ADVANTAGES OF 360° VIRTUAL GREEN SPACES TOUR TO SUPPLEMENT SUSTAINABLE ARCHITECTURE EDUCATION: CASE SRENGSENG URBAN FOREST IN WEST JAKARTA

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ABSTRACT

This paper aims to analyze the benefits of using 360° virtual tours as a tool in sustainable architecture education, with a case study of the Srengseng City Forest in West Jakarta. The technology used includes a *360° GoPro Max* camera, a *DJI Mavic 3* drone, and the *Keyplano* application to produce immersive and interactive visualizations of green spaces. Through this method, architecture students can learn important elements in sustainable design, such as vegetation layout, water management systems, and the ecological function of green spaces without having to make aphysical visit. The evaluation results show that most students experienced an increased understanding of sustainable architecture after using the virtual tour. Additionally, this technology offers significant accessibility and flexibility inthe learning process. However, limitations in physical sensory experience remain an obstacle. Therefore, the use of 360° virtual tours should be seen as a complement to physical field learning, with great potential to increase the effectiveness of sustainable architectural education.

Keywords: Green space, virtual tour, urban forest, sustainable architecture

INTRODUCTION

The SDG 11.7, by 2030, provide universal access to safe, inclusive and accessible, green and public spaces, particularly for women and children, oldere persons and persons with disabilities. Sustainable architecture aims to reduce the environmental impact of buildings and infrastructure through designs that pay attention to energy efficiency, the use of environmentally friendly materials, and the integration of green spaces that support urban ecosystems (Buchanan, 2005). One important aspect of sustainable architecture is the existence of green spaces, which not only play a role in improving environmental quality but also provide benefits for the mental and physical health of urban communities (Chiesura, 2004). Along with the development of technology, architectural education methods also continue to develop to adapt to the needs of the current generation. One innovation in architectural education is the use of 360° virtual tours technology, which allows students to explore various architectural spaces and green open spaces virtually without having to be physically present. This technology not only provides an immersive visual experience, but also allows students to understand the ecological, social, and design contexts of architecture in more depth (Fonseca et al., 2020).

Srengseng Urban Forest, located in West Jakarta, is one of the urban green spaces that successfully integrates ecological functions with community needs. This urban forest provides a recreational area for local residents, and functions as the city's lungs that help reduce air pollution in dense urban areas (Sudarmo, 2018). With an area of around 15 hectares, Srengseng Urban Forest offers views of diverse ecosystems that can be an example for architecture students to learn the concept of green space in an urban context.
Considering the importance of green space in sustainable design and the potential of 360° virtual tours technology, this paper aims to explore the benefits of this technology in supporting sustainable architecture education, focusing on a case study of Srengseng Urban Forest in West Jakarta. This paper is expected to provide new insights into innovative ways to teach sustainable architecture concepts to future generations.

How can 360° virtual tours provide significant benefits in sustainable architecture education by expanding access to urban green spaces and improving students' understanding of environmentally friendly design principles, especially in the context of limited resources, time, and field accessibility? The purpose of this study is to examine how 360° virtual tours technology can enhance students' understanding of sustainable architecture, particularly in urban green spaces. This study has several important contributions, both to architectural education and the wider community.

This study provides new insights into how 360° virtual tours technology can enrich architectural learning methods, particularly in supporting the understanding of sustainable architecture concepts and green space design without

physical or geographical limitations. With the increasing need for distance learning, this study will demonstrate how 360° virtual tours can overcome the constraints of field visits and still provide an immersive and interactive learning experience. Overall, this study has the potential to transform the approach to architectural education and introduce new technologies that support more flexible, efficient, and meaningful learning and access for students and the public.

METHOD

To achieve the research objectives, several stages and technological tools will be used, including a *GoPro Max 360°* camera, a *DJI Mavic 3* drone, and the Keyplano application. The following are the stages of the proposed research methodology:

1. Preliminary Study and Determination of Research Location
• Objective: Understand the characteristics of Srengseng Urban Forest as a green space that is relevant for sustainablearchitecture studies.
• Activities: Collection of information and literature on Srengseng Urban Forest, including history, ecological functions, and green space design. Initial survey to identify key points in Srengseng Urban Forest that are relevant tosustainable architecture principles (e.g., vegetation layout areas, water management systems, and green space interactions with the urban environment).

2. Visual Data Collection with *GoPro Max 360°* Camera
• Objective: Create a 360° visualization of various green space elements in Srengseng Urban Forest.
• Tools: *GoPro Max 360°* Camera.
• Activities: Taking 360° images and videos at important locations in the Srengseng Urban Forest, based on the map,the selection of shooting points must consider elements related to sustainable architecture, such as natural irrigation systems, vegetation layouts that function as pollution barriers, and areas of human interaction with nature. Processingand merging 360° images/videos to ensure that every corner of the green space is well documented.

3. Aerial Image Capture with *DJI Mavic 3* Drone
• Objective: To produce a 360° aerial visualization of the Srengseng Urban Forest for macro analysis of the green space layout.
• Tools: *DJI Mavic 3* Drone.
• Activities: Conducting drone flights over the Srengseng Urban Forest to take aerial images of the entire city forest area, the shooting was carried out at a height of 150 m above ground level with a viewpoint of the Srengseng Urban Forest and its surrounding areas, this aerial image will be used to provide topographic context and the overall layout of the green space.

Figure 1. DJI Mavic 3 Drone with battery

4. Visual Data Processing Using the *Keyplano* Application
• Objective: Create an interactive and informative 360° virtual tour.

- Tool: Keyplano application.
- Activities: combine 360° images/videos from GoPro Max and aerial imagery from *DJI Mavic 3* into the *Keyplano* application, create an interactive virtual tour that allows users to move from one point to another in the Srengseng Urban Forest, add interactive information such as text, graphics, or maps to explain the elements of sustainable architecture found in the Srengseng Urban Forest

5. Testing and Evaluation of Virtual Tours by Architecture Students
- Objective: Assess the effectiveness of 360° virtual tours in supporting sustainable architecture learning.
- Subjects: Architecture students who are studying sustainable architecture concepts.
- Activities: Students will be given access to the Srengseng Urban Forest virtual tour that has been developed and eachstudent will be asked to explore the virtual tour and analyze the sustainability elements present in the green space. After the exploration, students will be asked to fill out a questionnaire that evaluates aspects such as: ease of use, visual quality, information obtained, and the impact of the virtual tour on their understanding of sustainable architecture.

6. Data Analysis
- Objective: Identify the benefits of 360° virtual tours in sustainable architecture education.
- Activities: Analyze qualitative and quantitative data obtained from student questionnaires. Compare the understanding of students who use 360° virtual tours with those who follow the traditional method (physical field visits). Identify the advantages and disadvantages of using 360° virtual tours technology in sustainable architecture education.

Tools and Technologies Used:
1. *GoPro Max 360°* Camera: For detailed 360° image and video capture of the Srengseng Urban Forest location.
2. *DJI Mavic 3* Drone: For 360° aerial images.
3. *Keyplano* Application: To process and create interactive virtual tours that can be accessed by architecture students.This methodology aims to show how visual technologies such as 360° cameras, drones, and virtual tour applications can be utilized in sustainable architecture education, especially in studying urban green spaces such as the SrengsengUrban Forest.

RESULTS AND DISCUSSION

By utilizing technologies such as the *GoPro Max 360°* camera, *DJI Mavic 3* drone, and *Keyplano* application, a virtual tour was developed to help students understand the important elements in green space design and sustainable urban planning. The following is an analysis of the research results and discussion related to the effectiveness of this technology:

1. Visualization of Green Space in the Context of Sustainable Architecture

One of the important elements in sustainable architecture is the integration of green space into urban design to support ecological balance, air quality, and community welfare. The Srengseng Urban Forest, as an urban forest, offers a real example of green space that has been successfully integrated into a dense urban planning.

In this study, the visualization of the Srengseng Urban Forest as a green space through 360° virtual tours provides a comprehensive and in-depth representation of sustainable design elements. From the results of visual observations using a 360° camera and drone, it was found that the layout of trees, waterways, and open spaces in the Srengseng Urban Forest can be studied comprehensively by students. This technology provides immersive benefits, allowing students to experience the atmosphere of green spaces and understand how these natural elements can influence urban design.

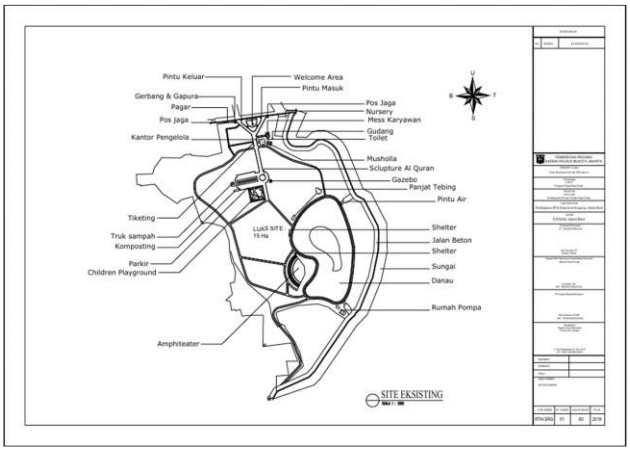

Figure 2. Existing site

Discussion:
- Advantages of immersive visualization: This virtual tour can replace physical visits by providing a nearly identical experience. Students can visually examine the relationships between elements in green spaces, such as the interaction between waterways and vegetation, which is difficult to do through traditional two-dimensional images or maps.
- Focus on sustainability: In the Srengseng Urban Forest, students can see how the green space layout system helps incarbon sequestration, air temperature cooling, and water management naturally. Through a virtual tour, these elements can be observed more efficiently and connected to the principles of sustainable architecture.

2. Flexibility and Accessibility of Virtual Technology in Learning

One of the main advantages of using 360° virtual tours technology is the wide accessibility and flexibility of time it offers. In the context of architectural education, time, cost, and location constraints are often obstacles for students toconduct direct field visits. Srengseng Urban Forest, despite being in Jakarta, may not be easily accessible to all students, especially during the pandemic or mobility restrictions.

This study shows that students who use 360° virtual tours can access Srengseng Urban Forest anytime and from anywhere. Through the *Keyplano* application, students can explore various aspects of the green space, zoom in on certain details, and navigate the city forest in a more flexible way.

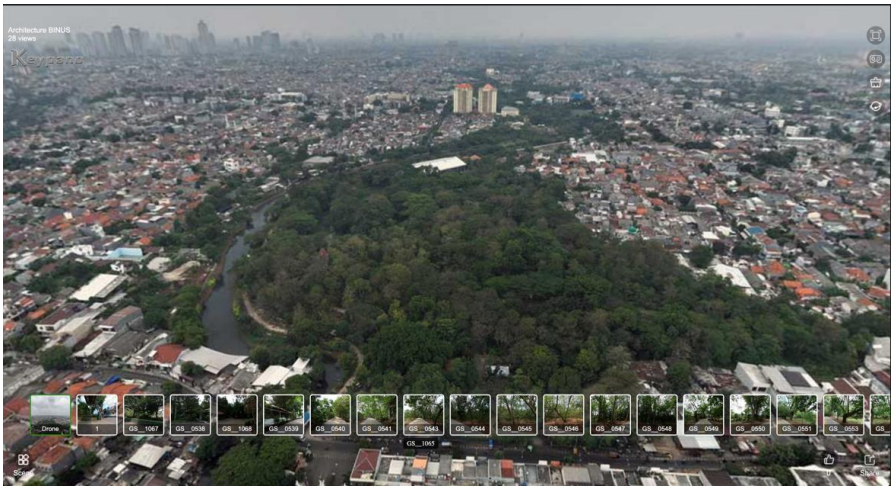

Figure 3. Aerial View of Srengseng Urban Forest by drone

Discussion:
- Cost and time savings: Virtual tours allow students to explore green spaces without having to spend transportation and logistics costs that are usually required for physical visits. This is especially helpful for students who do not live in Jakarta or do not have direct access to Srengseng Urban Forest.

• Physical limitations vs. virtual experience: Although virtual tours provide flexible access, direct physical interactionwith natural elements such as fresh air, tree scents, and temperature at the location cannot be perfectly simulated. Therefore, although this technology is very helpful, there are still shortcomings in sensory aspects that cannot be feltby students.

3. Interactivity and Learning Quality

The results of the evaluation of students who accessed the 360° virtual tours of the Srengseng Urban Forest showed that most of them considered this technology interactive and informative. This tour provides high-quality visual content that allows students to explore in depth various elements related to sustainable design, such as water management systems, vegetation layout, and relationships between ecological elements.

Students can see an overall picture of the green space layout, observe vegetation patterns and structures, and understand how this green space is integrated with the urban environment. With the interactive features provided by the *Keyplano* application, students can also obtain additional information about the elements observed, such as the types of plants used, drainage arrangements, and other design aspects.

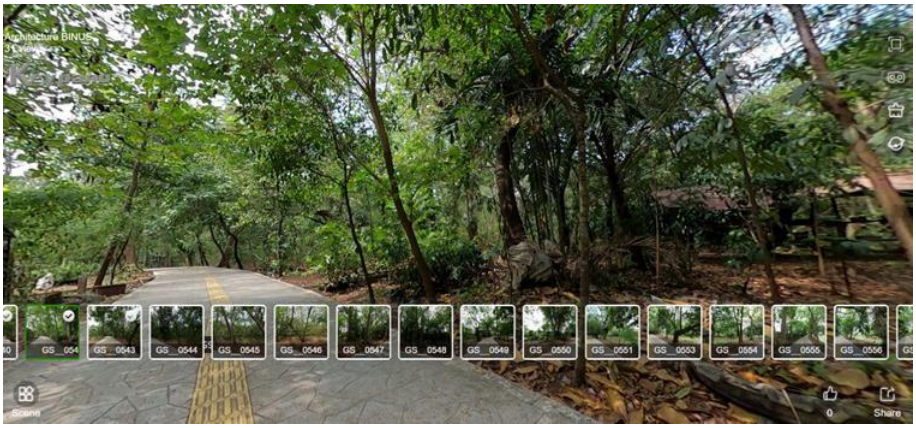

Figure 3. 360o Virtual Tour of Srengseng Urban Forest.

Discussion:

Reinforcement of concepts through visualization: The use of interactive visualizations helps students to better understand abstract concepts that may be difficult to understand only through text or two-dimensional illustrations. Virtual tours allow students to experience space in three dimensions.

CONCLUSION

This study shows that the use of 360° virtual tours in sustainable architecture education, with a case study of the Srengseng Urban Forest in West Jakarta, has several significant advantages. This technology provides immersive visualization that allows students to explore green spaces in depth and understand the important elements of sustainable design. The flexibility and accessibility offered by virtual tours allow students to access learning materials anytime and anywhere, overcoming the time and cost constraints that are usually obstacles in physical field visits.

Another advantage is the increased interactivity and quality of learning. Students can directly observe, examine, and understand the layout of green spaces and their relationship to sustainable architecture principles through the interactive features provided by the *Keyplano* application. The evaluation results showed that most students reported an increase in their understanding of sustainable architecture concepts after using virtual tours.

However, the limitations of sensory experiences, such as physical interaction with natural elements, remain a drawback of this technology. Therefore, virtual tours should be used as a complement to physical field learning, not as a full replacement. Overall, this study confirms that 360° virtual tours are an effective and innovative tool to support continuing architectural education and have great potential for further integration into architectural education curricula.

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REFERENCES

Buchanan, P. (2005). Ten Shades of Green: Architecture and the Natural World. Architectural League of New York.Buchanan, P. (2005). Ten Shades of Green: Architecture and the Natural World.

Architectural League of New York.Fonseca, D., Redondo, E., Villagrasa, S., & Navarro, I. (2020). Virtual Reality Integrated Into Teaching and Learningfor the Sustainable City: Immersive VR and Outdoor Activities for the Enhancement of Spatial Skills.

Sustainability, 12(15), 5971.

Sudarmo, D. (2018). Jakarta's Urban Forest and Its Role in Improving Air Quality. Journal of Urban Studies, 24(2),45-60.

Chiesura, A. (2004). The Role of Urban Parks for the Sustainable City. Landscape and Urban Planning, 68(1), 129-138.

Stevenson, F., & Williams, N. (2017). Sustainable Design Education: The Gap Between Attitude and Action. Journal of Architectural Education, 71(1), 44-54.