) ... Recently, redevelopment projects have been actively carried out, but I am concerned that improvement of the environment around the schools has not been particularly mentioned.

4) Statement 1 by the self-employed person in their 50s: I am self-employed in Wangsimni Doseon-dong. The commercial area is relatively active, but small business owners are having a hard time due to the recent increase in large-scale commercial facilities. As supermarkets and franchises are opening up near Wangsimni Station, the competitiveness of small stores is gradually decreasing. ... (continued)

5) Statement 1 by the landlord in their 60s: I am a resident who has been operating a renting business in Eungbong-dong for a long time. Although the residential infrastructure in this area is developing a lot, the lack of parks and green spaces is a problem. ... (omitted) ... In particular, considering the aging problem of this area, I think that there is an urgent need for leisure facilities and welfare centers for elderly citizens.

6) Statement 2 by the college student in their 20s: I think the Wangsimni area needs public space for young people. Despite being an area with a large youth population, there is a lack of places for young people to study or spend their leisure time. ... (omitted) ...

7) Statement 2 by the officer worker in their 30s: Transportation and medical facility improvement are important issues. First, I propose that the number of small clinics near Hanyang University

Hospital should be increased to reduce waiting time at large hospitals. This will increase medical service accessibility to deal with minor illnesses of non-emergent patients and allow nearby residents to quickly receive medical services. ... (omitted) ... In particular, I think it is necessary to expand the Wangsimni Station to a complex transit center.

8) Statement 2 by the professional in their 40s: I think that improving the educational infrastructure is important. In particular, from the perspective of parents, traffic safety on the roads near Muhak Middle School and Muhak High School should be enhanced. ... (continued)

9) Statement 2 by the self-employed person in their 50s: What I would like to suggest from the perspective of a self-employed person is a policy to protect local commercial businesses. ... (omitted) ... For example, some of the commercial facilities near Wangsimni Station may be preferentially provided to small business owners in order to lower the rents, and promotions may be strengthened so that local residents can use the local commercial businesses. In addition, there is also a need for creating opportunities to revitalize local commercial businesses by periodically holding local festivals or flea markets.

10) Statement 2 by the landlord in their 60s: I hope that welfare facilities for the elderly residents of Eungbong-dong will be expanded. ... (omitted) ... It would be good to additionally provide facilities such as health programs and walking trails that are easily accessible to the elderly. Furthermore, through the park improvement project around Mt. Eungbong, sports facilities and exercise equipment may be installed so that residents can take care of their health ... (omitted) ...

11) Statement 3 by the college student in their 20s: I think the Wangsimni-Haengdang area should develop into a youth-friendly space in the future. Reflecting the characteristics of the area where many college students reside, I hope that facilities that young people can conveniently use will be constructed ... (omitted) ...

12) Statement 3 by the officer worker in their 30s: I hope that the Wangsimni-Haengdang area will become the center of transportation and medical services in eastern Seoul. Since Wangsimni Station is a main transportation hub in Seoul, I think that the area will develop further if a medical cluster is formed along with the complex transit center. ... (omitted) ...

13) Statement 3 by the professional in their 40s: I hope that the Wangsimni-Haengdang area will become the center of education and safety in Seoul. ... (omitted) ... I hope that AI-based traffic management and unmanned surveillance systems will be introduced to create an environment where students can live more safely.

14) Statement 3 by the self-employed person in their 50s: I hope that the commercial businesses of this area will develop in a direction where local residents and small business owners can coexist, rather than being centered on large corporations. ... (continued)

15) Statement 3 by the landlord in their 60s: I hope that the Wangsimni-Haengdang area will develop in the future into a welfare center where the elderly and the young can live together harmoniously. ... (omitted) ... In the future, I hope that this area will develop into a comfortable place for elderly citizens and a vibrant place for young people, and I look forward to it becoming a composite space that satisfies everyone.

In the three rounds of discussion, there was a tendency to generate local issues corresponding to each agent's background. In 'Statement 1', the college student agent in their 20s mentioned learning spaces and youth-friendly facilities, and in the following statements, the agent was arguing only about the youth community centers and startup support centers according to the agent's own needs, indicating that there were no significant interactions with other agents. Regarding the discussion content, there was an advantage that the opinions of various residents were heard. The five agents set in the Lv11 prompt argued about youth, education, infrastructure, commerce, and green space and generated discussion results based on local characteristics and facilities existing within the research scope. The college student agent in their 20s, who emphasized study spaces and youth-friendliness, mentioned cultural spaces, startup support centers, and AR/VR-based learning facilities, and the office worker agent in their 30s mentioned local characteristics such as those of Wangsimni Station and emphasized the harmony of urban infrastructure. These results suggest that universal contents were generated based on the pre-training of the GPT-4o model.

Finally, the results of the Lv12 prompt in which the number of discussion agents was set to 10 are described below.

Lv12 Prompt results – Ten agents (a middle school student in their 10s, a college student in their 20s, an unemployed person in their 20s, an office worker in their 30s, a businessperson in their 30s, a professional in their 40s, a homemaker in their 40s, a self-employed person in their 50s, a landlord in their 60s, and a senior citizen living alone in their 70s)

1) Statement 1 by the middle school student in their 10s: The Muhak Middle School I attend is close to the Wangsimni-Haengdang area, which is good, but there are not enough facilities for teenagers to spend time after school. It would be nice if there is a youth culture center or library where I can stay for a while before going to the academy with my friends. Most of the cafes and stores around here are for adults, so I think there are not enough places for teenagers to use comfortably.

2) Statement 1 by the college student in their 20s: The area is close to Hanyang University, so it is easy to access for college students, but there are not many cafes or study cafes that I can frequently use. It is inconvenient because there are not enough places to kill time between school and home. There are many commercial facilities near Wangsimni Station, but I wish there were more affordable restaurants and convenient facilities for students.

3) Statement 1 by the unemployed person in their 20s: Preparing

for employment these days, I often go to the Wangsimni Station area, but there are not many public facilities to use. In particular, welfare services for low-income earners or the unemployed or employment-related support centers are not visible. I wish the community center or district office would provide more accessible employment support programs or meeting spaces.

4) Statement 1 by the office worker in their 30s: The area around Wangsimni Station is a good place for workers to commute to work, but it lacks cultural facilities to enjoy after work. There is a movie theater, but it would be nice if there are more cultural centers and sports facilities where people can enjoy leisure activities more. Also, if you go toward Haengdang-dong, the roads are narrow and there is not enough parking, so it is inconvenient to move around after work.

5) Statement 1 by the businessperson in their 30s: As I run a business, I am interested in facilities connected to commercial areas, but the Wangsimni-Haengdang area has many old commercial areas and many places that require remodeling. In particular, the commercial area near Wangsimni Station, where many customers visit, is active, but other areas are less accessible. I am looking forward to seeing whether the newly opening 'Lacervo Prugio Summit' apartment complex can contribute to the revitalization of the commercial area, but I think that connections with existing commercial areas should also be taken into consideration.

6) Statement 1 by the businessperson in their 30s: I work at a hospital, and the Wangsimni-Haengdang area is well equipped with medical infrastructure. However, it seems that more facilities are needed to respond to emergencies. In addition, as the number of patients visiting the hospital increases, traffic congestion is also getting worse. Accessibility to the hospital and the surrounding commercial and residential areas needs to be improved, and traffic improvement is also needed.

7) Statement 1 by the homemaker in their 40s: From the child-rearing perspective, there is a lack of facilities for children in the Haengdang-dong and Eungbong-dong areas. In particular, there are almost no play facilities or learning spaces for toddlers or elementary school students. The Wangsimni Station area is centered on commercial facilities for adults, so I wish there were more spaces for families to enjoy together.

8) Statement 1 by the businessperson in their 30s: What I feel while running a business is that there is a large floating population in the Wangsimni Station and Haengdang-dong areas, but there are not many places where people can actually stay. In particular, there is a lack of cultural facilities or rest areas that can be enjoyed indoors when the weather is not so good. The existing old commercial areas also seem to need modernization, and the lack of parking facilities is also a big problem.

9) Statement 1 by the landlord in their 60s: One thing I feel while working in the rental business is that tenants tend to have difficulty settling down for a long time. This is because the facilities are old and the surrounding environment is not improving rapidly. In particular, I am worried that the vacancy rate of commercial spaces will increase due to issues related to parking difficulties and aging buildings. I think that we need remodeling support programs or environmental improvement actions to satisfy tenants.

10) Statement 1 by the senior citizen living alone in their 70s: For senior citizens like me who live alone, the Wangsimni-

Haengdang area is a bit inconvenient. There are not enough proper senior welfare facilities or shelters, so we mostly stay at home. There are almost no places we can use when we go out. I wish there were places like cafes or small libraries that senior citizens can utilize comfortably.

In Lv12, unlike Lv10 and Lv11, the agent's speech was performed only once, and independent results were generated for each agent without interaction. This may be because the amount that can be generated at one session is limited during the prompt generation process. However, the age and occupation characteristics of individual agents were well reflected like Lv10 and Lv11, and the types of necessary facilities were generated differently for individual agents.

In summary, the evaluation results showed that the content and contextual quality of the results generated by the AI increased depending on the degree of specificity of the prompt. This indicates that the agent's characteristics may be well reflected according to the set-up conditions and suggests that it is possible to represent a specific class of citizens through prompt engineering. However, as the number of set agents increased, the interactivity was lowered. To solve this problem, it may be necessary to subdivide the prompt engineering process or employ an LLM that has been trained with the discussion process.

2. Expert Evaluation of Prompt Results

In this study, to evaluate the results according to the level of specificity of the prompt, six indicators were set, as shown in <Table 3>: 'logical consistency,' 'accuracy,' 'local context

reflection,' 'persona reflection,' 'prompt reflection,' and 'interactivity.'

To compare the prompt results from Lv1 to Lv12 based on these six indicators, 20 evaluators residing in Seongdong-gu and majoring in urban planning were selected for evaluation. The 20 evaluators consist of undergraduate, master's, and doctoral students majoring in urban planning. The evaluation was carried out by evaluating the results of the 12 combinations of ChatGPT4o prompt scenarios using the six indicators. The prompts and the full text results from Lv1 to Lv12 were provided to individual evaluators, who were requested to provide subjective evaluations for the six indicators on a Likert scale score ranging from 1 to 10 (Van der Lee et al., 2021). Specifically, the evaluators were asked to provide scores starting from the basic 10 points and deducting points according to conditions, and the average response scores were calculated for each prompt and indicator. The evaluation results for each indicator are shown in <Table 4> and <Figure 2>, and the specific details for each indicator are shown below.

1) Logical consistency

Logical consistency was highly evaluated for most results; however, it was relatively low at 6 points for Lv3, Lv6, and Lv9 prompts, in which the number of agents was 10, and the most specific Lv12 prompt. These evaluation results suggest that the more specific the prompt, the more logical consistency can be secured, underscoring the importance of prompt specification. Conversely, when the number of agents increases, logical consistency may be low due to limitations in the generated results.

Table 3. Prompt evaluation criteria

Category	Description
Logical Consistency	Evaluates whether the arguments made by AI-generated personas exhibit a coherent logical structure. Assesses whether claims and supporting evidence are organically connected.
Accuracy	Assesses whether the information or claims presented are fact-based. Evaluates if discussions are developed using accurate and reliable information.
Interactivity	Evaluates whether each participant (persona) appropriately responds to others' opinions. Assesses awareness of conversational context and relevant reactions.
Persona reflection	Evaluates how well the characteristics of personas defined in the prompt are reflected in the generated outcomes.
Local context reflection	Assesses whether the discussion incorporates characteristics specific to the Wangsimni-Haengdang area based on real-world news data and its integration into the dialogue.
Prompt reflection	Evaluates whether the generated outcomes adhere to the instructions specified in the prompt, including discussion objectives and speaking rules.

Table 4. Expert ratings on prompt-generated results

Category	Mean evaluation scores of generated outputs according to levels of prompt specificity (Lv)											
	Lv1	Lv2	Lv3	Lv4	Lv5	Lv6	Lv7	Lv8	Lv9	Lv10	Lv11	Lv12
Logical consistency	8.15	7.20	6.40	8.55	8.15	6.35	7.45	8.20	7.30	8.60	7.60	6.90
Accuracy	6.75	6.30	5.80	7.85	7.45	6.25	7.00	7.60	6.35	8.00	7.30	7.05
Interactivity	5.85	2.30	2.50	6.15	5.65	2.75	3.30	2.60	2.20	6.20	2.95	2.85
Persona reflection	8.65	7.70	7.20	8.35	8.35	6.65	7.65	8.25	7.75	8.40	8.25	8.30
Local context reflection	6.40	5.85	5.10	7.40	7.15	6.10	7.80	7.75	6.65	8.30	7.85	7.30
Prompt reflection	7.55	7.35	6.75	8.50	8.25	6.35	7.45	7.70	6.90	8.95	7.90	6.70

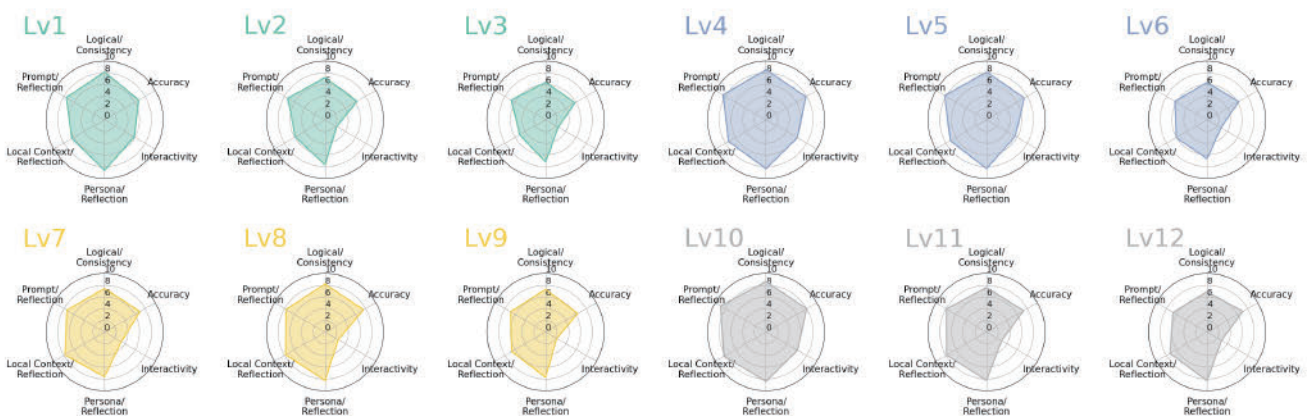


Figure 2. Summary of expert ratings on prompt-generated results

2) Accuracy

The accuracy of the prompts was high in Lv4, Lv5, Lv7, and Lv8, which specified one or more conditions. These evaluation results are consistent with previous studies that show that good results were produced when prompts were presented specifically, and the same results were found in human-imitation prompts (Bsharat et al., 2023). The results suggest that answers related to actual local problems were derived from high-accuracy prompts based on the given data.

3) Interactivity

Interactivity was evaluated highest for Lv4 and Lv10 prompts with the smallest number of agents. These results mean that under these conditions, reflection of opinions and active interaction between agents occurred, and logical and reasonable conclusions were derived through this. However, when the number of agents was 5 or 10, interactivity was evaluated relatively low, which suggests that setting multiple agents in a single model may increase the possibility that opinions between agents are not sufficiently reflected, and only independent opinions are presented.

4) Persona reflection

The persona reflection was evaluated highly in the high 7s in most results. This shows that the characteristics of the persona set in the prompt were well reflected in general, and each agent generated answers that matched the social background or interests of the persona. In other words, the model employed in the study was capable of successfully reflecting the universal and reasonable background of the persona set.

5) Local context reflection

In terms of local context reflection, Lv7 and Lv8 prompts that considered local characteristics and Lv10 and Lv11 prompts that additionally considered news information were evaluated highly at the high 7s and low 8s, respectively. When local context and news data were not utilized, the local context reflection was as low as 5s to 6s. These results suggest that information and data added in the prompt specification process can significantly contribute to the generation of results reflecting local context. Conversely, when local context was equally considered, the local context

reflection was evaluated as lower as the number of agents increased, suggesting that agents more than a certain number may have a negative impact not only on the generation of results but also on the utilization of additional information.

6) Prompt reflection

Finally, the prompt reflection was evaluated highly for Lv4, Lv5, and Lv10 prompts, showing that the guidelines and conditions required for discussion were effectively reflected in the answers under these conditions. As with the previous indicators, prompt reflection was evaluated relatively low when the number of agents was ten, suggesting that as the number of agents increased, the model failed to follow the given guidelines and conditions but generated universal results.

7) Summary of evaluation results

Overall, the results of Lv4 and Lv10, which set a small number of discussion agents and presented specific prompts, were evaluated as the best, recording high scores in all indicators. However, when the number of agents was set to 10, the scores were relatively low in all indicators, and the prompts were evaluated as not providing sufficient context and specificity. In other words, the fewer the number of agents, the higher the interactivity between agents, and the more specific the prompts, the more logical and accurate results can be obtained.

V. Conclusions

1. Discussion and Conclusions

This study analyzed the possibilities and limitations of citizen participation in urban planning using the GPT-4o model and prompt engineering. Specifically, through prompt content specification, a discussion process representing citizen participation was presented under various conditions, and the generated results were evaluated with various indicators. Regarding prompt content specification, the accuracy, local context reflection, and logical consistency tended to increase as discussion conditions, age and occupation of agents, and local context data were added step by step. This suggests that such specified prompts can gener-

ate good results by inducing participants to recognize the realistic problems of the area more accurately and to logically present feasible improvement measures. On the contrary, it was confirmed that as the number of agents increases, the interactivity between the personas decreased, and problems such as decreased local specificity in the generated results occurred. Through this, it was demonstrated that a small number of agents can be more effectively utilized to present more specific results when a single model is used. The major implications of the study are described below.

First, an LLM-based urban planning process may be established to set up virtual personas reflecting various backgrounds and occupations in order to collect broader and more in-depth opinions. Through this, substantial citizen participation may be expected. Due to the limitations of the existing method, it is difficult to reflect the background and environment of individual citizens in an actual resident participation workshop. However, the LLM-based agent employed in this study can effectively derive various perspectives and interests by setting specific conditions. This methodology supports more comprehensive decision-making in the urban planning process and suggests the possibility of reflecting the voices of various citizens. It is also suggested that the new methodology can replace or supplement citizen participation through prompt engineering in future urban planning processes.

Second, an LLM may be utilized to provide real-time data analysis and feedback systems and propose a dynamic and adaptive urban planning process. In this study, social requirements were considered by reflecting local issues and residents' demands to the agents by utilizing news data and local living area data. In other words, an LLM enables flexible plans to be prepared that adapt to the changing urban environment by reflecting real-time issues and providing immediate feedback using various data including text. When such additional information is considered, more detailed results may be presented for target areas of urban planning. Therefore, various data may be actively utilized in prompt engineering to establish a more precise and complex urban planning process.

Third, the LLM-based urban planning approach can contribute to cost saving and efficiency improvement. While the existing citizen participation process is time-consuming

and costly, LLMs can automatically collect and analyze citizens' opinions, thereby making decision support more efficient. This approach simplifies the overall urban planning process and allows for the reflection of diverse citizen opinions in an economical way.

In summary, this study suggests that citizen participation-type urban planning using an LLM can reflect diverse citizens' voices and promote sustainable urban development and that LLM can be used as an important tool in urban planning.

2. Limitations of Present Study

The present study has the following limitations.

First, although the local context reflection slightly differed depending on the prompt, universal results that can be applied to other regions were presented in general. In the case of LLM models, it is difficult to specifically confirm the source of the presented answers due to the model limitations. Therefore, additional prompt engineering processes such as inputting the type of data to be used may be needed in the future to accurately reflect local characteristics. In addition, the problems and improvement plans presented in the discussion results were generally similar. This may be considered as the consistency of the GPT-4o model, but it may be the result of training the model by repeatedly entering similar prompts. Further verification of the model's consistency can be carried out through future experimentation.

Second, the discussion process was not sufficiently considered in this study, and the discussion process specified in this study insufficiently represented the discussion process during actual resident participation workshops attended by about 10 participants for each administrative dong. Specifically, the prompt results when the number of agents was set to five or ten tended to only present their own opinions without showing empathy or opposition to each other's arguments, despite the fact that the discussion method was specifically presented. These results reveal the limitations of creating multiple agents from a single model. Furthermore, it was confirmed that the more agents, the lower the quality of the generated results in terms of various result indicators. To solve this problem, further research may need to be conducted such as using multiple model agents or presenting different discussion methods through a single model.

Finally, this study attempted to precisely identify the detailed differences between the evaluation items using a 10-point Likert scale. Since the rating was performed in this study by deducting points according to the degree of compliance with the evaluation items based on a maximum of 10 points, the direction of interpretation may differ depending on the respondent's evaluation criteria, and there may be differences in the interpretation when compared with existing studies. In addition, although the agents were defined comprehensively so that the application subjects of the study were broad, due to the limitations of the preliminary study, the results were compared and analyzed through expert evaluation rather than a survey conducted with similar subjects, which may limit the generalization of the results and suggest the need to consider the similarity of human evaluators in future studies.

In future studies, the limitations of the present study may be overcome, and a more specific discussion process may be provided by specifying the input data and further reviewing the prompt engineering process. In addition, higher performance may be achieved through fine-tuning or retrieval-augmented generation (RAG). Fine-tuning is a method of performing training by adding a dataset to an existing LLM to ensure task suitability in a specific field, and RAG is a methodology for improving the ability to identify information relationships among relevant facts by connecting an external database for a specific field. Through this, prompts may be further specified to improve the quality of LLM-based discussion results, reduce universality of generated results, and prevent hallucination that generates incorrect information.

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Appendix

An example of the JSON files used in the present study is shown below.

```
{
  "Goal": [
    "Vitalization of Seongsu-dong semi-industrial area and fostering of local development hub",
    "Reorganization of residential areas along the Han River and promotion of development projects",
    "Establishment of green transportation system and improvement of landscape",
    "Reorganization of the handmade shoes street and prevention of gentrification",
    "Fostering specialized resources in the Seoul Forest area"
  ],
  "Strategy": {
    "Strengthening of downtown high-tech industrial functions and management of mixed residential-industrial areas": {
      "Introduction of IT convergence digital industry": [
        "Attracting advanced knowledge-based industries through district unit planning, etc.",
        "Reviewing rental housing locations for youth and workers"
      ],
      "Preservation and fostering of local specialized industries": [
        "Making policies to support existing industries such as handmade shoes and printing"
      ],
      "Improving the environment of mixed residential-industrial areas": [
        "Reorganization of worn-out facilities, environmental improvement, and support for small-scale manufacturing businesses"
      ]
    },
    "Improving environment for industrial workers through promotion of regeneration projects, etc.": {
      "Revitalization of industrial regeneration and urban regeneration": [
        "Factory facility regeneration and small business support",
        "Improvement of handmade shoe industry and pedestrian environment",
        "Formation of Seoul Forest-Konkuk University Station specialized street"
      ],
      "Landscape improvement": [
        "Installation of landscape lightings utilizing lower portions of subway line 2 bridge piers",
        ],
      "Facilitating Seongsu Strategic Redevelopment Area redevelopment project": {
        "Connecting redevelopment project to waterfront space": [
          "Review of securing waterfront public land and improving accessibility"
        ]
      },
      "Inducing Seongsu-dong resident-participation type town regeneration": {
```

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    "Improvement of worn-out residential areas": [
      "Resident-participation type urban regeneration and strengthening of community functions"
    ]
  },
  "Strengthening the linkage system between major local resources": {
    "Connection of hubs and improvement of bicycle lanes": [
      "Connection of Han River-Jungnang Stream-Seoul Forest and expansion of bicycle lanes"
    ]
  },
  "Organization and revitalization of handmade shoe street": {
    "Establishment of street maintenance and support system": [
      "Installation of convenience facilities, maintenance of traffic routes, establishment of industrial cooperation body"
    ]
  },
  "Anti-gentrification policy": {
    "Location regulation measures such as win-win agreements": [
      "Establishment of resident council and suppression of franchise inflow"
    ]
  },
  "Specialization of cafes and workshops around Seoul Forest": {
    "Maintaining street environment and improving accessibility": [
      "Inducing opening of workshops, ensuring pedestrian passageways",
      "Connection to local festivals"
    ]
  },
  "Utilization of development-available land around Seoul Forest": {
    "Creation of composite cultural space": [
      "Development of park and cultural complex on Sampyo Ready-Mix Concrete site"
    ]
  }
}
}
```

The full text of the results generated from the Lv10 prompt (two agents (college student in their 20s and landlord in their 60s)) of this study is show below.

1) **Statement 1 by the college student in their 20s:** I am a college student living in Wangsimni 2-dong. I have recently felt that the residential environment of this area has changed a lot. In particular, with the construction of large apartment complexes such as 'Lacervo Prugio Summit', the area around Wangsimni Station is becoming more and more luxurious, but the problem is that the living convenience facilities are still insufficient. For example, there are many commercial facilities near Wangsimni Station, but there are almost no study cafes or small places

for reading books that college students can use at low cost. In particular, the cafes concentrated around Hanyang University are too crowded, and it is difficult to find a quiet space for study. As new redevelopment areas increase, I think we need more cultural spaces or resting spaces for college students. It is also unfortunate that small libraries and other facilities that used to be in the neighborhood have disappeared due to redevelopment.

2) **Statement 1 by the landlord in their 60s:** I am a landlord and have been running a commercial building in Haengdang 2-dong for a long time. I agree with some of the college students' opinions, but I see it from a slightly different perspective. Recently, with the construction of luxury apartments such as 'Lacervo Prugio Summit,' the commercial district around Wangsimni has developed significantly. Of course, there is the obvious problem of rising rents in gentrifying areas, but as a landlord like me, I cannot ignore the fact that the area's economic vitality is also greatly improving. For example, in the past, small stores mainly targeted students and low-income earners, but now a more diverse range of consumers are coming in. However, I think the issue of study spaces that the college student mentioned is also important. As the area develops, commercial facilities and residential environments are improving, but it is true that there is a lack of public services or small community spaces. There used to be small public libraries in the neighborhood, and there were more community spaces for local residents to gather together, but many of them disappeared during the redevelopment process. I think that customized service facilities that can supplement this are necessary.

3) **Statement 2 by the college student in their 20s:** As you said, local development certainly has positive aspects, but I feel that the development does not benefit all residents. In particular, I often visit Wangsimni Station and Hanyang University, and I feel that the living service facilities in this area are developing only for commercial purposes. For example, there are fewer affordable cafes or community spaces that students can use freely, and instead, there are more and more high-end restaurants or franchise cafes. Rather than living-oriented services that existing residents around Haengdang-dong can easily utilize, I feel that there are more high-end facilities targeting people of the high-income class who are new to this area. In addition, although Hanyang University Hospital and medical shopping centers are nearby, accessibility to welfare services such as hospital services and public medical support is still low for low-income families and students. As local development continues, shouldn't we also think about ways to resolve these gaps?

4) **Statement 2 by the landlord in their 60s:** I completely agree with the college student's opinion. As local commercial districts become more luxurious, I understand the sense of alienation felt by existing residents, younger generations, and especially students. As a person who runs a store, I can sense the change of the customers. In the past, there were many affordable stores visited by students and nearby residents, but now, as rents rise, those stores are closing and large franchises and high-end stores are moving in. Sales have increased in my store compared to the past, but the appearance of neighborhood stores frequented by local residents seems to be disappearing. However, I think local communities and public institutions should work together to enhance public infrastructure. For example, Seoul Metropolitan Government and Seongdong-gu Municipal Government should consider ways to expand public community centers and provide spaces that younger generations and low-income residents can use at a low cost. In addition, it seems that efforts are needed

from the private sector to provide convenient living facilities that can accommodate various classes. We also need to discuss ways to expand facilities such as the public library and community center that used to be in Haengdang-dong.

5) **Statement 3 by the college student in their 20s:** After listening to the landlord, I agree that regional development should not stop at mere commercial development but should also expand public infrastructure so that all residents can benefit fairly. In particular, I think that spaces such as public libraries and community centers are absolutely necessary. These days, people can only gather in cafes or commercial spaces, so there are not enough spaces where local residents can interact naturally. If you just go around Hanyang University, you can see that most of the places where young people can gather are paid commercial facilities, so accessibility is low. In addition, since the Wangsimni Station area has convenient transportation, there is a great influx of people from outside the area in addition to the local residents. So, shouldn't we create public facilities that more people can use? I think that if we expand existing community-oriented spaces such as small parks and walking trails and create learning and cultural spaces that residents can use for free or at a low cost, more people will receive the benefits. I hope that development will be carried out such that both the young people who study and live in this area and those who have lived there for a long time can benefit.

6) **Statement 3 by the landlord in their 60s:** After hearing the college student's opinion, I also had a lot to think about. It is especially sad that public facilities and community spaces have disappeared from this area. In the past, there used to be small parks, shelters, and community centers in Haengdang-dong or Eungbong-dong where residents often gathered, but many of them disappeared as redevelopment progressed. This change is also a concern for landlords like me. It is positive that commercial facilities are developing, but I don't think it is desirable for residents who have been living in this area for a long time to be pushed out by high-end facilities, without being able to enjoy the benefits of development together. Meanwhile, to create a balance between the people of the high-income class who are moving into this area and the existing residents, I think the public and private sectors should cooperate to create spaces and facilities for various classes. In particular, if facilities such as local public libraries and community centers are rebuilt and commercial facilities are developed in a way that various classes can access, it will create an environment that everyone can be happy with. For example, if small stores or community stores that operate at low rents increase again, the commercial district will become more diverse, and the sense of solidarity among residents will be enhanced.

The full text of the results generated from the Lv11 prompt (two agents (college student in their 20s, officer worker in their 30s, professional in their 40s, self-employed person in their 50s, and landlord in their 60s)) of this study is show below.

1) **Statement 1 by the college student in their 20s:** I am a college student living in Wangsimni 2-dong. I feel that there is a lack of study spaces and youth-friendly facilities among the living

service facilities in this area. Even though there are many Hanyang University students, they often use private spaces such as cafes. For example, there are many commercial facilities around Wangsimni Station, but I think there are not enough public study spaces such as libraries or study rooms. Recently, apartment complexes such as 'Lacervo Prugio Summit' are being developed, but it is sad that there is little discussion about spaces for young people or convenience facilities for teenagers.

2) **Statement 1 by the officer worker in their 30s:** I am an office worker living in Haengdang 2-dong. The problem that I feel while commuting to and from work is accessibility to transportation and accessibility to medical facilities. Although transportation is convenient near Wangsimni Station, I think there is a lack of proper medical facilities in the area. There are not many hospitals that are close and trustworthy, especially in emergency situations, except for Hanyang University Hospital near Wangsimni Station. Although a few medical shopping malls have opened recently, waiting times are still long, and I feel that they are not fulfilling their roles as specialized hospitals.

3) **Statement 1 by the professional in their 40s:** I am a professional living in Haengdang 1-dong. People say that this area has a well-developed educational infrastructure, but it seems that more systematic management is needed. For example, there are schools such as Muhak Middle School and Muhak High School, but traffic safety issues between the roads and the schools are serious. As a parent, I think that children need constant attention because I feel anxious about their safety when they go to schools. Recently, redevelopment projects have been actively carried out, but I am concerned that improvement of the environment around the schools has not been particularly mentioned.

4) **Statement 1 by the self-employed person in their 50s:** I am self-employed in Wangsimni Doseon-dong. The commercial area is relatively active, but small business owners are having a hard time due to the recent increase in large-scale commercial facilities. As supermarkets and franchises are opening up near Wangsimni Station, the competitiveness of small stores is gradually decreasing. In particular, the recent news of the redevelopment of the area into the 'Lacervo Prugio Summit' may have a positive effect on the local economy, but from the perspective of self-employed business owners, there is a risk that the commercial district will be reorganized around large corporations.

5) **Statement 1 by the landlord in their 60s:** I am a resident who has been operating a renting business in Eungbong-dong for a long time. Although the residential infrastructure in this area is developing a lot, the lack of parks and green spaces is a problem. In particular, Mt. Eungbong is the only green space where residents can take a walk, but it is not properly managed. Recently, there have been many reconstruction and redevelopment projects, but issues such as expanding green space are not being considered in this process. In particular, considering the aging problem of this area, I think that there is an urgent need for leisure facilities and welfare centers for elderly citizens.

6) **Statement 2 by the college student in their 20s:** I think the Wangsimni area needs public space for young people. Despite being an area with a large youth population, there is a lack of places for young people to study or spend their leisure time. I would like to suggest that a youth community center or a cafe-style study room be built near Hanyang University. This center should be a space that is easily accessible to college students

and job seekers and should be operated at a low cost. In addition, if it provides free Wi-Fi and food and drinks at low prices, it would be a great help to the youth.

7) **Statement 2 by the officer worker in their 30s:** Transportation and medical facility improvement are important issues. First, I propose that the number of small clinics near Hanyang University Hospital should be increased to reduce waiting time at large hospitals. This will increase medical service accessibility to deal with minor illnesses of non-emergent patients and allow nearby residents to quickly receive medical services. It would also be good to consider reducing traffic congestion by making additional entrances and expanding public transportation transit facilities near Wangsimni Station, which is crowded during rush hour. In particular, I think it is necessary to expand the Wangsimni Station to a complex transit center.

8) **Statement 2 by the professional in their 40s:** I think that improving the educational infrastructure is important. In particular, from the perspective of parents, traffic safety on the roads near Muhak Middle School and Muhak High School should be enhanced. It is necessary to install more traffic lights and crosswalks on roads around schools and enforce speed limits more strictly in school zones. We also need spaces or shelters where students can wait safely near schools. There has been a lot of redevelopment recently, so it would be good to have transportation policies that prioritize students' safety along with infrastructure development in this area.

9) **Statement 2 by the self-employed person in their 50s:** What I would like to suggest from the perspective of a self-employed person is a policy to protect local commercial businesses. The expansion of commercial facilities centered on supermarkets and franchises poses a great threat to small business owners. I think it would be good to create spaces such as shopping malls or community markets exclusively for small business owners. For example, some of the commercial facilities near Wangsimni Station may be preferentially provided to small business owners to lower the rents, and promotions may be strengthened so that local residents can use the local commercial businesses. In addition, there is also a need for creating opportunities to revitalize local commercial businesses by periodically holding local festivals or flea markets.

10) **Statement 2 by the landlord in their 60s:** I hope that welfare facilities for the elderly residents of Eungbong-dong will be expanded. I think we especially need facilities like senior welfare centers. Now, there are few places for the elderly to spend time, and natural spaces like Mt. Eungbong are not properly managed. It would be good to additionally provide facilities such as health programs and walking trails that are easily accessible to the elderly. Furthermore, though the park improvement project is centered on Mt. Eungbong, sports facilities and exercise equipment should be installed so that residents can take care of their health.

11) **Statement 3 by the college student in their 20s:** I think the Wangsimni-Haengdang area should develop into a youth-friendly space in the future. Reflecting the characteristics of the area where many college students reside, I hope that facilities that young people can conveniently use will be constructed, such as cultural spaces and start-support centers. I hope that a space can be created around Wangsimni Station where young entrepreneurs and community activities can flourish. I think that smart spaces such as digital libraries and AR/VR-based learning facilities are also needed. If spaces are utilizing future-oriented technologies are formed, I think this area will become more

attractive.

12) **Statement 3 by the officer worker in their 30s:** I hope that the Wangsimni-Haengdang area will become the center of transportation and medical services in eastern Seoul. Since Wangsimni Station is a main transportation hub in Seoul, I think that the area will develop further if a medical cluster is formed along with the complex transit center. I envision a future where medical, transportation, and commercial infrastructure are harmonized with Wangsimni Station at the center. In addition, we hope to transform the area into one where local residents can live healthier and more comfortable lives by expanding eco-friendly transportation and green spaces.

13) **Statement 3 by the professional in their 40s:** I hope that the Wangsimni-Haengdang area will become the center of education and safety in Seoul. Currently, there are some educational facilities somewhat established but further development is needed. In addition, I hope that the introduction of safe road systems utilizing smart technologies, such as AI-based traffic management and unmanned surveillance systems, will create an environment where students can live more safely.

14) **Statement 3 by the self-employed person in their 50s:** I hope that the commercial businesses of this area will develop in a direction

where local residents and small business owners can coexist, rather than being centered on large corporations. Since the Wangsimni-Haengdang area has a vibrant commercial district, I hope that local festivals and community-centered commercial activities will become more active. For example, it would be good if regular local markets or street festivals are held to create places where the local economy can circulate actively. In addition, I hope that programs that can provide technical support to small business owners will be provided so that the commercial district can become more solid.

15) **Statement 3 by the landlord in their 60s:** I hope that Wangsimni-Haengdang area will develop in the future into a welfare center where the elderly and the young can live together harmoniously. I hope that the green space centered on Eungbong-dong will be expanded along with the welfare facilities for elderly citizens. In particular, Mt. Eungbong is an important resource for the health of local residents, so I hope that health management programs and exercise facilities will be created to better utilize it. In the future, I hope that this area will develop into a comfortable place for elderly citizens and a vibrant place for young people, and I look forward to it becoming a composite space that satisfies everyone.
