Obstacles as determining factors of independent wheelchair user’s spatial experience at public transitional space

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Abstract. Experiencing space holds an important role in shaping one's perception in interpreting the meaning of a space. Humans interpret spatial experiences differently, depending on their bodily experience and the senses that are included. However, for independent wheelchair users, the difference in experiencing space may be more obvious. Liebergesell et.al.[1], and Stafford [2] stated that the way wheelchair users see space is driven by their efforts to be able to mobilize easily so that accessible space becomes essential. The objective of this study is to examine the role of mechanical and psychological obstacle according to wheelchair users in the public transitional space. The difficulties found by wheelchair users result a worrying spatial experience. This study uses qualitative methods with direct observation and firsthand experience. The findings of this study show that the intensity of mechanical obstacles is linear with the psychological obstacles, and both of them cause certain emotional response that determines the spatial experiences according to wheelchair users. The findings of this study can help understand the role of obstacles that might reduce the ease of access and potentially produce an unpleasing impression of public space according to wheelchair users to create inclusiveness in urban space.

1. Introduction
Goldsmith [3] stated that independent wheelchair users are someone who uses a wheelchair to move independently. According to Liebergesell et al. [1], in their daily lives, they depend on the quality of the built environment around them. To be independent is determined by how the environment around wheelchair users can accommodate their needs. Kairy et al. [4], stated that wheelchairs are no longer a tool but have rather become the embodiment of their own body so they liken the wheelchair as their legs and it cannot be separated from them. Thus, accessible space is a major concern for wheelchair users when experiencing space. According to Stafford [2], Kairy [4], and Boettger [5], transition space, or space that connects places to other places, becomes the most essential space for wheelchair users because it supports their movement and mobility. Liebergesell et al.,[1] stated that the spatial experience of wheelchair users is formed with a tendency to gain accessibility. So that obstacle-
detection becomes one of the determining factors in shaping spatial experience. The sensorial experiences that form wheelchair users experiences shapes by visual, audio, and tactile experience.

Nussbaumer [6] stated that the sense of vision can create a different interpretation of some things, because most people do not see the world only with the results of information created by their eyes, but through personal experience and application of the various values they have. Fitzsimons [7] and Liebergesell et al [1] said, that the visual experience of wheelchair users is used to detect objects or the presence of supervision from other people along their track. Nussbaumer [6] stated that hearing experience could be used to detect crowds and kinesthetic movements of the sounds that are produced by their surroundings. Therefore, according to Liebergesell et al., [1], Fitzsimons [7], and Stafford [2], these aspects cause a psychological impact that builds up worries to wheelchair users. Nussbaumer [6] stated that tactile space experience is an experience related to the sense of touch. Wheelchair users can experience tactile by hand and wheels that cross against the surface of the track. Poor track quality can make it difficult for wheelchair users to access space and tend to create worries.

According to Boys [8], space can have an impression when experienced by a mobile body. Simpson [9] stated that difficulties in accessing space, especially when carrying out movements in daily life become a strong reason for the low social participation of persons with disabilities and the potential for social isolation, anxiety, and depression. As Stafford [2] said, these difficulties are caused by obstacles in space that make the space inaccessible to wheelchair users, thus giving a frightening interpretation for wheelchair users to access it. Liebergesell et al., [1] stated that there are two types of obstacles faced by wheelchair users, called architectural obstacles and social obstacles. Architectural obstacles are obstacles that caused by the built environment which can be in the form of aspects, elements, or important parts of a space that have the potential to reduce the level of comfort and safety for wheelchair users such as a limited space, the wide of maneuver space, poor surface quality, the stairs and so on. Whereas social obstacles are obstacles caused by community assessments of disability that limitations in self-disability are seen as a problem and a lack. These obstacles could be found by excessive supervision, excessive help, and so on. While Nussbaumer [6] classified obstacles into several groups, including mechanical obstacles and psychological obstacles. Mechanical obstacles are obstacles related to technical aspects caused by the environment. These obstacles can be dangerous objects, sharp surface elements, and so on. Psychological obstacles are obstacles that disrupt the comfort and safety of a person psychologically.

Based on the interview, when accessing a room, small details in the room can be seen as challenges according to wheelchair users. Differences in height levels without the presence of ramps and uneven surface quality can make a worrying spatial experience. The existence of supervisors from the community also plays an crucial role in making the wheelchair user’s spatial experience. Excessive supervision results worries because wheelchair users are seen as an object that caused problems.

| Table 1. Psychological and Mechanical Obstacles |
|-----------------------------------------------|
| **Psychological Obstacles**                   | **Mechanical Obstacles**                  |
| Nussbaumer (2014)                             | Objects that caused potential danger       |
| Performance Anxiety                           | Elements with the sharp surface            |
| Safety Anxiety                                | Elements that caused a potential crash     |
| Interpersonal Anxiety                         | Narrow space                               |
| Liebergesell et.al. (2018)                    | The absence of maneuver space              |
| Excessive supervision                         | Bad quality of track’s surface             |
| Excessive help                                | The absence of access for different height |

The results of the literature studies can be used to assess the effect of obstacles in forming a wheelchair user spatial experience.
2. Method
The method used in this paper are literature review, direct observation, and firsthand experience in the transitional space in the Ratu plaza area. The aspects studied were in the form of crowds, track surface quality, access to differences in heights, area of crossing space, and detection of the presence of objects that have potential danger.

In order to understand the process of forming a wheelchair user’s spatial experience, we use qualitative research methodology with qualitative data gathering method. Literature study was used to define indicators for analyzing the case study. The observation was conducted to determine the process of forming the wheelchair user’s spatial experience. The observation was carried out by a simple journey at Ratu Plaza area with several transitional spaces, such as: pedestrian lane and pedestrian crossing bridge, using photographic and mapping survey techniques. The observation is conducted during rush hour at weekdays. This approach is aimed to capture the mobility and accessibility of urban space. The observed aspects are the presence of mechanical obstacles such as the quality of the track surface, the existence of access to connect different levels, the width of circulation space, and detection of the presence of objects that have potential hazards. While aspects observed to detect the presence of psychological obstacles are the presence of other people’s supervision. The interview was conducted to a mid-thirties permanent wheelchair user. This method was aimed to capture the wheelchair user’s interpretation of space and to analyze the process of the making of their spatial experience.

According to Boettger [5], the transitional space is closely related to the process of movement because it is a space that connects a space with another space. Transitional space cannot stand alone and plays an essential role in forming space experiences because it is the place for displacement from one point to another. This causes the transition space to be a space that plays an significant role in the daily life of wheelchair users.

Kray et al. [9], stated that in the coverage of public facilities, transitional space is all space that becomes a connection between facilities in the public space, such as the space between the parking area and the entrance area, the space between that connect one building and another, the space on the pedestrian pathway, the pedestrian crossing bridge (JPO), etc. Therefore, the aspects used in the analysis are as follows:

| Table 2. Analysis aspects          | Psychological Obstacles | Mechanical Obstacles                  |
|-----------------------------------|--------------------------|---------------------------------------|
| Area                              | Psychological Obstacles | Mechanical Obstacles                  |
| Pedestrian crossing bridge, Pedestrian Lane | Excessive supervision   | The existence of elements that caused potential danger |
|                                   |                          | Bad quality of track’s surface         |
|                                   | Excessive help           | The absence of maneuver space          |
|                                   |                          | The absence of a ramp                  |

3. Results and Discussions
3.1. Location
The case study took place in the Transitional Space in the Ratu Plaza area, which included Pedestrian Lanes and JPO (Pedestrian Crossing Bridge). This public transition space is located in the Central Business District with the TOD (Transit Oriented Development) concept so that it has high accessibility and is ideally accessible to everyone. TOD area covers various public facilities and transportation modes that are connected.
At the Ratu Plaza area, there are obstacles that evoke the unpleasing impression that leads to bringing up worries according to wheelchair users. These obstacles raise difficulties to wheelchair users when accessing space. The level of difficulty faced causes various kinds of impacts such as deceleration while moving or even can make wheelchair users stuck and unable to continue activities independently.

3.2. Pedestrian Lane
On the Ratu Plaza Pedestrian lane, the obstacle that was found was the bad quality of the surface’s track. Broken pedestrian lane causes wheelchair users unable to continue their activities independently so that they depend on others, causing excessive supervision of the surrounding community and create a worrying spatial experience.

These barriers that are classified as mechanical barriers can be detected through the visual senses and also the experience of tactility. When a wheelchair user crosses the sidewalk, crack appear on the surface of the track and causes anxiety. This crack makes wheelchair users unable to continue their activities independently so that it depends on the help of others. These cracks are caused by poor surface quality, and differences of the material on the pedestrian path. With the presence of mechanical obstacles, causes wheelchair users to be the center of attention. The public sees wheelchair users who cannot easily access space as a problem. These obstacles cause excessive attention and help from the surroundings, which cause psychological effects to wheelchair users. These findings are in accordance with Stafford [2] and Liebergesell et al. ‘s [1] statements that said that with the presence of a high level of crowd and high supervision of the surrounding environment for wheelchair users, caused concern about the psychological condition of wheelchair users. This psychological effect gives an unpleasant impression to wheelchair users so that city space cannot be fully enjoyed by wheelchair users.
3.3. Pedestrian Crossing Bridge (JPO)

When accessing the JPO, wheelchair users experience four stages marked by four areas in the figure 2. In area A, wheelchair users want to cross the JPO and start detecting the trajectory of the JPO in front of them. At this stage, wheelchair users begin to be vigilant to measure their ability and ease of access. At this time, there is a height detection by wheelchair users because it can be seen a certain slope in the track area. In this area, wheelchair users also do crowd detection. There are crowds that found in area A because of the high mobility of people passing by the JPO. The presence of this crowd has a psychological impact on wheelchair users. This is also influenced by the experience of kinesthetic movements. Wheelchair users feel anxious because of the high intensity of movement around them when compared to the speed of themselves which must push the wheel so that the movement becomes slower. In area B, wheelchair users begin to cross the sloping track. This JPO has a slope of 1:10 gradient which can be classified as very steep for wheelchair users, so it is not possible to be accessed independently. This obstacle increases anxiety according to wheelchair users, so they only depend on the help of others. In area C, wheelchair users can only pass through with the help of others, so that the kinesthetic movements of wheelchair users are not so different from the movements of those JPO users around them. In this area, crowds were found which became a psychological obstacle according to wheelchair users, and reduced comfort when accessing JPO. In Area D, area with flat track lanes, wheelchair users feel more comfortable because they can move independently.

![Figure 2. Section 2 JPO](image)

**Figure 3.** Obstacles (a) Cracks on Ratu plaza pedestrian line, (b) steep ramp, (c) The crowds on Ratu Plaza Pedestrian Lane, (d) Crowds on Pedestrian Crossing Bridge
Table 3. Analysis result

| Area       | Mechanical Obstacles                      | Found obstacles                | Psychological Obstacles      |
|------------|--------------------------------------------|--------------------------------|------------------------------|
| Pedestrian | Bad quality of track’s surface             | Cracks on track’s surface      | Excessive Supervision        |
| Lane       |                                             |                                | v                            |
| JPO        | The existence of elements that caused potential danger | Steep ramp                     | Excessive Supervision        |
|            |                                             |                                | v                            |

Mechanical obstacles that found in this area such as the steep slope of the ramp and the cracking of the track surface due to the existing design are incompatible with the regulation and standard design for the wheelchair user facility. Road repairs and additional facilities for wheelchair users must be carried out such as providing elevators. With the existence of these obstacles, urban space cannot be fully enjoyed by wheelchair users so that it is not in accordance with the concept of design inclusiveness that the public facilities cannot be enjoyed by all urban communities equally. While according to Liebergesell et al., [1] and Boys [8], the psychological obstacles that exist in this area are caused by the paradigm in seeing disability, especially those with wheelchairs, as a problem. The limitations and differences when accessing space are seen as a deficiency, resulting in excessive attention and help. As Stafford [2] said, from the presence of obstacles, there are impacts to the wheelchair user such as anxiety and the difficultness in accessing facilities so that wheelchair users depend on the help of others. In the long term, this can reduce social participation in social isolation.

4. Conclusion

Obstacles have an important role in determining the spatial experience according to wheelchair users. The way wheelchair users experience space is encouraged by their efforts to achieve ease in accessing space. The sensorial experience of wheelchair users works with a tendency to support accessibility so obstacles detection becomes part of the process of experiencing space. Mechanical Obstacles are formed from the surface quality of the track, the availability of access and the slope of the JPO. While psychological obstacles are formed from excessive supervision and help from the surroundings. In this area, mechanical obstacles are related to psychological obstacles. The intensity of mechanical obstacles is linear with psychological obstacles. It turns out that obstacles can be very influential to the spatial experience. Wheelchair users see a direct space of 2 types, accessible or not. Accessible space is space that can easily accommodate the movement and activities of wheelchair users. There are several requirements that make space accessible for wheelchair users, which are; having enough width for a wheelchair; having a flat, not-textures and anti-slip surface; no objects that block the track; have access to different heights, and; not contain the excessive crowd. According to the results of this paper, it is shown that obstacles are potential to build up worries according to wheelchair users so that the role of the senses in detecting and experiencing obstacles becomes crucial. The higher the level of difficulty faced by wheelchair users when accessing space, the higher the potential worries caused. Therefore there is a reference to design standards to help reduce the potential for obstacles. This proves that accessibility is not only related to the technical aspects of the environment but also plays a role in the shaping of spatial experiences and might influence the sensorial experience according to wheelchair users.
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