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The Influence of Formal Sensory Aesthetics to Encourage Ecological Behavior

Case Study: Green Roof Central Market, Jakarta, Indonesia

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Abstract – This study aims to determine the influence of the sensory formal aesthetics of green roofs in encouraging ecological behavior. Jakarta's ecological crisis stems from lack of green spaces and unfriendly community behavior. Optimizing green roofs and appealing to aesthetics can stimulate environmental protection efforts. Qualitative approach with Robert K. Yin's case study method to propose a model proposition based on the influence of aesthetics on ecological behavior, testing it on mall visitors. Data collection through observation, surveys, semi-structured interviews, and expert validation. The research findings regarding the formal sensory aesthetics of the Central Market green roof can influence the ecological behavior of visitors as demonstrated in the model. Aesthetics with the goal of environmental education within it, influence behavior through the understanding of sustainability in its design and facilities. The relationship between aesthetics and ecological behavior includes experiences of returning to nature, feelings of connection with nature, and environmental knowledge media, which influence environmental awareness and ecological behavior. Visitor characteristics, duration, and frequency of visits also influence the ecological behaviors that occur and sensory perceptions of aesthetics. This study emphasizes the role of education in aesthetics to influence ecological behavior, through relationships in form of experiences, feelings and environmental knowledge.

Keywords: *Central Market, ecological behavior, formal sensory aesthetic, green roof.*

I. INTRODUCTION

The urgent global ecological crisis such as biodiversity loss, landslides, UHI, pollution, etc., is caused by irresponsible human behavior. One of them is happening in Jakarta, the capital city of Indonesia, which is facing an increasingly complex ecological crisis. One of them is the lack of green open spaces, which currently stands at 9.98%, far from the ideal standard of 30%. According to Nirwono Yoga, an urban planning observer, creative solutions are needed to optimize land and building spaces in Jakarta to be converted into green open spaces (Dewi, 2024). The lack of green open spaces is further exacerbated by the community's behavior, which is still not environmentally friendly, and this is also influenced by the lack of environmental education. Such as understanding environmental conservation in waste management, tree planting, energy conservation, and the preservation of flora and fauna, which are still relatively low. Therefore, an ecological behavioral change is needed in society, while also optimizing green spaces in the form of green roofs amidst the land limitations in Jakarta. The type of

green roof chosen is intensive, which is a rooftop garden utilized for human activities. Human behavior that favors the environment contributes the most to environmental preservation. In addition to technical solutions for fulfilling green spaces, behavioral change is greatly needed; otherwise, the Earth will become increasingly unsalvageable.

The Central Market green roof was chosen in this study with the consideration that it is an intensive green roof so it is easily accessible, crowded with visitors, an eco lifestyle hub, with a sustainable living concept that can educate visitors to behave ecologically. Intensive green roofs, in addition to their ecological role, also have an aesthetic role. Hangrove argues that the history of environmental conservation began with aesthetics. Callicott also argues that most of our conservation decisions are motivated by beauty rather than duty (Mikkonen & Raatikainen, 2024). Connectedness with nature is developed by a person when interacting with nature, either through experience, cognition, emotion or feelings between humans and the beauty of their environment, this is an accurate predictor of ecological behavior (Rim et al., 2025). Aesthetic experts state that aesthetic experiences derived from nature are the basis for influencing environmental behavior (Zhou et al., 2021). Rolston suggests that aesthetic views also extend to environmental knowledge, where environmental cognition has been repeatedly confirmed to play an important role in influencing environmental behavioral intentions (Wu et al., 2022).

The aesthetics of a green roof encompass all the senses and body movements of its users, so that it can be understood and utilized to behave and feel something. Aesthetics is an understanding through sensory observation of the interest in aesthetic elements such as shape, color, texture, which is called formal sensory aesthetics (Suryasari et al., 2022). Aesthetics are formed by 3 aspects, namely the subject which forms the aesthetic experience, the object in the form of aesthetic properties which show aesthetic properties and the value in the form of aesthetic parameters (Junaedi, 2021).

The aspect of the subject consists of individuals who understand, observe, and enjoy the object. Then the object is perceived sensorially by the subject until it forms an aesthetic experience.The experience is formed when the object possesses values and qualities that resonate with the subject (Paris, 2024). Aesthetic experience is shaped by cognition (logic), which is recognition; conation (energetic), which is the drive to act; and emotion (emotional), which is feeling. (Junaedi, 2021).

The aspect of objects in the form of aesthetic properties is divided into two, namely "cultural" which comes from human intervention and "natural" which comes from the Creator. Aesthetic properties take the form of material or objects, activities, and language (Junaedi, 2021).

The aspect of value in the form of aesthetic parameters that emerge when the subject experiences aesthetic interest in the object based on subjective and objective beauty (Brady & Prior, 2020). Aesthetic parameters are divided into order, chaos, majesty and deception (Folkmann, 2023). Order consists of harmony (compositional harmony), mimesis, and masterly (creator's expertise) (Folkmann, 2023). Chaos is divided into creativity, deformation (change of shape), disharmony (inconsistency), and anti-originality (rejection of originality) to trigger attraction. (Junaedi, 2021). Each object can have more than 1 type of aesthetic value.

Aesthetics has a relationship or reciprocal relationship with human behavior. This relationship is in the form of humans perceiving aesthetics in objects through the senses, which is usually called secondary quality in aesthetics. (Stoltz & Grahn, 2021).

Research on ecological behavior is growing rapidly. Behavior influenced by cognition and affect has been proposed by several researchers as a theoretical model. Individual feelings are generated by affective aspect stimuli, thoughts are generated by cognitive aspect stimuli that influence behavior. Otto and Pensini (2021), argue that feelings of connectedness to nature are important internal drivers in increasing ecological behavior. Leopold highlighted that it is easier to arouse the need to protect the environment through aesthetic appeals, through the compatibility of beauty and moral goodness (Parsons & Carlson, 2024).

Environmental awareness in the form of recognizing issues, environmental impacts and solutions is the beginning of the formation of ecological behavior (Fettahlıoğlu & Aydoğdu, 2020). Ecological behavior is formed by 4 aspects, including environmental knowledge, changes in habits, environmental responsibility and social interaction (Teixeira et al., 2023; Hastuti et al., 2024). All of these aspects aim to get individuals involved and motivated in environmental protection activities. These protection activities are divided into 3 basic points of behavior, including the preservation of natural resources in

air, water and soil, reducing energy consumption in electricity, oil and gas; and the conservation of plant and animal life (Hastuti et al., 2024). The three basic points of ecological behavior are carried out in the form of using/recycling recycled materials, saving energy, green consumerism, sorting waste, planting trees, reducing plastic use and carbon emissions (Hastuti et al., 2024).

Thus, the researchers propose a model proposition regarding aesthetic theory that has 3 formative aspects within it (Junaedi, 2021) in the environment. Aesthetics has a relationship with human ecological behavior in the form of experience, feelings, and cognition (Wang & Yu, 2018) within it, which is referred to assecondary qualities in aesthetics. (Stoltz & Grahn, 2021). Ecological behavior shaped by environmental awareness (Teixeira et al., 2023), finally forming 3 basic points in the form of environmental activities (Hastuti et al., 2024). This proposition model will serve as a guide and foundation for research to understand the influence of sensory formal aesthetics on the ecological behavior of visitors to the Central Market green roof (see Fig. 1).

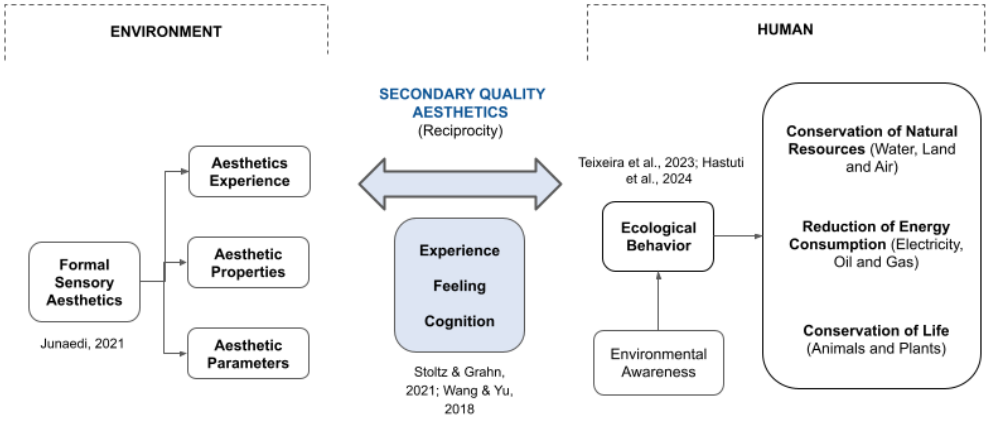

Fig. 1. Propositional model of the influence of sensory formal aesthetics on ecological behavior
Source: Author (2025)

Therefore, the objectives of this research are 1) to understand the formal sensory aesthetics present in the Central Market green roof using Junaedi's (2021) theory in influencing ecological behavior, 2) to understand the relationship between formal sensory aesthetics and the ecological behavior of visitors to the Central Market green roof through Junaedi's (2021) aesthetic theory, the relationship between aesthetics and behavior from Wang & Yu (2018), and ecological behavior from Teixeira et al (2023), 3) to create a model of formal sensory aesthetics that can influence the ecological behavior of visitors to the Central Market green roof.

The qualitative research method uses the case study method from Robert K. Yin, with consideration of using existing theoretical foundations to determine the focus and direction of the research (Setyowati et al., 2023). The proposition model proposed by the researchers (see Fig 1) is used as the basis for the framework in observations, semi-structured interviews, surveys, and expert validation.

Some researchers such as Dinh & Zhang (2025) also study the design of green roof landscapes and green spaces on university campuses, which can shape environmental attitudes and behaviors. Students who frequently engage with the elements of landscape spaces and green roofs cultivate experiences, a sense of belonging, develop positive emotions, and tend to demonstrate environmental awareness through ecological actions. Lee et al (2024) also developed an engaging green roof design model through the identification of space and time, multi-sensory engagement, and connecting the natural experiences of green roofs. Where the experience of green roofs is shaped by sensory, complex, movement, and vistas that influence individual attitudes and behaviors. So (2024) also investigates physical activity, perception, and aesthetic preferences of environmental quality and psychological health of visitors using green roofs in Hong Kong that influence behavior. Based on several studies, there has yet to be research examining the influence of formal sensory aesthetics on ecological behavior with a case study of the green roof at Central Market, Jakarta, Indonesia.

This research contributes to the influence of green roof aesthetics on environmental protection, through a new approach for architects designing green roofs or other green spaces, considering aesthetic aspects that can affect the ecological behavior of their users. Where nature and humans must complement each other in the effort to combat the ecological crisis.

II. METHODOLOGY

This study uses qualitative research methodology with Robert K. Yin's case study method, a single exploratory case study type on the Central Market green roof (Setyowati et al., 2023). Primary data includes observation and documentation, surveys, semi-structured interviews, and expert validation (see Fig. 2). Secondary data includes journals and books related to sensory formal aesthetics, ecological behavior, and the relationship between aesthetics and ecological behavior on intensive green roofs.

The research data collection techniques were carried out through literature review, proposition models, observations, documentation, semi-structured interviews, and surveys to examine the formal sensory aesthetics and visitor behavior. Data were collected through a survey of 105 respondents who were mall visitors (see Fig 2), which included 10 respondents who also served as interview participants and 5 landscape architecture experts who completed the online questionnaire through Google Forms. Semi-structured interviews were conducted with 10 participants (7 visitors and 3 staff), and followed by expert validation involving the same 5 experts after conducting observations, surveys, and interviews. This interview was conducted simultaneously with the observation, aiming to understand and comprehend the influence of aesthetics on the ecological behavior of visitors to the Central Market green roof. Then the researcher confirmed the results of the observations and interviews through a questionnaire to support the observation and interview data. The criteria for expert selection required that they be landscape architecture specialists with a deep understanding of behavioral dynamics within landscape environments.

The assessment of the questionnaire uses a 1-5 likert scale, where a scale of 1 means strongly disagree to a scale of 5 means strongly agree and open-ended questions so that respondents can freely express their opinions. The sampling technique used is convenience sampling because the mall visitors are constantly changing (Sukabumi, 2022). The questions asked included the duration and frequency of visits, activities, the areas they visit most often, three basic points of ecological behavior in the form of ecological activities, three aspects that form aesthetics (experience, property, and aesthetic parameters), opinions on seeking similar designs, and whether the aesthetics of the Central Market green roof can encourage visitors' ecological behavior.

The results of the analysis from literature, observation, questionnaires, and interviews were then analyzed using content analysis techniques to identify keywords and categorize them according to the research objectives. The results of this analysis produced a model of the influence of aesthetics on behavior, which will be validated by 5 experts, consisting of 2 IALI (Indonesian Landscape Architects Association) members and 3 professional architects and landscape architects, who were previously asked to fill out a questionnaire. Expert validation is conducted by presenting and explaining the analysis results in the form of a model and asking several questions through the model to identify which parts need improvement or development. The results of the validation analysis are in the form of a model showing the influence of formal sensory aesthetics on ecological behavior that has been validated. The overall research methods are suitable for understanding the influence of formal sensory aesthetics on ecological behavior in the context of the Central Market green roof.

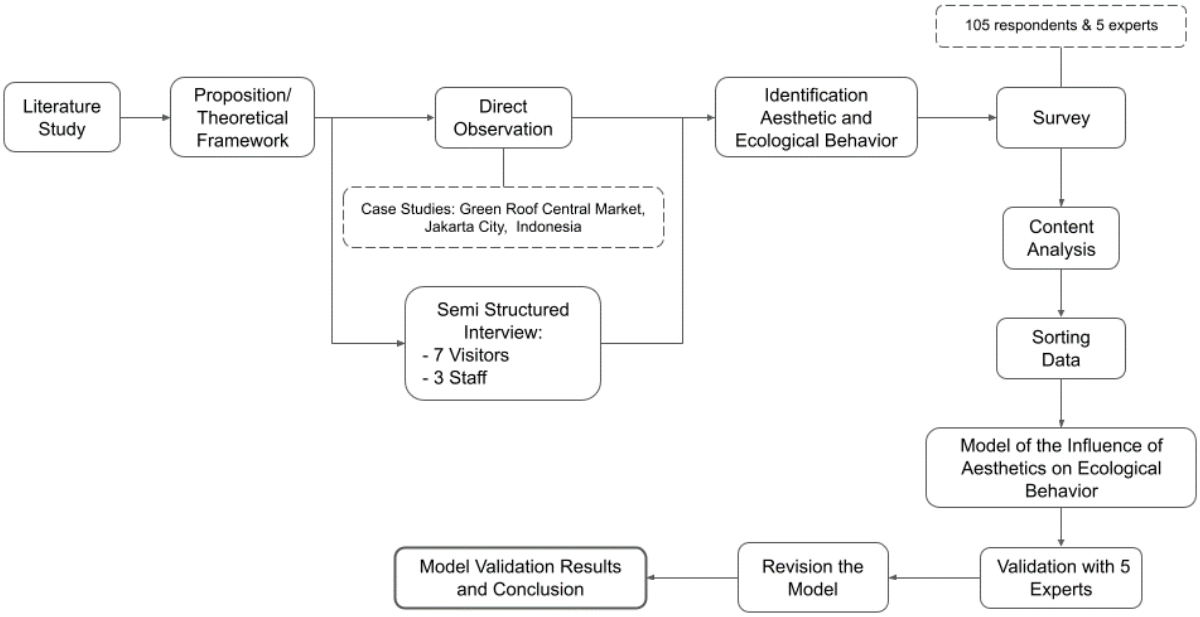

Fig. 2. Research flow
Source: Author (2025)

A. Case Study

The selected case study is the Central Market green roof located in Golf Island, Pantai Maju Area, Jl. Boulevard Raya, Kamal Muara, Penjaringan District, North Jakarta, with an area of 595 m^2 (see Fig. 3). The consideration of choosing this green roof is because it is intensive so it is easy to access, is visited by many visitors, is an eco-lifestyle hub and has a sustainable living concept, seen from the application of cross ventilation, natural lighting, solar panels, environmentally friendly materials, has a green roof and vertical gardens. This design creates unity between the building which is a human intervention with the natural environment. Central Market has also succeeded in achieving the EDGE Advanced Green Building certificate and received certification from the World Bank Group - International Finance Corporation (IFC) and the Green Building Council Indonesia (GBCI) (IndonesiaExpat, 2023), so that the selection of this case study is in accordance with the research objectives. Its design can improve understanding of environmental impacts, foster environmental awareness and influence ecological behavior through its sensory formal aesthetics.

Green roof central market also calls for a no plastic campaign, holding environmental workshops such as mini terrariums and urban gardening activities together at certain events as an effort to combat sustainability issues (NOWJakarta, 2022).

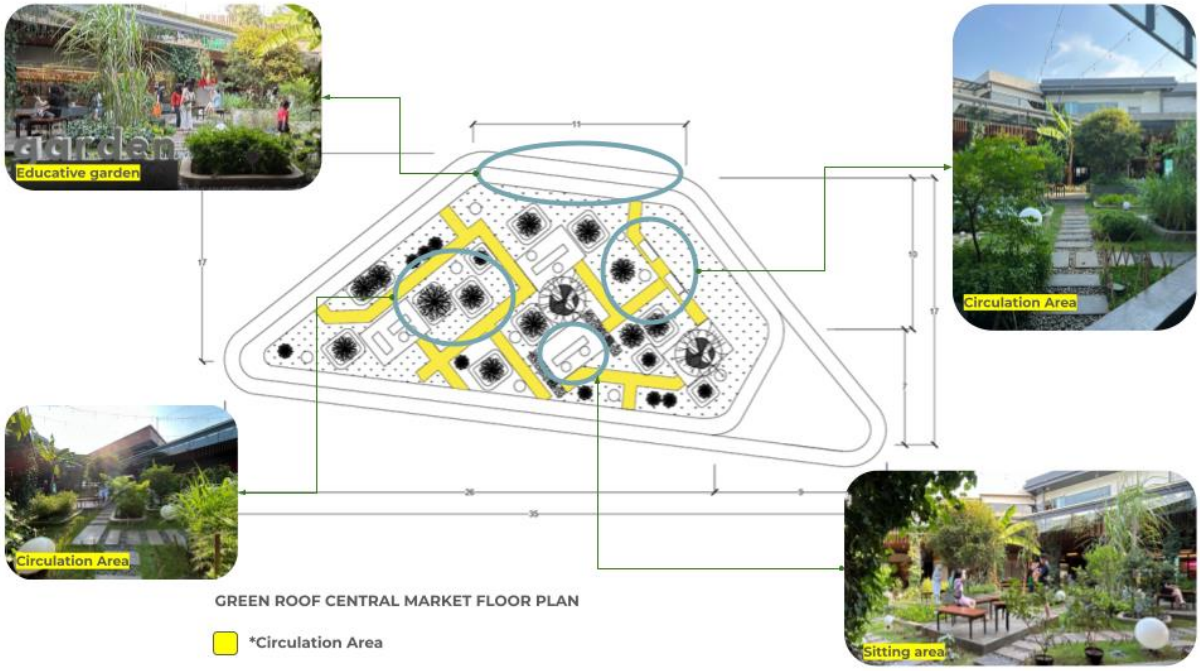

Fig. 3. Green roof Central Market floor plan
Source: Author (2025)

The Central Market green roof is designed in the form of an educational garden in the form of an edible garden. Fruit, vegetable, and medicinal plants educate visitors in utilizing every square meter of limited land to produce resources such as food (see Fig. 4). The green roof can be accessed from various sides, equipped with a seating area for socializing, relaxing, and discussing the environment. The circulation path is designed comfortably to explore every corner of the green roof, observe the aesthetics that come from nature and interact directly through sensory stimulation from nature.

Fig. 4. Green roof Central Market
Source: Author (2025)

This green roof is also equipped with a dog park called Hyde Park on the 2nd floor (see Fig. 5), providing a hotel and dog pool. This facility is to accommodate dog owners to take them for a walk to the green roof while playing and interacting with nature.

Fig. 5. Dog park
Source: Author (2025)

III. RESULTS AND DISCUSSION

A. Identification of Sensory Formal Aesthetics and Ecological Behavior of the Central Market Green Roof

The first stage is to identify the formal sensory aesthetics using Junaedi's theory (2021) and the ecological behavior from Teixeira et al. (2023), which will be presented in the form of a table through observations, semi-structured interviews, and literature (see Table 1). Identification is divided into three formative aspects: aesthetic experience shaped by cognition, conation, and emotion; aesthetic properties in the form of material objects and activities; aesthetic parameters in the form of order and chaos adjusted to the values held by the green roof of Central Market.

Based on the results of observations and interviews, the aesthetic experience comes from the perception by the visitors' senses through the appeal of the green roof design. The cognitive aspect is shaped by education and environmental discussions through informational boards about the types of plants in each planter, an educational garden in the form of an edible garden that teaches how limited space can be maximized to produce food, a green roof design with a sustainable living concept, a circulation path design that encourages visitors to explore every corner of the green roof, and a plastic-free campaign driven by Central Market itself (see Fig. 6). Based on interview data, visitors pay attention to the design and ask how to prevent the green roof from leaking, how the water recycling system works, how rainwater is collected, etc. Thus, this design facilitates environmental knowledge and education, which play an important role in fostering an appreciation for nature and understanding sustainability among visitors (Usman et al., 2023).

Fig. 6. Aesthetic experience - cognition in green roof Central Market
Source: Author (2025)

Conative aspects through visitor activities involving the senses of hearing, sight, smell, and touch (see Fig. 7). Directly interact with plants and animals through the dog park facilities while enjoying the design and atmosphere of the park (visual, auditory, and tactile). Visitors can bring their pet dogs and play together in the dog park area. Sitting and walking leisurely, observing and enjoying the natural atmosphere, listening to the sound of the wind passing through the trees of the green roof (visual, kinesthetic, auditory), engaging in environmental discussions while exploring every corner of the park through landscape design observation, smelling the damp aroma of the soil when it rains, touching the texture of the plants and materials used (visual, auditory, olfactory, tactile & kinesthetic).

Fig. 7. Aesthetic experience – conation in green roof Central Market
Source: Author (2025)

Emotional aspects through the application of the sustainable living concept that provide a sense of connection with nature, contribute to creating a sustainable environment, and improve the quality of life for the surrounding community (Baobeid & Ghamdi, 2021). The trapezoidal geometric shape of the

green roof is efficiently designed to utilize limited space and is easily accessible from various sides (see Fig. 8). The sound and aroma of the water feature at the entrance steps, the sound of dogs playing, the rustling of leaves that provide a refreshing feeling, fun, and enhance the connection with nature. The fragrant aroma of flowers that enhances mood and creates a pleasant feeling (Nadeem et al., 2024). The combination of eco-friendly material textures from Milan eco wood, terracotta tiles, terrazzo, black coral stone, WPC, fine Japanese grass, and andesite tiles, make an impression of neat, inviting, and harmonizing with nature, the green roof, and other design elements in Central Market provides tranquility and relaxation (Amalina & Marlina, 2024).

All aspects of this aesthetic experience influence visitors' connection with nature through direct interaction, which involves the emotional and cognitive aspects between humans and the beauty of the green roof design environment.

Fig. 8. Aesthetic experience - emotion in green roof Central Market
Source: Author (2025)

Aesthetic properties in the form of a dog park facility (Hyde Park) consisting of a dog hotel and pool with a playful and cheerful design (see Fig. 8) encourage visitors to play and interact with the dogs present there (Vieira et al., 2022). An educative garden with various plants and information boards for environmental knowledge. Fountain stair waterfall at the entrance area that provides a sensory experience with the sound and visuals of water, bringing visitors closer to natural elements. All these eco-friendly facilities are designed to influence ecological behavior and environmental protection campaigns (Vieira et al., 2022). Eco-friendly materials are dominated by reclaimed Milan eco wood, terrazzo, and terracotta, helping to enhance visitors' understanding of the environmental impact of sustainability. Environmentally friendly activities such as education through design, materials; interacting and playing with animals and nature, sitting and walking leisurely observing the beauty of nature, exploring and discussing the environment through the formal aesthetics of the green roof's sensory nature, and taking photos.

The aesthetic parameters align with the values of the Central Market green roof, in the form of order, namely harmony, mimesis, and mastery, as well as chaos in the form of creativity (see Fig. 9). Harmony is evident in the trapezoidal shape of the green roof, with square geometric shapes without corners at the edges of the plants, designed neatly, efficiently, and flexibly, utilizing limited space. The use of curved lines in the dog park creates a friendly, flowing, and dynamic impression, encouraging visitors to move freely and comfortably, and to spend more time interacting with their pets (Gheorghe et al., 2024). Mimesis is evident from the decorative butterfly-stylized lamp that serves as the focal point of the entrance area, while also educating about the positive relationship between butterflies and the flowers that need to be protected (Bashan et al., 2021). Masterly seen from the designer's skill in creating a dog mural with leaves on the side of the room to enhance the cheerful and fun impression, as well as the repetition of curved lines in the dog park. The selection of efficient and neat square plant edging, the

entrance design that serves as a focal point through the placement of plants, the waterfall staircase design, and the decorative butterfly lamps. Creativity is evident in the design of the dog park with a fun play area and pool, decorative butterfly-style lamps, and the entrance design that utilizes warm lighting from decorative butterfly lamps and natural lighting, attracting visitors to enter the green roof.

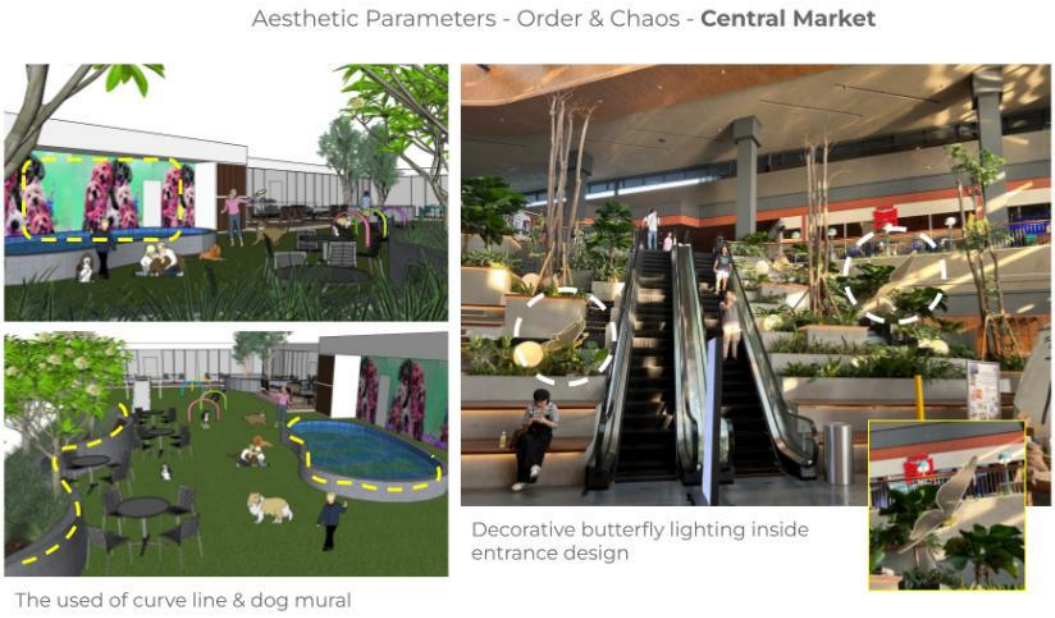

Fig. 9. Aesthetic parameters – order and chaos in green roof Central Market
Source: Author (2025)

Based on the results of observations and interviews, visitors are engaging in more environmentally friendly activities through the three basic behavior points theory (Hastuti et al., 2024). Some visitors brought their own water bottles and tote bags or recycled paper bags to reduce plastic use, disposed of their waste according to its category, and maintained the cleanliness of the green roof environment. Awareness of optimizing eco-friendly energy sources is triggered through a design that uses solar panels and cross ventilation throughout the green roof area.Visitors feel that the green roof area is cool, healthy, and natural through its design and the utilization of natural resources. Visitors also expressed a desire to have the same design, with many plants, which inspired them to want to plant greenery in their homes. Interacting with dogs at the dog park trains empathy and a sense of responsibility towards pets, thereby teaching care and increasing happiness among visitors (Willis, 2024).

Table 1. Identification of Formal Sensory Aesthetics and Ecological Behavior in the Green Roof of Central Market

Formative Aspects	**Formal Sensory Aesthetics in Green Roof Central Market**		
Subject (Visitors to the Central Market green roof)	Aesthetic Experiences	Cognition (Logical Effect)	Environmental Education
		Conation (Energetic Effect)	Direct interaction with nature, playing with pets in the dog park & educational park Walking and enjoying the view and natural atmosphere of the green roof
		Emotion (Emotional Effect)	The concept of Sustainable Living
			The efficient and flexible geometric shape of a trapezium

			The sound of water features at the entrance steps, animals (dogs), rustling leaves – refreshing, relaxation & connection with nature
			The scent of trees, flowers, water features - relaxation, close to nature, delightful
			Smooth texture on terrazzo, Milan eco wood, terracotta tiles, black coral stone, wpc, Japanese grass, andesite tiles – impression of inviting, blend with nature, calm
			Butterfly Pea Flower as a visual and educational - improves mood, productivity, calms & pampers the eyes connecting with the beauty of nature
Object	Aesthetic Properties ***Cultural***	Object/ Materials	Dog park (Hyde park): Dog Hotel, Dog pool (Object)
			Fountain stair waterfall (entrance), educative garden in form of edible garden (Object)
			Milan eco wood, terracotta tiles, terrazzo, andesite tiles, black coral stone, wpc (Materials)
		Activity	Environmental Education
			Interacting & playing with Animals and nature
			Relax, exploring, sit and discuss, take a photo, enjoy the ambience of landscape design
Value	Aesthetic Parameters ***Order***	Harmony	The shape of the green roof is trapezoidal, with geometric square and rectangular plant edging that has no corners, and curved lines in the dog park.
		Mimesis	Decorative butterfly lighting on the entrance stairs
		Masterly	Dog & leaf wall mural, repeating curved lines in dog park, rectangular geometric layout of planter boxes, entrance design menjadi focal point
	Chaos	Creativity	Dog Park Design (Dog play area, dog pool)
			Decorative lighting butterfly
			Stair access to the green roof with terraced garden design and waterfall stairs supported by warm lighting

3 Basic Points of Ecological Behavior	**Type of Ecological Activity**	**Ecological Activity in Green Roof Central Market**
Conservation of natural resources	The use of recycled goods or no plastic	Bring a drinking bottle and a tote bag or recycled paper bag
	Waste sorting & maintaining cleanliness	Throwing away trash according to category
Reduction of energy consumption	Aware and practice saving electricity, gas, oil	Start practicing energy conservation inspired by educational designs on green roofs
Conservation of life (Plants and Animals)	Inspired to plant trees after visiting the green roof Central Market	Inspired to plant plants in their respective homes
	Caring for and protecting plants and animals	Be responsible and empathetic towards animals & plants

Source: Author (2025)

B. Confirmation of Ecological Behavior Influenced by Aesthetics

The next stage confirms the ecological behavior influenced by the aesthetics of the Central Market green roof through a questionnaire (see Table 2).The questions are based on the results of the identification of aesthetics & ecological behavior (see Table 1) and the proposition model (see Fig. 1).This result also shows the demographic information of the respondents (Holt et al., 2019) to understand the relationship between individual characteristics and ecological and aesthetic behavior.

The first questionnaire data shows that the majority of visitors to the green roof are aged 25-29, totaling 60 people (54.5%), who are workers and already have families. Visitors who are workers need a place to unwind and a leisure atmosphere due to their busy jobs. Family visitors bring their children for recreation and environmental education through the presence of formal sensory aesthetics. The female gender, with 58 people (52,7%), visited the green roof more than the male gender, with 52 people (47,2%). This is because they tend to use the green roof as a place for social activities such as gathering with friends, chatting, walking, and taking photos. This activity is also influenced by the age of working women who are already married.

The frequency of visits is mostly done 1-2 times a month by 88 people (80%), because the majority of the visitors are working and family-oriented, who are busy on weekdays and free on weekends. The duration of time most spent by visitors is 1-2 hours by 49 people (44.5%). Duration and frequency influence behavior, as they help visitors understand and appreciate the benefits of the environment and biodiversity (Hayyun & Susanti, 2024). This is in line with field data that will be discussed in the ecological behavior section.Research by Deville et al (2021) also shows that demographics, duration, and frequency spent in nature lead to an increased perceived value of connecting with nature, which in turn leads to greater ecological traits and behaviors.

The most frequently visited facilities are the educative garden in the form of an edible garden, with 92 people (83.6%), followed by the seating area with 69 people (62.7%), and the dog park with 53 people (48.2%).These three facilities have become favorites because family visitors bring their children to learn about the types of plants that can be grown on the green roof, explore, care for them, and so on, so that the children engage in ecological activities.The seating area has become a favorite spot for casual discussions while bringing their pets, socializing, taking photos, and enjoying the atmosphere of the green roof landscape.The dog park is often visited as a space for dog owners to interact and play with their pets, providing a fun and enjoyable atmosphere.These educational, interactive, and comfortable facilities influence visitors' environmental awareness in acting ecologically.

The next questionnaire data asks whether visitors have engaged in the 3 basic points of ecological behavior (Hastuti et al., 2024) in the form of environmental protection activities.The ecological behavior questionnaire aims to confirm whether the data obtained from the survey aligns with the data from previous observations and interviews.The first activity, awareness of using recycled materials and not using plastic, was done by 83 people (75%).The activity of sorting waste, disposing of waste according to its category, and maintaining the cleanliness of the green roof environment was carried out by 88 people (80%).Aware and practicing energy conservation, whether electricity, water, or gas, 83 people (75%) do it.Inspired and with the intention to plant greenery in their homes after visiting the green roof at Central Market, 78 people (71%) want to plant and have green plants in their homes.Caring for and protecting existing animals and plants, 82 people (74%) do so.This data shows that the survey data is consistent and supports the observational data and interviews on the ecological behavior of visitors.The research by Othman et al. (2021) also shows that aesthetics, experiences, and feelings towards trees on green roofs and in other urban green spaces have a positive relationship with environmental protection behaviors in daily life, such as the use of green products, urban gardening, water recycling, less packaging, and tree planting.

Table 2. Confirmation of Ecological Behavior Influenced by Aesthetics in Green Roof Central Market Visitors

No	Characteristics		N(%)
1.	Age	15 – 19 years	11 (10%)
		20 – 24 years	18 (16,3%)
		25 - 29 years	60 (54,5 %)
		30 – 34 years	21 (19%)

2.	Gender	Male	52 (47,2%)
		Female	58 (52,7%)
3.	Visit Frequency	1 month 1-2 times	88 (80%)
		2 month 1-2 times	12 (10,9%)
		5 month 1-2 times	10 (9%)
4.	Visit Duration	30 minutes	38 (34,5%)
		1 – 2 hours	49 (44,5%)
		3 – 5 hours	23 (20,9%)
5.	The facility is frequently visited	Dog park	53 (48,2%)
		Seating area	69 (62,7%)
		Educative garden (edible garden)	92 (83,6%)
		Cafe	38 (34,5%)
	3 Basic Points of Behavior	**Type of activity**	
6.	Conservation of natural resources	The use of recycled goods and no platistic	83 (75%)
		Waste sorting & maintaining cleanliness	88 (80%)
7.	Reduction of energy consumption	Aware and practice saving electricity, gas, oil	83 (75%)
8.	Conservation of life (Plants and Animals)	Inspired to plant trees after visiting the green roof Central Market	78 (71%)
		Caring for and protecting plants and animals	82 (74%)
		Aesthetics	
9.	Aesthetic Experience		86 (78%)
10.	Environmental education through green roof design and facilities (Cognition)		85 (77%)
11.	Interacting with animals and nature (Conation)		91 (82,7%)
12.	Walking and exploring to enjoy the design and view (Conation)		90 (81,8%)
13.	Visual & tactile dari tekstur eco wood, black coral stone, japanese grass. Aroma dari bunga, pepohonan. Suara aliran air, anjing, gemerisik pohon (Emotion).		85 (77,2%)
14.	The concept Sustainable Living gives a feeling of connection with nature (Emotion)		82 (74%)
15.	Looking for a similar design		85 (77%)
16.	Green roof aesthetic elements of Central Market influence users to behave ecologically		93 (84,5%)

Source: Author (2025)

The final questionnaire asked about aesthetics among visitors, to support the results of aesthetic identification in (see Table 1).The aesthetic experience of 86 visitors (78%) derived from nature and formed through 3 constitutive aspects serves as the basis for influencing ecological behavior.Another study was also found in Australia that emphasized that aesthetic experiences with nature influence individuals' values and beliefs, which in turn affect their intentions to engage in ecological behavior (Wang & Yu, 2018). Carroll also emphasizes that the experience of beauty derived from examining the aesthetic qualities of nature influences the appreciation of nature that comes from emotions/feelings

(Parsons, 2023). For example, fallen and decaying leaves feel soft underfoot like a carpet, making people feel warm and at home (Parsons, 2023).

The first aspect, cognition in the form of environmental education through its design and facilities, involved 85 people (77%). Children and adults explore each plant and the design of the green roof, observing shapes, systems, materials, and reading information boards about the types of plants, thereby gaining knowledge about specific environmental topics and influencing their behavior. Mukherjee (2023) also shows that individuals with more scientific knowledge and familiarity with environmental issues are more willing to pay higher taxes to protect the environment.

The conative aspect in the form of interaction with animals and nature involved 91 people (82.7%) and walking to explore the view of the green roof involved 90 people (81.8%). This direct interaction enhances the understanding of biodiversity and motivates visitors to take action in preserving the environment (Wang et al., 2022). Mohamed et al (2021) found that interaction with nature plays an important role in awareness and behavior related to environmental protection.

Emotional aspects are triggered through formal sensory aesthetics, such as the natural visuals and textures of Milan eco wood, the soft black coral stone blending with Japanese grass, the scent of flowers, fresh leaves warmed by the sun, the sound of flowing water, dogs, and the rustling of trees. The entire aesthetic of nature stimulates the senses and brings 85 people (77.2%) closer to nature. The concept of sustainable living green roof Central Market educates sustainability through direct interaction with natural aspects on the green roof for 82 people (74%). The European Environment Agency also mentions that sustainable living designs, green spaces in the form of green roofs and gardens, are effective in educating individuals about sustainability through natural experiences, ecological processes, and the importance of resource conservation (EEA, 2020).

Thus, this data shows that cognitive aspects of environmental education, conation in direct interaction with nature and animals, and emotions through stimuli from natural materials, educational gardens in the concept of sustainable living, play an important role in influencing ecological behavior, environmental awareness, and bringing visitors closer to nature.

Visitors also sought designs similar to the green roof of Central Market, with 85 people (77%). This data shows that visitors are comfortable engaging in activities in green open spaces and need the presence of natural elements amidst their busy work activities. Kasim et al (2019) also showed that green spaces with diverse and fresh landscapes will influence individual interest and make them comfortable to stay longer.

The last question of the questionnaire is whether the formal sensory aesthetic elements of the Central Market green roof influence users to behave more ecologically. As many as 93 people (84.5%) agreed that the formal sensory aesthetics play an important role in influencing ecological behavior, through direct experiences with space design, facilities, and environmentally friendly materials (Balasubramanian et al., 2022).

Therefore, based on the questionnaire data, age, gender, frequency, and duration of visits influence how visitors perceive aesthetics through sensory perception, feelings, and behavior. Aesthetic perception based on these visitor characteristics influences the formation of ecological behavior activities, through environmental education in aesthetics, feelings of connection and harmony with nature, as well as aesthetic experiences derived from the green roof. Three aspects of aesthetics influence visitors' ecological behavior, through designs and facilities that overall highlight the environmental education aspect within aesthetics, such as an educative garden in the form of an edible garden with eco-friendly materials within the concept of sustainable living on the green roof of Central Market.

C. The Relationship Between Aesthetics and Ecological Behavior

The next stage seeks to find the relationship between formal sensory aesthetics and ecological behavior through literature, proposition models, results of aesthetic and ecological behavior identification (see Table 1), and results of ecological behavior confirmation influenced by aesthetics (see Table 2). The results of the relationship between aesthetics and behavior are presented in the form of a model (see Fig. 10).

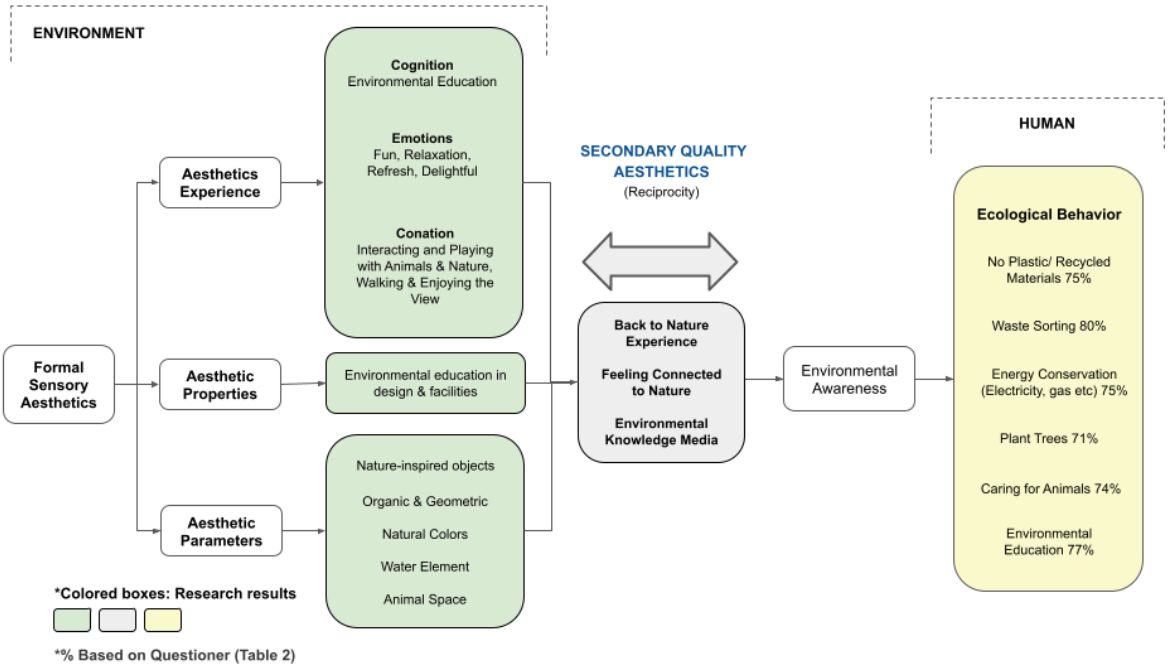

Fig. 10. Model of the influence of formal sensory aesthetics on ecological behavior in the green roof Central Market
Source: Author (2025)

The first part explains the environment of the Central Market green roof, which has a formal sensory aesthetic within it. The aesthetics are formed through three aspects, namely experience, property, and aesthetic parameters. Aesthetic experience is formed through cognitive aspects in the form of environmental education; emotional aspects that create feelings of fun, relaxation, refreshment, and delight when on the green roof; and conative aspects in the form of interacting and playing with animals and nature on the green roof, walking leisurely, and enjoying the view from every corner of the green roof garden. These three aspects that shape aesthetic experiences influence each other in determining what ecological behaviors occur. Research by Wang (2018) also shows that aesthetic experiences of nature have a positive impact on environmental protection intentions.

Aesthetic properties in the form of the entire design and facilities that educate visitors to behave ecologically, whether through materials, concepts, or educational gardens, thus influencing the occurrence of ecological behavior. Research by Zhang & Yong (2021) in Singapore also shows that building designs with rooftop facilities or green spaces can serve as educational and supportive environments to motivate users to engage in ecological behavior. Supporting green features such as greenery, ventilation, waste disposal facilities, and indoor environments have a more significant tangible impact on users to motivate them to act ecologically.

The aesthetic value of the Central Market green roof lies in its design, which is inspired by natural characteristics (elements of water, decorative butterfly lighting, eco-friendly materials resembling natural textures).The combination of balanced, neat, proportional, and non-monotonous organic geometric shapes in the design makes users comfortable spending extended periods on the green roof.The use of colors inspired by nature, such as natural stone, wood brown, and green from vegetation, invites and brings visitors closer to nature. The flowing water element at the entrance is calming and refreshing, both in sound, visual, and scent, bringing the characteristics of nature. The area for animals, specifically provided for dogs, adds a warm, interactive, and friendly impression. All these aesthetic values strive to represent nature by incorporating elements of vegetation, water, animals, colors, and forms resembling nature in a densely populated urban area, despite human intervention. The aesthetic value that seeks to incorporate elements of nature in this green roof influences the occurrence of ecological behavior. Research by Kruize et al (2019) in 4 European cities also shows that adults who take their children to various types of green space designs such as green roofs or parks, and play with their pet dogs, walk more and spend more time in green spaces. The utilization of green roofs shapes experiences and motivations that have the potential to enhance ecological behaviors and attitudes in both adults and children.

The middle section explains the relationship between aesthetics and behavior in the form of experiences of returning to nature, feelings of connection with nature, and media of environmental knowledge that influence ecological behavior on the green roof of Central Market.

The experience of returning to nature through aesthetics is an effective stimulus in influencing visitors to engage in environmental protection. Several empirical studies also report that the experience of returning to nature through aesthetics influences ecological behavior, such as an empirical study in Germany that shows an increase in individuals' experiences in natural environments (such as aesthetic experiences with plants and animals), conducive to the formation of environmental awareness values, which then enhances their desire to take environmental protection actions (Riechers et al., 2022).

The feeling of connection with nature through aesthetics becomes an important factor in stimulating ecological behavior at the Central Market green roof. Visitors' feelings about aesthetic elements derived from nature become an important factor in determining whether they will participate in environmental protection behaviors, such as tree planting or purchasing eco-friendly products (Zhao et al., 2023).

Environmental knowledge media in the design of the green roof Central Market influences the formation of environmental awareness and concern. Other research also shows that environmental education provided in organic environments is proven to be effective in influencing the encouragement of ecological behavior (Pirchio et al., 2021).

Through the three points in the relationship of aesthetics, it fosters environmental awareness to appreciate the beauty of nature and influences the encouragement of ecological behavior.Leopold also argues that the capacity to appreciate the beauty of nature encourages someone to protect the environment.It stems from environmental awareness shaped by experience, feelings, and cognition (Parsons & Carlson, 2024).

Ecological behavior formed through environmental awareness results in environmental protection activities, including the use of recycled materials and avoiding plastic, waste sorting, energy conservation (electricity, water, and gas), tree planting, caring for animals, and environmental education.

Thus, the green roof of Central Market, through its aesthetics, can influence the ecological behavior of visitors through the relationship between aesthetics and behavior. This relationship involves a return to nature experience and a feeling of connection to nature through the representation of natural elements in the green roof design, and environmental knowledge media through environmental education in its facilities and green roof design.

The characteristics of the visitors also influence the sensory perception of aesthetics, feelings, experiences, and the three aspects that form aesthetics (experience, property, and aesthetic parameters) within it. Thus, it also determines what ecological behaviors occur on the green roof of Central Market.

D. Model Validation

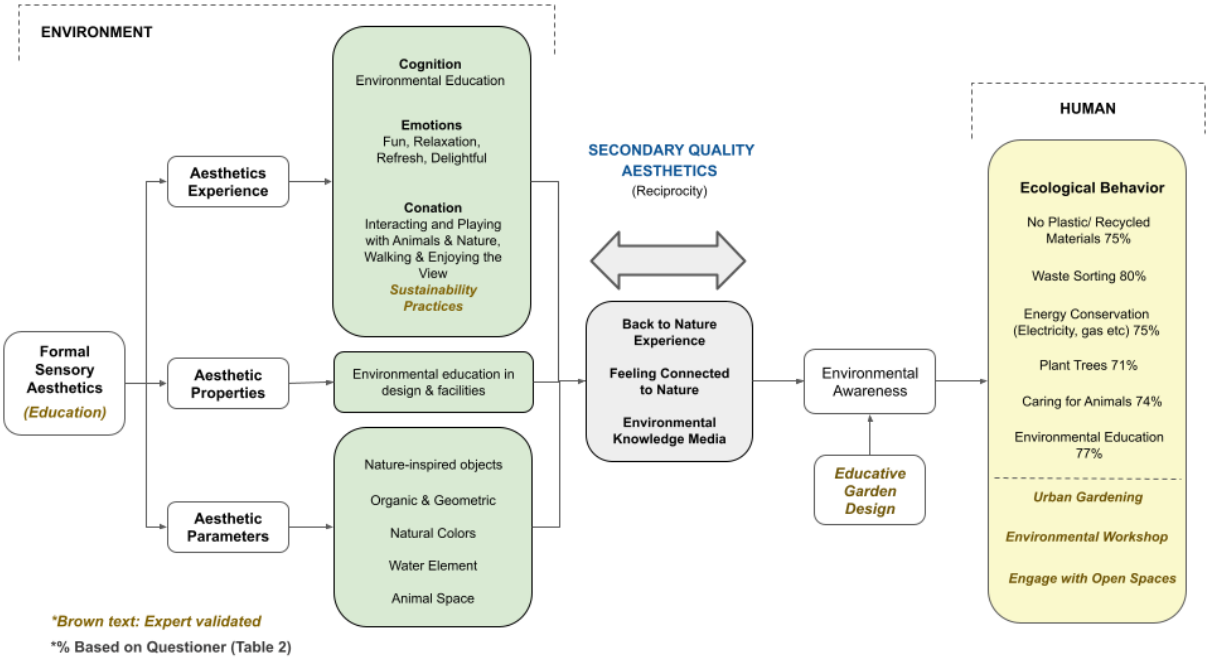

Fig. 11. Validation model of the influence of formal sensory aesthetics on ecological behavior in the green roof Central Market
Source: Author (2025)

The next stage involves expert validation through the model that has been previously created. Based on the validation results, there are additions to the formal sensory aesthetics of the Central Market green roof, which has the primary function and goal of educating visitors about sustainability through its design and facilities.

Additions to the conative aspect in the form of sustainability practices where visitors are encouraged not to use plastic through a campaign, taught to garden using limited space, environmental workshops, etc. An addition to emphasizing the role of the educative garden design in the form of an edible garden that triggers environmental awareness.

The addition of activities on ecological behavior, such as teaching urban gardening in edible gardens during specific events, environmental workshops, and comfortable outdoor activities with natural elements, triggers education and awareness of utilizing natural energy sources through the concept of sustainable living. Understanding green spaces and rooftops, as well as trees in urban areas, promotes physical or social activities outdoors comfortably (Othman et al., 2021).

Therefore, the green roof of Central Market has an aesthetic with the primary goal of educating visitors to behave ecologically, through experiences and feelings of connection to nature as well as environmental knowledge through its design and facilities.

IV. CONCLUSION

The results of this study indicate that the sensory formal aesthetics of the green roof at Central Market can influence the ecological behavior of visitors, as demonstrated through the model. Aesthetics that prioritize environmental education objectives can influence ecological behavior through an understanding of sustainability. That understanding takes the form of sustainability practices through design and its facilities. The relationship between formal sensory aesthetics and ecological behavior, such as the experience of returning to nature, the feeling of being connected to nature, and environmental knowledge media, influences the formation of environmental awareness in an effort to encourage ecological behavior. Ecological behavior is also influenced by the characteristics of visitors who are workers and already have families, as well as the duration and frequency of visits, which determine the types of ecological activities that occur. Three aspects that form aesthetics, namely experience, property,

and aesthetic parameters, are also influenced by the characteristics of visitors in perceiving aesthetics through their senses. The proposed model is developed by integrating aesthetic theory, the relationship between aesthetics and ecological behavior, and the ecological behavior itself, shows consistency with the findings of investigations and empirical analyses that are overall supported. The results of this study are expected to be considered by architects and designers, as when designing green roofs, they can take into account the aesthetic aspects that can have an educational purpose to influence the community to engage in ecological behavior for environmental protection. The suggestion for future researchers is to test the results of this research model on different case studies.

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