Student Communal Space Optimization Using Space Syntax Method Case Study: UIN Maulana Malik Ibrahim Malang (Campus 1)

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***Abstract-*. Communal spaces are essential for students to engage in various activities on campus. Previous research on student communal spaces has primarily focused on the internal aspects of these spaces, such as their capacity to accommodate student activities, students' perceptions of the communal space, the social interactions that occur within them, and behavioral analyses of students in these spaces. Consequently, this study seeks to examine student communal spaces from an external perspective, specifically by investigating the connectivity and visibility of the surrounding environment to identify the most optimal areas that hold significant potential for development into student communal spaces. UIN Maulana Malik Ibrahim Malang has yet to provide high-quality and optimized communal spaces for students within the campus environment. Using the Space Syntax method, this study reveals three areas with the potential to be developed into student communal spaces on campus based on the results of Axial Graph Analysis (AGA) and Visibility Graph Analysis (VGA): the area between the Science and Technology Building and the Megawati Building, the area in front of the microteaching lab, and the grand staircase area. The findings of this study are expected to serve as recommendations for the university in planning the development of student communal spaces within the campus environment.**

Keywords; Student Communal Space, Space Syntax, Optimization

I. INTRODUCTION

Students at all levels of education tend to form small to large groups and identify specific locations for gathering and interacting [1]. In addition, to serving as a place for teaching and learning, the campus functions as a social space that fosters interaction and socialization among its members. These interactions often occur in hallways, corridors, staircases, cafeterias, or other common areas [2].

The spatial arrangement that shapes communal spaces is fundamentally influenced by the characteristics of the communal space itself, the activities of students utilizing the space, and the behavior of users. To determine an appropriate design for campus development, it is essential to consider the available facilities and the quality of the learning environment [3]. The presence of communal spaces, such as public open areas, plays a critical role in enhancing the quality of life and well-being of academics, particularly students [4], [5], [6], [7]. Public open spaces are significant as they promote active lifestyles and foster beneficial interactions between humans and nature, contributing to both physical health [8] and mental well-being [9], overall well-being [10], and quality of life [11].

The criteria for public open spaces as social spaces on a university campus often include proximity to the campus's main circulation routes [12], due to their high accessibility, the presence of safe pathways [13], and strategic placement at crossroads or near essential student services (e.g., photocopy shops or cafeterias). These spaces are typically equipped with seating areas and shade-providing elements, which may consist of either specific materials or natural elements such as trees [1]. However, it is not only the distance that influences usage but also the size and attractiveness of public open spaces. Larger public open spaces tend to draw users from greater distances, whereas smaller spaces, even if located nearby, may be less attractive [14]. The concept of proximity pertains to the physical distance between two destinations, while the concept of choice relates to the variety of accessible alternatives. Beyond the physical form of green spaces, factors such as accessibility [15], [16], and the selection of specific spaces [17], [18] can influence how effectively a space serves as a venue for public interaction.

Earlier studies on student communal spaces have largely concentrated on their internal characteristics, including their ability to support student activities [19], students' perceptions of the spaces [20], social interactions within them [21], and analyses of student behavior in these

areas [22]. In response, this research aims to explore student communal spaces from an external standpoint, focusing on the connectivity and visibility of the surrounding environment to identify the most suitable areas for potential development into student communal spaces.

UIN Maulana Malik Ibrahim Malang students tend to do their assignments outside the campus locations, such as coffee shops, cafeterias, and mosques, due to the inadequacy of on-campus communal spaces. The limited availability of suitable communal areas forces students to seek alternative spaces that better support their informal activities. Additionally, the quality of the provided communal spaces fails to meet students' needs, particularly regarding supportive facilities, accessibility, and visibility. Based on these considerations, UIN Maulana Malik Ibrahim Malang was selected as an appropriate case study.

This research aims to identify areas with optimal spatial configurations for use as communal spaces on the UIN Maulana Malik Ibrahim Malang Campus 1 and to optimize the spatial conditions surrounding these spaces to serve as effective communal areas for students. The study employs the Space Syntax approach, considering the proximity of public open spaces as communal areas and the ease with which students can access them. Measurements of connectivity and the accessibility of public open spaces for learning and interaction can be conducted using the Space Syntax method. Originally introduced by Hillier and Hanson at University College London in 1984, Space Syntax represents spatial structures through axial maps, the basic unit of measurement in Space Syntax from which all syntactic calculations are derived. This research focuses on the campus pathways at UIN Maulana Malik Ibrahim Malang as the unit of analysis. By identifying the characteristics of communal spaces and examining road access configurations, this study seeks to evaluate their effectiveness as public open spaces. The findings are expected to provide useful insights for campus designers and decision-makers to enhance the design of public spaces that support productive social interactions and meaningful learning experiences for students.

II. MATERIAL AND METHODS

In this study, the data utilized includes a map of UIN Maulana Malik Ibrahim Malang, comprising buildings and open spaces (solid-void), as illustrated in Figure 1. Field observations were subsequently conducted in the UIN Maulana Malik Ibrahim Malang area to identify building zones, parking areas, and other spaces that are unsuitable for communal purposes due to specific conditions. The research employs both quantitative and qualitative methods.

Figure 1 UIN Maulana Malik Ibrahim Map
(Personal Documentation, 2024)

The study uses the DepthmapX software to analyze the spatial configuration, aiming to identify the most effective spaces based on the highest values of connectivity, integration, and visibility. The data collected is processed and analyzed through these metrics. The analysis focuses on measuring integrity, connectivity, and visibility to assess the compactness of the road network in supporting public spaces (Mohammed & Abaas, 2024). The integrity value represents the relative distance from one observed space to all other spaces within the spatial system (Turner et al., 2005; Claudia Yamu et al., 2021). Connectivity is calculated based on the number of spaces directly connected to a specific path.

DepthmapX will compute the axial graph (connectivity, integration, and choice) and visibility graph for the UIN Maulana Malik Ibrahim Malang area. This analysis will result in recommendations for potential areas that could serve as communal spaces for students.

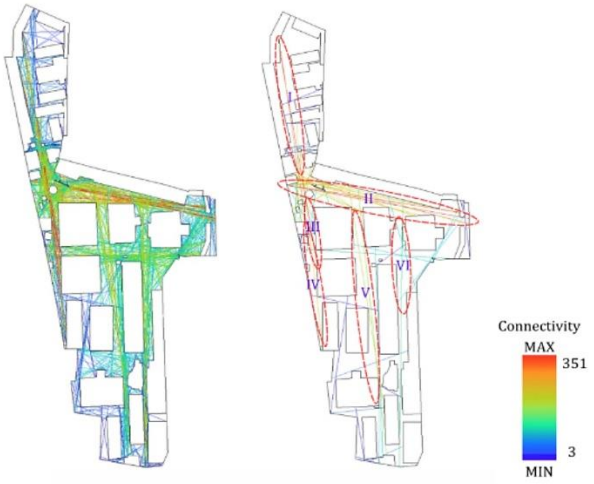
III. RESULT AND DISCUSSION

A. Axial Graph Analysis (AGA)

The axial map is used to analyze the potential movement and accessibility of communal spaces from both

roads and academic buildings. The higher the level of accessibility, the redder the color index produced. Conversely, the bluer the color index, the lower the accessibility and movement in the area. There are three main aspects calculated in an axial map: connectivity, integration, and choice.

Connectivity



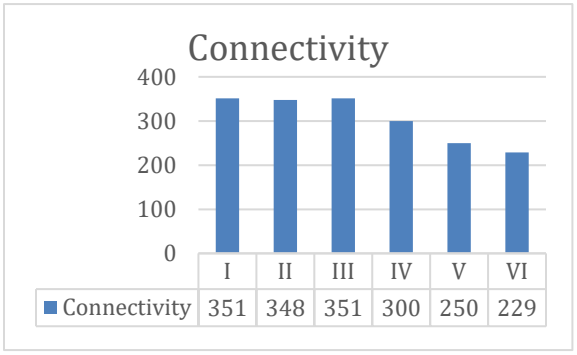
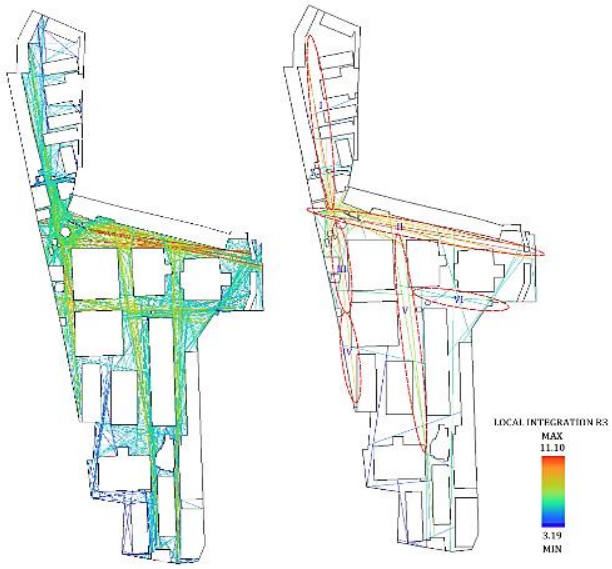


Figure 2 Connectivity Analysis
(DepthmapX Analysis Result, 2024)

Connectivity identifies areas that are directly connected (Mohammed & Abaas, 2024). The use of connectivity analysis aims to locate areas with the highest levels of interaction, facilitating student access to these spaces. As shown in Figure 2, the area with the highest connectivity is located along the corridor of the male dormitories (Area I) with a score of 351, in front of the Saintek Building (Area III) with a score of 348, and in front of the microteaching lab building (Area II) with a score of 348. Areas with red to yellow color indices have a high potential to serve as communal spaces due to their high accessibility from surrounding buildings. However, because Area I is restricted to male students, it is considered a more private space, limiting access for the wider student population. In Area III, there are no spaces with the potential to serve as communal areas for students, as the space is already fully occupied by parking lots. In contrast, Area II still has available green open space, which could be optimized to create a communal area for students.

Local Integration



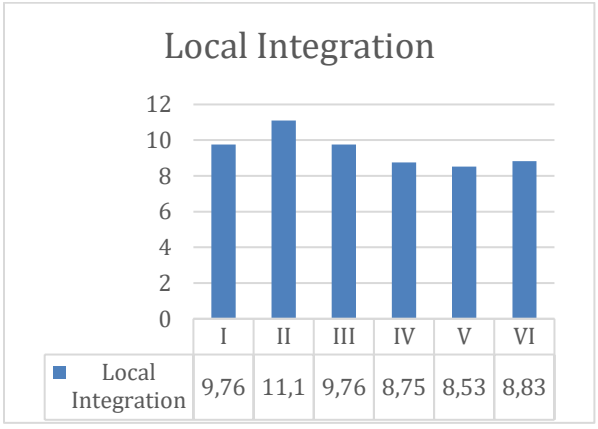


Figure 3 Integration Analysis
(DepthmapX Analysis Result, 2024)

This analysis identifies the potential movement within the area, with a relatively low value scale. Local integration examines the local movement of pedestrians and their access to specific destinations. The integration analysis of the UIN Maulana Malik Ibrahim Malang campus (Figure 3) shows that the area in front of the microteaching lab building (Area II) has the highest integration value, at 11.1. The second highest is the area in front of the Saintek Building (Area III) and the male dormitory area (Area I), both with an integration value of 9.76. The third highest is the grand staircase area (Area VI), with an integration value of 8.83. However, only two areas are identified as having the potential to be developed into student communal spaces: Areas II and VI.Filtration of natural peat water showed a

persistent brownish-red color, which suggests the presence of lignin compounds and substances from the humification process, including minerals like iron (Fe) and manganese (Mn). This high color indicates a natural color with positively charged colloidal particles that cannot be deposited by gravity [13]. The 20 µm filter effectively retained larger particles but failed to remove dissolved colorants. The peat water exhibited a low pH, attributed to fulvic and humic acids. Other parameters, including removal of total dissolved solids (24,4%), alkalinity (10,8%), organic matter (2,7%), and turbidity (5%), showed minimal reduction post-filtration, with the decrease in TDS correlating with turbidity, indicating a low concentration of suspended solids. The test results of natural pH peat water samples with a temperature of 25-27°C are shown as follows.

Local Choice

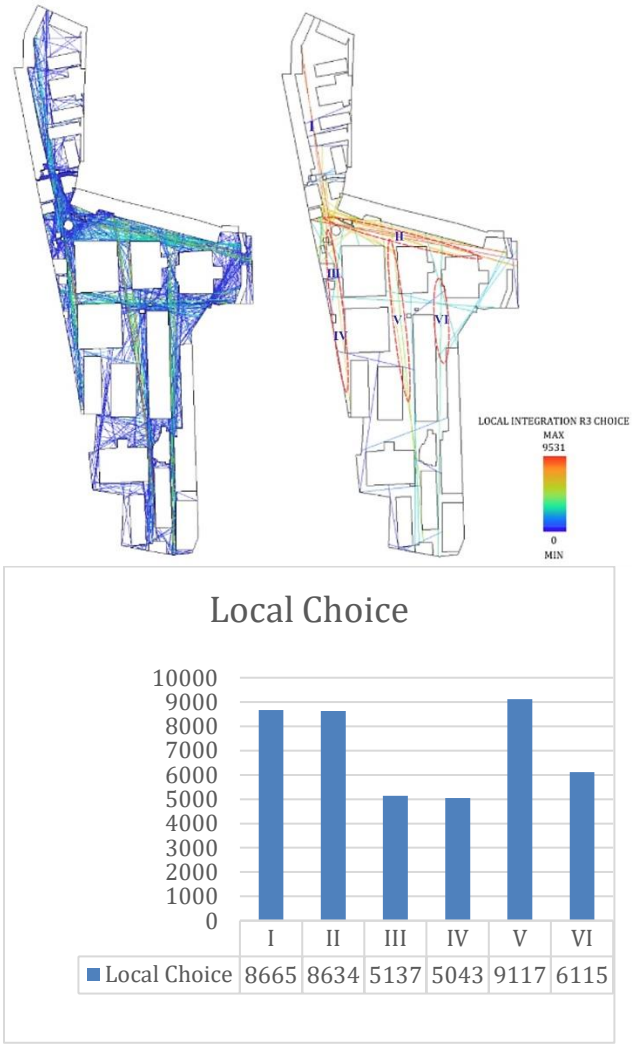


Figure 4. Local Choice Analysis
(DepthmapX Analysis Result, 2024)

The local choice analysis aims to identify areas within UIN Maulana Malik Ibrahim Malang that offer high access options, thereby facilitating user access to these locations. The results of this analysis (Figure 4) indicate that the area between the Megawati Building and Building B (Area V) has the highest local choice value, at 9,117. The male dormitory area (Area I) and the area in front of the microteaching lab building (Area II) have nearly identical local integration values of 8,665 and 8,634, respectively. The third highest value is found in the grand staircase area (Area VI), with a score of 6,115. Among these four areas, only three are identified as having the potential to be optimized into student communal spaces: Areas II, V, and IV.

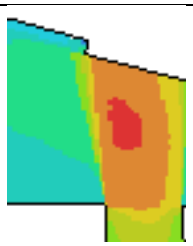
B. Visibility Graph Analysis (VGA)

In this study, visibility graph analysis is employed to identify areas within UIN Maulana Malik Ibrahim Malang that have the potential to serve as communal spaces based on their visibility characteristics. As illustrated in Figure 5, several areas on the campus exhibit the highest visibility, indicated by shades ranging from red to orange. The five areas with the highest visibility values include the area in front of the microteaching lab building (Area II), the area in front of the Humanities Building (Area VIII), the grand staircase area (Area VI), and the area between the Megawati Building and Building B (Area V). Based on field conditions, only three areas are identified as suitable for optimization into student communal spaces: Areas II, V, and VI.

Figure 5 Visibility Graph Analysis
(DepthmapX Analysis Result, 2024)

After analyzing all areas within UIN Maulana Malik Ibrahim Malang using Axial Graph Analysis (AGA) and Visibility Graph Analysis (VGA) techniques, along with observations of real conditions on site, only three areas are identified as most suitable for maximizing their function as student communal spaces. These areas are the space in front of the microteaching lab building (Area II), the area between the Megawati Building and Building B (Area V), and the grand staircase area (Area VI). Table 1 demonstrates that the AGA and VGA values for each of these areas are relatively high, indicating significant potential for their design as student communal spaces based on actual field conditions.

Tabel 1. Potential Areas and The AGA-VGA Value

	II	V	VI
Area			
Connectivity	348	300	229
Local Integration	11,1	8,53	8,83
Local choice	8634	9117	6115
Visibility graph			

(Personal Analysis, 2024)

Furthermore, the findings of this analysis align with previous research indicating that effective communal spaces are those located near roadways and public areas. These three areas are recommended to UIN Maulana Malik Ibrahim Malang for consideration in the planning and development of student communal spaces within the campus environment.

When compared to the factual conditions on-site, among the three areas, Area V is the most suitable for development into a student communal space. This is because Area V has the largest expanse of land compared to Areas II and VI, and is predominantly composed of green spaces. As a result, students can engage in activities while enjoying a lush, cool, and refreshing environment.

IV. CONCLUSION

Communal spaces for students within the campus environment are crucial for enhancing student productivity. These spaces are not only utilized for completing assignments but also serve as venues for personal development, particularly in soft skills. Students can socialize, engage in organizational activities, and build their confidence. Previous studies have predominantly focused on the internal aspects of student communal spaces, while research addressing external aspects, such as connectivity and visibility, remains lacking. This is where the primary contribution of this study lies.

UIN Maulana Malik Ibrahim has many potential areas that could be developed into student communal spaces; however, in reality, these spaces have not been fully utilized despite the significant demand from students. This study demonstrates that there are three areas with the potential to be optimized as student communal spaces based on the results of the Axial Graph Analysis (AGA) and Visibility Graph Analysis (VGA). The results of this study are anticipated to provide guidance to the university in formulating plans for the development of student communal spaces on campus.

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