The use of space syntax method in mapping passive contacts in slum area of Semanggi, Surakarta

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Abstract. Social interactions happen anytime and anywhere, started with human actions and/or movements. These movements lead to a meeting between people indicating opportunities to know and to admit the existence of each other and discover each other’s nature through observations and conversations. This is called ‘passive contact’. This research is conducted to test the passive contacts that happen in settlement using space syntax method and then compare it with direct observation. Space syntax works objectively without involving goals and motivation, assuming nothing about the individual and their cognitive capacity explicitly, despite human are moving and socializing to another directed by their cognition. Spatial configuration used in spatial layout of urban space or a settlement, analysed by space syntax methods producing an axial map that presents the degree of connectivity, integrity and intelligibility value. This research used case study method with Semanggi as the case. The results of this research show that space syntax method is not enough to explain how passive contact can be formed. Therefore, additional research needs to be done to cover the factors that can not be covered by space syntax analysis. Direct observation in certain periods is considered very effective to cover the gap of analysis that space syntax could not cover.

1. Introduction

Social interaction is started with human actions and/or movements. One of the favoured assumptions of dealing with or interpreting human actions is that the “prime mover” is individual motivation or goal achievement. These motives and/or goals will direct human behavior and in psychology, this process is called “cognitive process”. Theoretically, cognitive process is the process of acquiring knowledge through our thoughts, experiences and senses [1]. In relation to spaces in an environment or spatial layout, this process is called “spatial cognition”. According to [1] from American Psychological Association, spatial cognition is a branch of cognitive psychology that studies how people acquire and use knowledge about their environment to determine: i) where they are, ii) how to obtain resources and iii) how to find their way home.

Based on previous studies, the precious researchers have found that spatial layout affects the spatial cognition of people residing in a settlement. In this case, the intended spatial layout involves spatial characters such as: a) street width, b) distance between dwellings and c) location of public spaces. Spatial characteristics used in the spatial layout of an urban space or a settlement, have mostly been analyzed by space syntax methods that produce an axial map designed to present degrees of connectivity, integrity and intelligibility value [2] in [3]. Space syntax works objectively without
involving goals and motivation, assuming nothing explicitly about the individual and their cognitive capacity. However, it was suggested that human movement and socializing were directed by the process of a person’s cognition [3].

In previous research, Kim [4] employed spatial behavior observations, questionnaires, interviews and sketch mapping to research into the lives of 76 study participants. Kim found a problem in that sketch maps could not reliably tell the difference between the ability of the respondent as a cartographer and their own cognitive competence.

Space syntax analysis is done by mapping the sketch folder axially, which then yields results regarding correlations between spatial integration and observed movement as well as the correlation between more intelligible and less intelligible relating to spatial integration. By separately testing the response of those who live on each part, the older half and the newer half of the settlement, Kim reached several significant conclusions about the influence of spatial configuration on how residents understand their surroundings and the role of that configuration’s intelligibility. In addition, in other research Hillier in [3] suggested that movement depends on spatial morphology, and the degree to which this is the case. Therefore, this concept informs the maximum degree to which other factors, such as: a) individual goals, b) motivates, c) specific attractors, d) specific generators, e) land uses and f) development densities can be involved. However, if we wish to turn this concept into an explanatory theory that gives an account of why behaviors of this sort take place, Penn [3] believed that we have to generate a reasonable account of cognition. ‘Reasonable’ in the sense that it is compatible not only with what we know about how the human brain works, but also with the direct observation that comes from our own research about how human cognition affects and influences observable behaviour.

The aim of this research is to test the passive contacts that happen in settlement using space syntax method in representing connectivity, integrity and intelligibility of value relation to the place of contacts in social aspects of a settlement and its resident and then compare it with direct observation. These analyses employ a case study method on the slum area of Semanggi, which is classified as one of the worst slum areas in Surakarta in regard to the quality of space, facilities and infrastructure [5]. Two neighbourhood areas (RT) in RW 23 Semanggi, Surakarta City are used as research locus and were investigated in detail.

2. Theoretical Framework

2.1. Social Interaction

According to Loomis [6], a relationship between two persons could be called a social interaction if it has the following characteristics: a) the number of interaction doers of two or more persons, b) the existence of communications between doers using symbols, c) the presence of a time dimension that includes past, present and future and d) the existence of goals to be achieved as a result of the interaction.

In this research, the type of social interaction that will be observed is passive contacts. Passive contact is an accidental interaction without any specific initial goals. A passive contact refers to a meeting between people who inadvertently may indicate opportunities or the possibility to know and admit the existence of each other, as well as the opportunity to discover and know each other’s nature through observations and conversations [7]. In [8] he noted that passive contacts are an important factor in deciding who to meet with possibility of forming a relationship.

2.2. Space Syntax

Simply, spaces can be interpreted as the containers of activities. The complexity of belonging in an urban environment begins with various activities that later result in the arrangement of the space. Various activities require the configuration of effective and efficient space defined from and by the formation of the structure of space. As part of a configured space, not only are the shapes of the nodes displayed, but so are the paths that generally are public. These paths and nodes connect land and spaces, thereby tying them into a system of relationship: a linkage system.
A space system is composed of two main components: i) layout and ii) configuration [9]. Physically, this space system is manifested in morphology. Both of the above components are very important because they define human movement and can be used as parameters in development of a give, specific area.

Layout can be defined as a set of relationships where overlapping objects rely on each other in a structure [20]. In the context of urban space, this relationship is embodied in the interaction space that can be identified by movements from one space to another. With the object in the form of spaces, the strength of this interaction is influenced by the properties of the space system’s morphology, among others:

- Land use, building structures, patterns and pattern-road network (Conzen in [9])
- Buildings, open spaces, pattern-and the road network [11]

Among the morphological properties, the network patterns become important components in city design, as they affect aspects of the quality of the space in the form of permeability and accessibility [9]. Permeability is a parameter that indicates the extent to which the space layout provides options in travel and accessibility, measured by the interaction between individuals within the system space. Hillier in [9] explained that the pattern and intensity of movement of individuals is affected by the layout of the space; the structure of space can be considered as the single most determining factor influencing movement in and between spaces. To measure interaction in layout space, space syntax uses several dimensions as measured by applying the concept of topological distance (topological distance) called depth (depth).

2.2.1. Connectivity. Connectivity is a local property that measures the dimensions by calculating the number of spaces that are directly connected with each other in a room layout space [12, 13]. Connectivity is called as local property because the information about the relationship of the spaces can be directly observed, while the spaces that cannot be directly observed will not be taken into account. The amount of space that is connected is calculated by applying the concept of distance and is called ‘the depth’ or just ‘depth’. Thus, the depth is said to be linked directly when having only approximately 1 step or more step depth. Measurement of connectivity is conducted to find any levels of spaces that are interacting with the spaces that are nearby.

2.2.2. Integrity. Integrity is a global property that measures the dimensions in the form of the relative position of each space towards other spaces in a layout space [12,13]. Global property is so called as the calculation of the value of integrity not only involves spaces that are directly connected, but also other spaces not directly connected with those spaces being observed. In other words, this calculation also involves the spaces that cannot be observed from the observation room, where the assessment of the integrity of a space will involve the entire space within a layout space [10]. Integrity is one of the key measurements within the space syntax because this measurement method, analysis of space layout as a system can be done relative easy. The relative position of the space is calculated by applying the step depth method. From the relative position it can be known how far (step depth) a space is from other spaces.

2.2.3. Choice or Betweenness. Choice or betweenness shows how often an area or space is skipped and the rate of the shortest path to get to a space.

Space syntax analysis has found that the spatial configuration is correlated very strongly with observed movement of the residents. This analysis does not include the many factors considered important to model the patterns of human movement in the environment. The aspect that becomes the deciding factor was environment geometry. Despite, the aspect about space syntax and spatial cognition also just have few description.
2.3. Spatial Cognition
Humans travel over the earth's surface to reach destinations. This typically requires planning and the ability to stay oriented while moving. Navigation is central to this coordinated and goal-directed travel through space. Navigation consists of two components: i) locomotion and ii) wayfinding. Locomotion refers to the guidance of oneself through space in response to local sensori-motor information in and from the immediate surrounds. This includes such tasks as: a) identifying surfaces of support, b) avoiding obstacles, and c) moving toward visible landmarks. Locomotion generally occurs without the need for an internal model or cognitive map of the environment. Wayfinding refers to the planning and decision-making that allows one to reach a destination that is not in the immediate sensory field, and includes such tasks as: i) choosing efficient routes, ii) scheduling destination sequences, iii) orientating to non-local features, and iv) interpreting verbal route directions.

When travelling people also use symbolic media such as maps to navigate and stay oriented. Maps used for navigation show robust alignment effects, a common confusion in using maps when the tap of the map is not the direction in the surrounds that one is facing when looking at the map. This disorientation results from the fact that spatial perception is 'orientation-dependent'; objects and pictures have a top and a bottom in the perceptual field. In the case of road or trail maps, many people turn the map to bring about alignment. Unfortunately, this option is not available with ubiquitous 'You-Are-Here' maps, which are surprisingly often placed in a misaligned way with respect to the viewer's perspective. The resulting alignment effect is reflected by the fact that misaligned maps are interpreted more slowly and with greater error by most people than when dealing with aligned information sources [14].

3. Methods
3.1. Case Study
This research uses case study that is considered able to reveal the complexity of a case and to show the importance of this research. This case study is conducted to achieve the aim of this research that is to test the passive contacts that happen in settlement using space syntax method in representing connectivity, integrity and intelligibility value relation to the place of contacts in social aspects of a settlement and its resident and then compare it with direct observation.

3.1.1. Place. The location of this research determined by two criteria: i) the level of the slum area in Surakarta City and ii) a slum site having public spaces and a complex spatial layout in its settlement. Among the top five heaviest slum areas in Surakarta City, Semanggi is the one that best meets these criteria. Specifically, two neighborhoods (RT) in Semanggi were chosen as research locations: RT 02 and RT 05. Both areas have complex spatial layouts and some public spaces such as: i) public toilets, ii) public seating, iii) stores and iv) streets.

3.1.2. Time. The time used in the implementation of this research is begin from morning to noon. Timing is based on the conditions to be found in an active settlement. This almost full day period was chosen to obtain more diverse type of social interaction activity.

3.2. Data Retrieval
3.2.1. Space Syntax. The space syntax data are retrieved from redrawing the solokotakita’s map using AutoCAD software then verified back in the field and it produced a base map. This base map is used to be analysed using depthmapX software, which is a space syntax software, then producing axial map that contains the degree of connectivity, integrity dan choice or betweenness.

3.2.2. Direct observations. Non-structured interview surveys were carried out with local residents to elicit aspects of their cognition and perceptions of the local area. Detailed observations (photo and trace) were made of movement patterns in the two neighborhoods. Furthermore, these direct
observations will be analysed and the results will be compared to the axial map produced by space
syntax analysis.

3.3. Analysis
This type of study involves qualitative research which are the methods to explore and understand the
significance ascribed to social and human problems by a number of individuals or a group of people
[15]. The analysis was conducted to find out the patterns of interaction that occur in the slum areas
of a city in Indonesia, based on typology that has been found before. The analysis is done by creating a
base map which is then used to conduct a space syntax analysis and direct observations regarding the
focus issue of this researcher’s interest. Data for direct observation mapping is obtained from
observations, documentation and interviews every day at the specified time for 30 days. The mapping
results are then combined and compared to see how the patterns of interactions that occur and the
cause.

4. General Findings
4.1. Spatial Layout
Semanggi village area is located in Pasar Kliwon subdistrict in the south-eastern side of the city of
Surakarta (Figure 1). The area of Pasar Kliwon subdistrict is 74.24 hectares, with most of the land use
in Semanggi village being for settlements. Other activities in this area are economic, including: a) trade,
b) industry, c) services, d) offices and e) informal sector activities. The slum area of Semanggi
village is 30.57 hectares [16].

According to [5], the status of the land settlement in RW 23 is divided into two: legal and
illegal, with the latter on the riverside. In this settlement, there are many unlivable or substandard
houses, with the high density of the building which caused by the housing layout due to the limitations
of the land. Due to the environmental conditions, the land is used as efficiently as possible. This land
scarcity situation has resulted in the small size of each dwelling; the smaller the dwellings the more
can be erected.

In this paper, the selected locus of research is RT 02 and 05 of the 23rd administrative unit (RW
23), chosen because it includes the most densely populated area, which is in Semanggi village itself.
This administrative unit is divided into five neighborhoods (RTs) i.e. RT 01, 02, 03, 04 and 05. The
preference for the choice of these neighborhoods in this case study was because they could represent
the Semanggi village.

Figure 1. Location of Semanggi village and Division of its neighborhoods

According to the [5], the status of the land settlement in RW 23 is divided into two, legal and
illegal (on the riverside) where there are many unlivable houses (RTLH). Due to those conditions,
most of the dwelling units have no distance or space from the residential buildings on either side
(Figure 2 & 3). The distance of the existing residence is only a residential occupancy with a separator
distance on the other side of the road, separated by wide ± 1.5 – 2 meters. The area of each unit is the
average of 16 – 160 m² [17]. The length of the streets in RT 02 & 05 of RW 23 of Semanggi Village is ± 598 meters. The streets are divided into three types: i) main streets (w = 3 m), ii) environment streets (w = 2.5 m) and iii) streets between buildings (w = 75 cms – 1 m).

4.2. Residents
The residents of RW 23, Semanggi consist of the area's original residents, ex Silir brothel’s sex workers and migrant residents; most of them being Madura people. Based on interviews with Mr. Nur Rahmat (Chairman of RW 23) those migrant residents were the relatives of the original Semanggi’s residents who ‘came for a visit’ and stayed on.

4.2.1. Residents’ Activities. Most of the residents of RW 23 are working out of the settlement, so that at the time of working hours, the settlement becomes quiet. It is then reactivated in the afternoons when the residents return from their places of work. Based on observation, residents often gather at the time of the afternoon just to simply say hello and chat about the everyday events in their lives. The housewives, who use most of their time to take care of their homes, mostly interact with each other at the vegetable stalls, the terraced houses and even on the road (Figures 4 & 5).

Figure 2. Housing Layout of RT 02 & 05 of RW 23 of Semanggi
Figure 3. Streets in RT 02 & 05 of RW 23 of Semanggi (black)

Figure 4. Two older women do their activities outside their house.
Figure 5. Outdoor activities in the neighborhoods of RW 23.
5. Results and Discussion

5.1. Space Syntax Analysis

The base map produced by AutoCAD software, which is obtained from solokotakita map and field verification was done to create the figure ground map to find out which parts are buildings and which parts are streets. This map of figure ground technique is created by using theory where those two things are distinguished by color. Buildings as solid mass are drawn in black, while streets as void mass are drawn in white (Figure 6).

![Figure 6. Map of figure ground technique of Semanggi Slum Area](image)

The base map that consists of the spatial layout of the buildings and roads of Semanggi, particularly RT 02 and RT 05, becomes the material in the space syntax analysis carried out by depthmapX software. In that analysis results regarding the value of connectivity, integration and choice are shown in Figure 7.

![Figure 7. The Result map of space syntax analysis](image)

Based on Figure 7, the highest value of connectivity, integration and choice is on the main settlement street, which has a width of approximately three meters. The medium-low values are
located on the other narrower neighborhood streets. The type of its social interaction is passive, where people encounter each other and interact without any explicit motivations and goals.

5.2 Direct Observations
Data collected from direct observation involved: a) the number of perpetrators of social interaction activities, b) the types of social interaction and c) where the social interaction is taking place. The number of perpetrators of social interaction activities was shown by the differences in pattern symbols accordance to the below information, while the types of social interaction are classified into two categories: i) active contacts and ii) passive contacts, these types are shown by the number 1 or 2 as in Figure 8. Places of contact in the Semanggi slum area are spread out at several nodes identified as streets; public seating; public toilet; stores; mosque; house terraces.

![Figure 8. The result map of direct observation research](image)

Information:
- 6 – 10 persons 1 = active contacts
- 3 – 6 persons 2 = passive contacts
- 2 persons

In this case, activities resulting from social interaction in the Semanggi slum area can be seen in Table 1.

| Active Contacts                  | Passive Contacts          |
|----------------------------------|---------------------------|
| - Chatting                       | - Meeting                 |
| - Borrowing and asking something | - Greeting               |
| (things borrowed have included food ingredients, e.g. salt, sugar, onion, chilli, etc.; kitchen utensils; tools; etc.) |                          |
| - Asking for help                |                           |
| (emergency or not)              |                           |

5.3 Discussion
Based on theory, space syntax is a tool to predict the pattern of movement of individuals without invoking purpose and/or motivation, and without explicitly assuming anything about individuals; particularly the capacity of their cognition. The prime mover of human action is the motivation and goals of each individual who is directed by the behavior.
While, the results from direct observation, interaction or social contacts that occur include two types of interaction: i) active contacts and ii) passive contacts. The contact pattern that emerges is also more widespread, not only highlighting contacts taking place on the streets of the neighborhood but also in public spaces, terraces, stalls, communal sanitary facilities or public toilets. In these cases, the doers of activities range from just two people to a group that could reach ten or more people. The numbers depend on the area of the contact itself; the more room in a space or location, the more extensive its spatial dimensions, the more people are likely to use it.

In addition, the influence of other factors that can be seen from the above mapping pattern (Figure 8) is the distance between residential communities with public space in the settlements. This distance affects the desire or motivation of residents for using of public spaces. They tend to prefer a public space that is closest to their homes. Thus, the shorter the distance between home and public space, the greater the motivation and the higher the frequency of using the space.

6. Conclusion
Based on the discussions that have been presented, the pattern of activities mapping or social contact that occurs in the Semanggi slum area indicates that space syntax has not yet been sufficiently effective in identifying points or nodes where human interaction may be possible. This deficit finding is because there are some factors that have an important influence upon the formation of activity or social interaction that cannot be covered in or gained from an analysis of space syntax. Therefore, in cases where an area has a specific layout and greater complexity, it is recommended that research should be carried out by employing direct observation to initiate and enable behavior mapping.

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