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Integrating Aesthetic Assessment of Tourism Landscapes into Environment-Based Education Curriculum

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ABSTRACT

Riau Province holds significant potential for the development of natural tourist attractions, particularly around the Koto Panjang Hydropower Reservoir, including Puncak Kompe, Raja Onam, and Taman Bunga Tepian Mahligai. Evaluating the aesthetic quality of these landscapes is crucial for supporting tourism and sustainable development. This study assessed the visual landscape aesthetics of these destinations using the Scenic Beauty Estimation (SBE) method. Data collection involved field observations, photography via DSLR cameras and drones, and questionnaires distributed to two groups of respondents: visitors and non-visitors. The SBE method categorized aesthetic values into low, medium, and high, based on respondent perceptions. The analysis revealed variations in aesthetic quality across the destinations. Puncak Kompe achieved the highest SBE score of 42 among visitors, indicating strong visual appeal. Raja Onam and Taman Bunga Tepian Mahligai also received high aesthetic scores of 49 and 40, respectively, from their respondent groups. Scores above 40 were classified as high, confirming the scenic richness of these locations. These findings highlight the significant aesthetic and visual value of the studied sites, suggesting their potential to attract a broad range of visitors. Additionally, the study illustrates the effectiveness of integrating the SBE method into environmental education. This research offers valuable insights for promoting sustainable tourism development in Riau, while also serving as a reference for incorporating landscape aesthetics into environmental education curricula.

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1. INTRODUCTION

Natural tourist attractions are one of the choices of tourist destinations that are in great demand by the public because they offer unique natural beauty and nuances. As one of the provinces with great potential for natural tourism development, Riau has many interesting destinations, including the area around the Koto Panjang Hydropower Reservoir. This area not only offers the beauty of the distinctive landscape but also the potential to be further developed as a sustainability-based tourist destination. This location includes various tourist attractions such as Puncak Kompe, Raja Onam, and Tepian Mahligai

Flower Garden, which are attractions for visitors due to their landscape characteristics and visual aesthetics.

Landscape aesthetics have an important role in the management of tourist areas. The beauty of the landscape, as expressed by (Akhsan, 2019; Li & Zhang, 2024), is a natural resource that needs to be preserved and developed without damaging its original character. This aesthetic assessment of the landscape is quite complex because it involves aspects of human perception of existing visual elements (Bondar et al., 2022; Karkina, Batyrshina, & Valeeva, 2020). According to (Hamid, 2012), aesthetic perception arises from a visual assessment of the appearance of an object which is influenced by the reaction of observers to the visual function of the landscape. Therefore, a systematic method is needed to evaluate the beauty of landscapes, such as the Scenic Beauty Estimation (SBE), which combines visual observations with respondents' assessments. Although the importance of landscape aesthetics in supporting the management of natural tourism has been widely discussed, there is a significant gap in literature and practice in the field of education (Al-Saud et al., 2024; Torquati, Cutler, Gilkerson & Sarver, 2013; Yu, Xu, Zou, Yang, & Ding, 2022). In particular, there have not been many studies that integrate the concept of landscape aesthetic assessment into the environment-based education curriculum (Semken & Freeman, 2008; Sunassee, Bokhoree, & Patrizio, 2021; Wu, Li, Ma, Wang, & Zhu, 2022). In fact, the introduction of methods such as SBE in learning can provide educational benefits, such as increasing students' understanding of the importance of environmental conservation, strengthening analytical skills, and developing awareness of aesthetic values in daily life.

In addition, most environmental education curricula today still focus on aspects of conservation and natural resource management without explicitly teaching how to evaluate and appreciate the beauty of landscapes (Yu et al., 2022). This creates opportunities to develop innovative learning approaches, where landscape aesthetic assessments can be integrated as part of an environment-based curriculum (Ren, 2024). This study aims to evaluate the aesthetics of the landscape in the Koto Panjang Hydropower Reservoir tourist area using the SBE method and explore how the results of the assessment can be integrated into the development of an environment-based education curriculum. Thus, this research not only contributes to the management of natural tourist destinations but also offers a new perspective in increasing environmental awareness through an educational approach.

2. METHODS

This research was carried out in the Koto Panjang Hydropower Lake tourist area, which includes three main destinations: Puncak Kompe, Raja Onam, and Tepian Mahligai Flower Park. Administratively, the research location is in District XIII Koto Kampar, Kampar Regency, Riau Province, and takes place from October to November 2023. The tools used in this study include DSLR cameras, drones, and stationery, while the materials used are questionnaires and landscape photos from observations in the field.

The type of research used is quantitative-descriptive, aiming to analyze the collected data and present it in the form of numbers, tables, and diagrams, which are then explained narratively. The research sample was taken using the purposive sampling method based on predetermined criteria. From a visitor population of 18,688 people, the number of samples was calculated using the Slovin formula with a margin of error of 10%, resulting in 100 respondents. The respondents were divided into two groups, namely 50 people who had visited the research site and 50 people who had never visited.

The research data consists of primary data and secondary data. Primary data was obtained directly from the research location, in the form of landscape portraits, questionnaire answers, and photo documentation. Meanwhile, secondary data was obtained from literature, journals, proceedings, and archival documents relevant to tourist destinations in the Koto Panjang Hydropower Lake area. Data collection techniques include field observation to observe location conditions, accessibility, facilities, and landscapes; shooting using DSLR cameras and drones with eye-level settings from morning to evening

for optimal lighting; and filling out a questionnaire by respondents to assess the landscape on a scale of 1–10.

The application of the SBE method consists of three main steps, namely compiling pictures at each point of the landscape with color results, presenting each photo on the slide to the respondents and providing questionnaires and analyzing the results of the respondents (Asgitami, 2017). The data of each landscape is grouped based on an assessment scale from 1-10 then each scale is calculated the sum of frequencies (f), cumulative frequencies (cf), cumulative opportunities (cp), and Z values with the following formula (Malyati, 2019).

F = Number of similar scores that appear
CF = $\sum F - F(n)$
CP = $Z\frac{F}{\sum F} \times 100 = \frac{X-\mu}{P}$

Information:
$\sum F$ = Total frequency
F (n) = Frequency to n-
X = Landscape-tested
= Average
= Standard Deviation

The data that has been analyzed is then included in the Scenic Beauty Estimation (SBE) formula as follows:

$$SBE_X = \{ Z_{YX} - Z_{Y0} \} X\ 100$$

Information:
SBEX : The value of estimating the beauty of a landscape in the xth
ZYX : The average value of the xth landscape z
ZY0 : The average value of z of a particular landscape as a standard

The SBE value of each landscape is grouped into three categories, namely low, medium, and high. In accordance with the respondents' answers that have been processed using *the Scenic Beauty Estimation (SBE) formula.* According to (Malyati, 2019), to determine the category of beauty, it is calculated using *a Simplified Rating* with the formula:

$$= \frac{\text{Max Score} - \text{Min Score}}{}$$

It can also be seen based on the assessment criteria in Table 1.

Table 1. Assessment Criteria

Category	Characteristic
Low	a. Vegetation is not well organized b. Facilities and infrastructure are not well organized c. There is garbage or waste d. Poor pavement elements
Medium	a. The vegetation is not well organized enough b. Facilities and infrastructure are quite well organized c. No garbage or waste d. Pavement elements are quite good

High	a. Well-organized vegetation b. Facilities and infrastructure are well organized c. No garbage or waste d. Excellent pavement elements

Source: (Nurwajehi, Trisutomo, & Ekawati, 2019)

The landscape that is chosen or preferred by many respondents as a beautiful landscape is the landscape with a high SBE value or the lowest Z value, which is a value close to 0. The results of this analysis are expected to provide an overview of the aesthetic quality of the landscape in the Koto Panjang Hydropower Lake tourist area and its potential to be integrated into the environment-based education curriculum.

3. FINDINGS AND DISCUSSION

3.1 Landscape Aesthetic Assessment in the Koto Panjang Hydropower Tourist Area

This study evaluates the aesthetic quality of landscape visuals in three main tourist locations in the Koto Panjang hydropower plant area: Puncak Kompe, Raja Onam, and Taman Bunga Tepian Mahligai. The results of the assessment were carried out through the Scenic Beauty Estimation (SBE) method, using respondents who were divided into two groups: those who had visited and those who had never visited. Respondents were asked to rate the landscape on a scale of 1–10 to describe their perception of the visual quality of the landscape. The data was then analyzed to classify the visual aesthetic quality into three categories: low, medium, and high.

3.1.1 Puncak Kompe

The results of the assessment show variations in aesthetic value in the landscape at Puncak Kompe. Respondents who had visited gave the highest SBE score of 42 (landscape 1) and the lowest -22 (landscape 2). Respondents who had never visited gave a high score of 40 (landscape 7) and a low score of -49 (landscape 8). The aesthetic quality of the high landscape in Puncak Kompe is characterized by a harmonious layout, cool vegetation elements, and good infrastructure. In contrast, low-scoring landscapes were identified as having untidy layouts, minimal maintenance, and unattractive visual elements.

Based on the results of the assessment of the visual aesthetic quality of the landscape by respondents who have visited and have never visited the 10 selected landscapes, the SBE value of the Puncak Kompe landscape is presented in Figure 1.

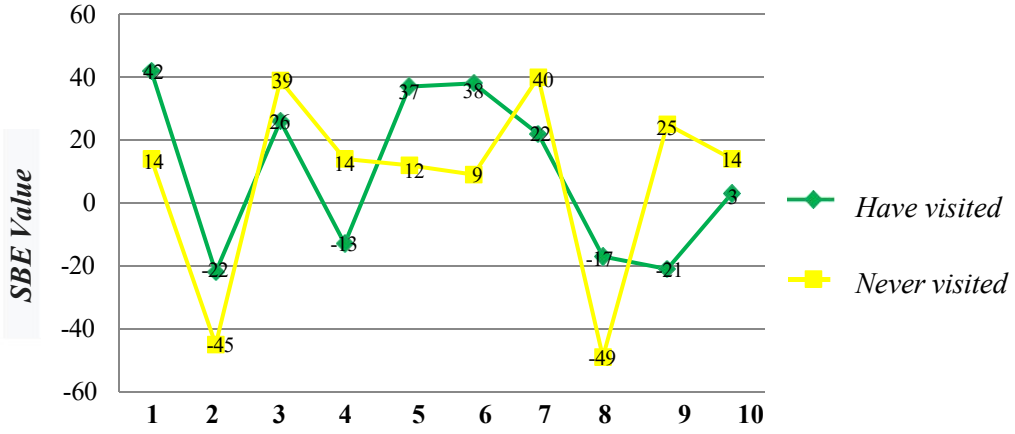

Figure 1. Distribution of SBE Values at the Peak of Companies

Based on the results of the SBE assessment in Figure 5, the landscape in Puncak Kompe using respondents who had visited was found in landscape 2 with a score of -22 and the highest SBE in landscape 1 with a score of 42. Meanwhile, the SBE score using respondents who have never visited has the lowest SBE score in landscape 8 with a score of -49 and the highest SBE value in landscape 7 with a score of 40.

Landscapes with the lowest SBE scores mean that these landscapes show low visual quality and are least liked by respondents. Meanwhile, the landscape with the highest SBE score showed high visual quality and was preferred by respondents (Chandra *et al*., 2018).

Figure 2. Lowest (Left) and Highest (Right) SBE Scores at the Peak of Companies Using Respondents Who Have Visited

Of the 10 landscape samples in Puncak Kompe used in this study, the SBE values that have been obtained are divided into 3 categories, namely low, medium and high categories. The division of categories is based on the classification contained in Table 3. Furthermore, in more detail about the classification of landscape visual quality classes in each landscape sample is described in Table 2.

Table 2. The level of landscape aesthetic quality at Puncak Kompe uses tourists who have visited and have never visited

Landscape	SBE Values		Category	
	Have Visited	Never Visited	Have Visited	Never Visited
1	42	14	High	High
2	-22	-45	Low	Low
3	26	39	High	High
4	-13	14	Low	High
5	37	12	High	High
6	38	9	High	Medium
7	22	40	High	High
8	-17	-49	Low	Low
9	-21	25	Low	High
10	3	14	Medium	High

Source : Processed data results (2023)

From the results of the calculation in Table 3, the classification of landscape quality classes based on respondents who have visited the low category is in the range of -22 to -0.667, the medium category

is in the range of -0.667 to 20.667 and the high category is in the range of 20.667 to 42. Furthermore, based on respondents who have never visited, the low category is in the range of -49 to -19,667, the medium category is in the range of -19,667 to 9,663 and the high category is in the range of 9,667 to 40.

3.1.2 Raja Onam

In Raja Onam, the results of the analysis showed that the landscape with the highest visual quality achieved an SBE score of 49 (landscape 8) for respondents who had visited and a score of 38 (landscape 2 and 6) for respondents who had never visited. Low-value landscapes, such as landscape 7 with SBE-46, generally show a lack of visual harmony, the presence of irregular elements, and a lack of maintenance. The comparison shows that landscapes with dominant natural elements are preferred, while areas with poor layout need improvement.

Based on the results of the assessment of the visual aesthetic quality of the landscape by respondents who have visited and have never visited the 10 selected landscapes, the SBE value of Raja Onam landscape is presented in Figure 14.

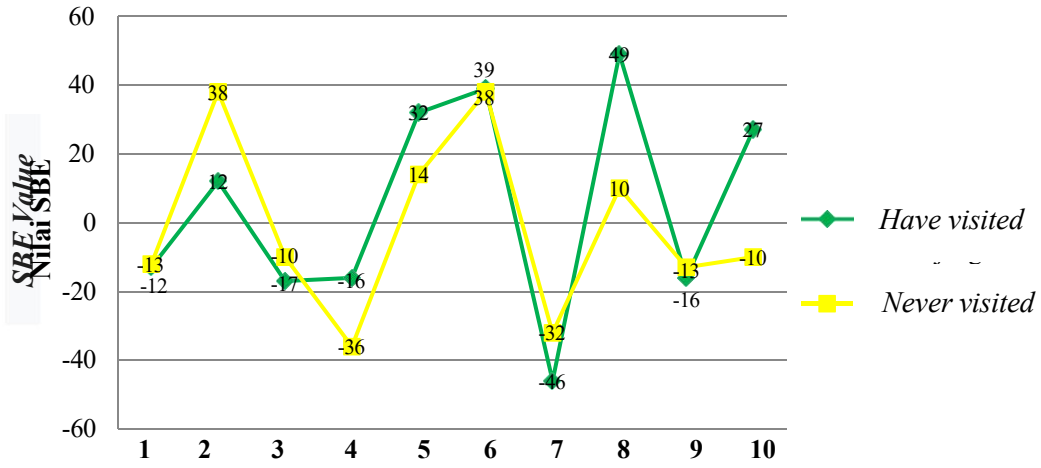

Figure 3. Distribution of SBE Values in Raja Onam

Based on the results of the SBE assessment in Figure 14, the landscape in Raja Onam using respondents who have visited the landscape with the lowest SBE score is found in landscape 7 with a score of -46 and the highest SBE value in landscape 8 with a score of 49. Meanwhile, the SBE score using respondents who have never visited has the lowest SBE score in landscape 4 with a score of -36 and the highest SBE value in landscapes 2 and 6 with the same score of 38. For more clarity can be seen in Figure 4 and Figure 5.

Figure 4. Lowest (Left) and Highest (Right) SBE Scores in Raja Onam Using Respondents Who Have Visited

Figure 5. Lowest (Lower) and Highest (Top) SBE Scores in Raja Onam Using Respondents Who Have Never Visited

All SBE scores that have been obtained are then classified based on low, medium and high aesthetic quality using a simplified rating. This level of quality is useful for comparing one landscape with another so that low-quality landscapes can be repaired or more maintenance is carried out so that the landscape becomes a high-quality landscape. The classification of the level of landscape aesthetic quality in Raja Onam can be seen in Table 3.

Table 3. Classification of Landscape Aesthetic Quality Grade Level In Raja Onam

Respond	SBE Values	Category
Have Visited	-46 to -14.33	Low
	-14.33 to 17.33	Medium
	17.33 to 49	High
Never Visited	-36 to -11.33	Low
	-11.33 to 13.34	Medium
	13.34 to 38	High

Source: Processed data results (2023)

Of the 10 landscape samples in Raja Onam used in this study, the results of the SBE values that have been obtained are divided into 3 categories, namely low, medium and high categories. The division of categories is based on the classification contained in Table 5.

3.1.3 Mahligai Flower Garden

The assessment at the Mahligai Tepian Flower Garden revealed that landscapes with high aesthetic value, such as landscape 9 (SBE 36 for respondents who had visited) have harmonious visual elements and attractive decorations. In contrast, low-value landscapes, such as landscape 2 (SBE-16), indicate a lack of good layout and adequate care of vegetation elements. The park has high aesthetic

potential, but some of the landscape needs improvement, such as the addition of interesting visual elements and vegetation maintenance.

Based on the results of the assessment of the visual aesthetic quality of the landscape by respondents who have visited and have not visited the 10 selected landscapes, the SBE value of the Tepian Mahligai landscape is presented in Figure 6.

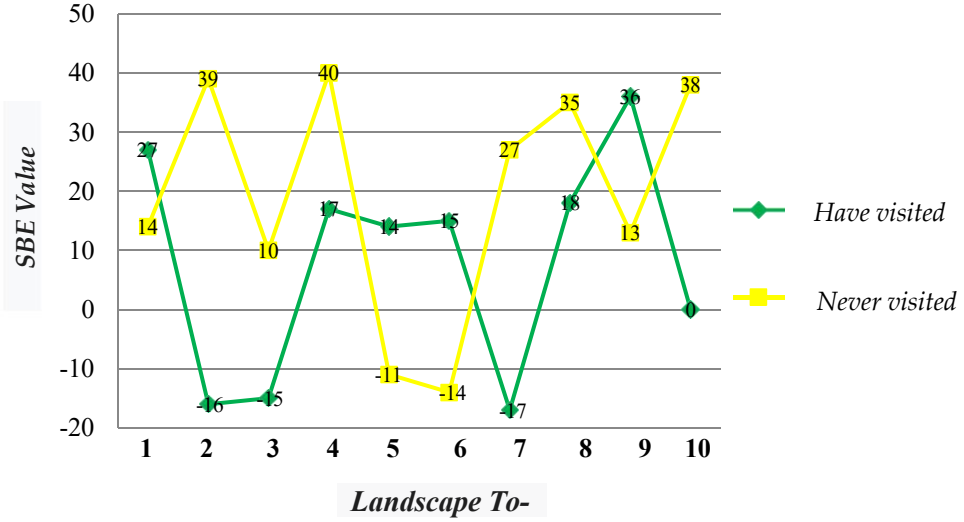

Figure 6. Distribution of SBE Values on the Banks of Mahligai

Judging from Figure 6, the results of the visual quality assessment of the landscape in the Mahligai Tepian Flower Park show a significant variation between respondents who have visited and respondents who have never visited. The landscape in Tepian Mahligai using respondents who had visited was found to be the landscape with the lowest SBE value in landscape 7 with a score of -17 and the landscape with the highest SBE value, namely landscape 9 with a score of 36. Meanwhile, the SBE score using respondents who have never visited has the lowest SBE score in landscape 6 with a score of -14 and the highest SBE value in landscape 4 with a score of 40. For more clarity, see Figure 7 and Figure 8.

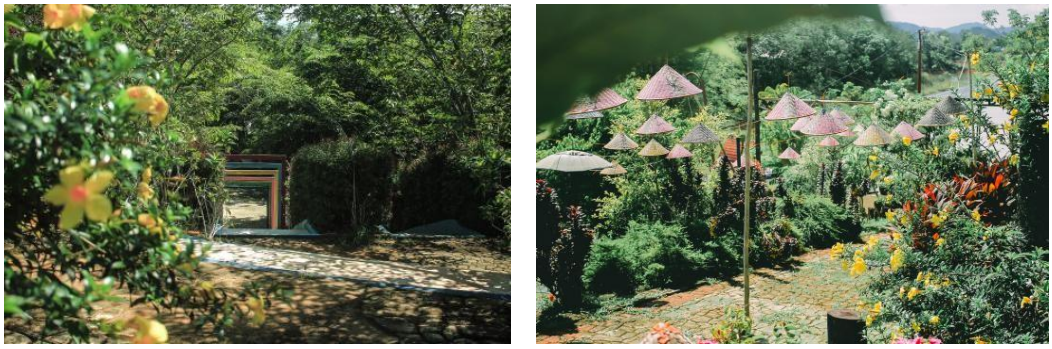

Figure 7. Lowest (Left) and Highest (Right) SBE Scores on the Edge of Mahligai Using Respondents Who Have Visited

Figure 8. Lowest (Left) and Highest (Right) SBE Scores on the Banks of Mahligai Using Respondents Who Have Never Visited

All SBE scores that have been obtained are then classified based on low, medium and high aesthetic quality using a simplified rating. This classification is carried out because the scores of respondents vary from landscape to landscape. The classification of the level of landscape aesthetic quality in Tepian Mahligai can be seen in Table 4.

Table 4. Classification of Landscape Aesthetic Quality Classes on the Edge of Mahligai

Respond	SBE Values	Category
Have Visited	-17 to 0.667	Low
	0.667 to 18.33	Medium
	18.33 to 36	High
Never Visited	-14 to 4	Low
	4 to 22	Medium
	22 to 40	High

Source: Processed data results (2023)

Of the 10 landscape samples in Tepian Mahligai used in this study, the results of the SBE values that have been obtained are divided into 3 categories, namely low, medium and high categories. The division of categories is based on the classification contained in Table 7.

3.2 Comparison of Visual Aesthetic Quality of Landscape

Each landscape possesses unique characteristics that differentiate its visual aesthetic quality from others. These differences are evident in several aspects, including the inherent natural beauty, spatial layout, color harmony, composition of visual elements, and the emotional or perceptual impact experienced by viewers when observing the scenery (RA, Hadinoto, & Akbar, 2024; Ren, 2024; Sukma, 2019). Elements such as the arrangement of vegetation, presence of water bodies, terrain variation, and cultural or man-made features all contribute to shaping the distinct aesthetic appeal of a landscape. The purpose of evaluating and comparing the visual aesthetic quality of various landscapes is to develop a deeper understanding of which landscapes are categorized as having high, medium, or low aesthetic value. Such evaluations are essential in guiding landscape management strategies, tourism planning, and conservation efforts to enhance the attractiveness and sustainability of these environments.

Furthermore, understanding aesthetic differences provides valuable insights for policymakers and stakeholders to prioritize areas that require improvement or preservation. This systematic classification ensures that landscapes with high aesthetic value are maintained, while strategies can be developed to enhance those with lower scores. In this study, the Scenic Beauty Estimation (SBE) method was applied to quantify these aesthetic values, and the results are categorized accordingly. The classification of

average SBE scores into high, medium, and low categories is summarized in Table 5, providing a clear reference for future landscape management and development initiatives.

Table 5. Classification of Landscape Aesthetic Quality Grade Levels in 3 Locations.

Respond	SBE Values	Category
Have Visited	5.1 to 6.567	Low
	6.567 to 8.034	Medium
	8.034 to 9.5	High
Never Visited	-1.3 to 5.5	Low
	5.5 to 12.3	Medium
	12.3 to 19.1	High

Source: Processed data results (2023)

Furthermore, the average SBE score in Puncak Kompe, Raja Onam and Tepian Mahligai is adjusted to the classification that has been determined in Table 5 and the results are obtained as shown in Figure 9.

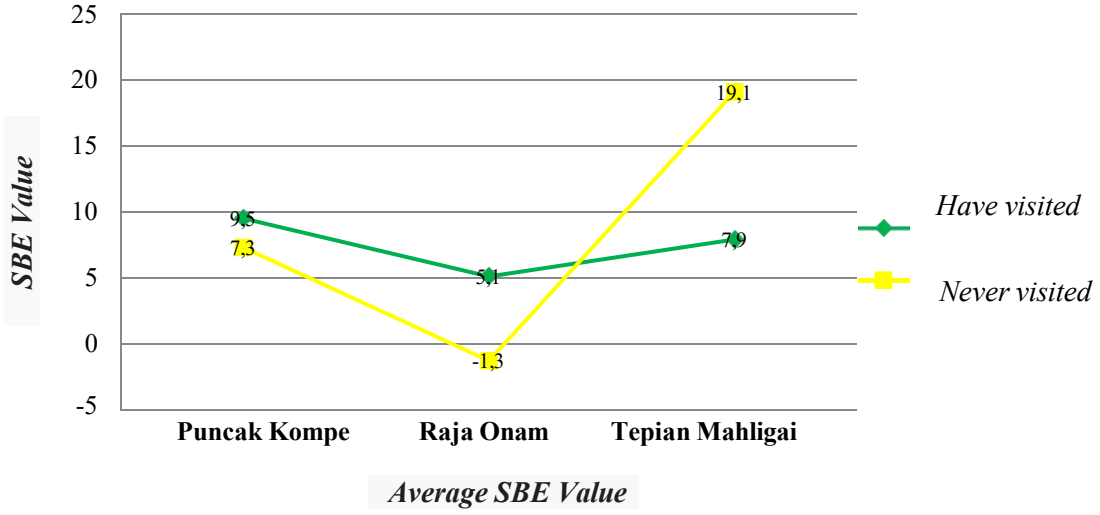

Figure 9. Average SBE Score in 3 Research Locations

The analysis presented in Figure 9 reveals a significant difference between respondents who have previously visited the study locations and those who have never visited. This disparity is particularly evident in the case of Taman Bunga Tepian Mahligai, where firsthand experience appears to influence the respondents' perception of aesthetic quality. This supports the understanding that individual experiences and familiarity with a landscape can shape subjective judgments of beauty (Kolb & Kolb, 2005; Ren, 2024).

The classification of landscape aesthetic quality based on respondents who have visited shows that the low category falls within an SBE score range of 5.1 to 6.57, the medium category from 6.57 to 8.03, and the high category from 8.03 to 9.5. Meanwhile, for respondents who have never visited, the low category ranges from -1.3 to 5.5, the medium from 5.5 to 12.3, and the high from 12.3 to 19.1. Specifically, for respondents who have visited, Raja Onam recorded the lowest score (SBE 5.1), Taman Bunga Tepian Mahligai fell into the medium category (SBE 7.9), and Puncak Kompe achieved the highest score (SBE 9.5). Conversely, for those who have never visited, Raja Onam again scored lowest (SBE -1.3), Puncak

Kompe was classified as medium (SBE 7.3), and Taman Bunga Tepian Mahligai achieved the highest SBE score (19.1).

These variations highlight how respondent background and direct experience influence aesthetic evaluations. The consistently low SBE scores for Raja Onam across both groups indicate that improvements in landscape management, design, and maintenance are necessary to enhance its visual appeal.

A comparative analysis of the three locations reveals that the aesthetic quality of a landscape is influenced by the interplay of visual elements, spatial layout, and upkeep. The preference for Puncak Kompe among respondents who have visited suggests that on-site experience reinforces positive perceptions, while Taman Bunga Tepian Mahligai's appeal to those who have never visited may be linked to its visually striking elements captured through media or external descriptions.

Furthermore, this study underscores the relevance of integrating landscape aesthetic assessments like the Scenic Beauty Estimation (SBE) method into environment-based education. By teaching students to assess and analyze landscapes, educators can foster greater awareness of the connection between visual aesthetics and environmental sustainability (Li & Zhang, 2024; RA, Hadinoto, & Akbar, 2024).

The findings contribute meaningfully to the development of an environment-based curriculum by illustrating practical applications of aesthetic assessment. For instance, students can be trained to evaluate local landscapes using SBE scales, identifying visual strengths and areas for improvement (Akhsan, 2019; Lieberman, 2013). This process not only sharpens their analytical skills but also nurtures a sense of environmental responsibility.

Additionally, engaging students in projects that involve real-world landscape evaluation—such as assessing their school or community environment—promotes active learning and encourages them to propose creative solutions for landscape enhancement (Hoang, Al-Tawaha, Vu, Qaisi, & Křeček, 2021; Tranter & Malone, 2004). Understanding how elements like vegetation care, waste management, and spatial planning influence landscape aesthetics can deepen their appreciation of sustainability practices.

Ultimately, integrating landscape aesthetic assessment into educational curricula offers a contextual and meaningful learning experience. It empowers students with critical thinking, creativity, and environmental stewardship skills, providing them with the tools to contribute to sustainable local tourism and environmental management (E. S. Wahyuni, Aspan, & Mauliza, 2023; S. Wahyuni, Liza, Rusandi, Situmorang, 2023; Zhou & Lian, 2020).

4. CONCLUSION

This study evaluated the aesthetic quality of natural tourist attractions in Riau, focusing on destinations around the Koto Panjang Hydropower Reservoir, specifically Puncak Kompe, Raja Onam, and Taman Bunga Tepian Mahligai. Using the Scenic Beauty Estimation (SBE) method, which quantifies landscape aesthetics based on subjective human perceptions, the study incorporated field observations, photography (via DSLR cameras and drones), and respondent questionnaires. Respondents were classified into two groups: those who had previously visited the locations and those who had not. The findings revealed clear variations in aesthetic quality across the three sites. Puncak Kompe received the highest SBE score (42) among visitors, while Raja Onam and Taman Bunga Tepian Mahligai attained scores of 49 and 40, respectively, highlighting their strong visual appeal. Landscapes with higher aesthetic value demonstrated well-organized visual elements, harmonious layouts, and effective vegetation maintenance, whereas lower-scoring landscapes reflected inadequate management and maintenance practices.

A notable finding is the difference in aesthetic assessments between respondents with direct experience and those without, emphasizing the influence of firsthand engagement in shaping perceptions. Furthermore, the study underlines the relevance of integrating landscape aesthetic

evaluations into environment-based educational curricula. By incorporating methods like SBE, educators can foster students' analytical skills, enhance environmental awareness, and encourage appreciation of landscape aesthetics as part of sustainable development education.

However, the research has certain limitations. The study's scope was limited to three tourist locations, and the respondent sample size, while adequate, may not fully represent broader demographic variations. Additionally, the subjective nature of aesthetic assessment could be influenced by personal biases or cultural backgrounds.

For future research, it is recommended to expand the study to include a wider range of tourist destinations and larger, more diverse respondent groups. Further studies could also explore the integration of qualitative insights, such as in-depth interviews or focus group discussions, to complement SBE findings. Moreover, longitudinal research examining how improvements in landscape management impact aesthetic perceptions over time would provide valuable contributions to both tourism development and environmental education strategies.

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