Qualitative Assessment for Walkability: Duhok University Campus as a Case Study

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Abstract. The University Campus as a learning environment needs to be a safe comfortable and accessible place, where students enjoy walking and social interaction. This study evaluates the quality of walking environment by analyzing both physical features of streets sidewalks and individual perceptions of pedestrians. The research approaches to answer the question: to what extent is the University Campus safe and attractive for the students to walk? The research used mix methods and case study approach to achieve study objectives. The mix methods include onsite observation, visual survey and questionnaire with students using walkability checklist to determine the walking quality on streets sidewalks. In this regard four variables are considered based on previous literature review as; safety and pedestrians' facilities, comfortable walking environment, walking connectivity and lastly walking attractiveness. The result shows that the lack of safety and pedestrian facilities, poor designed sidewalks and connectivity leads to low level of walkability and increase car dependency in the study area. The findings provide guidelines for increasing the efficiency of walking, in order to encourage students to choose walking over car driving.

Keywords: walkability; sidewalks; pedestrian facilities; physical features; Duhok University Campus

1. Introduction
1.1 Walkability concept
The term walkability refers to the ability to easy safe, convince and interest walk in an area (Speck 2012). Park (2008) defined walkability as the easier form of movement and an important physical activity to improve human health. The quality of the built environment encourages people to walk by providing safe, comfortable paths. However, the lack of adequate public transport as well as the inefficient sidewalk and pathway infrastructure leads to increase the using of the car as the main mode of movement on Duhok University campus. The study evaluates the quality of walking environment by analyzing both physical features and individual perceptions of the students on University campus. The research is aiming to enhance walking efficiency by introducing alternative physical design features for streets
sidewalks to encourage walking over driving among students, who would prefer a convenient walking route between educational and recreational destinations.

1.2 The benefits of walkability concept
Walking is an enjoyable, convenient and healthy mode of transportation. It has many benefits for the human such as improving mental physical health, reducing travel cost, protecting environment, reducing pollution, as well as creating livable communities. It is also an efficient way of completing a relatively short trip, especially where parking is challenging. Many researchers and city planners have focused on the importance of creating walkable communities. Speck, J. (2012) in his book walkable city defined walkability as a useful way to move in an area. He identified four main attributes for increasing walkability as: useful, safety, comfort and interest, while Gehl, J. (2010) in his book Cities for people studied walkability in human dimension. Spoon (2005) identified the main advantages of a walkable community as an accessible, livable, attractive, safe, diverse and healthy living environment. Other benefits are defined by (Litman 2007) such as land use efficiency, cost reductions, equity and enhancing public health. McNally (2010) identified the economic benefits of walkability as it is more cost effective and could provide business and economic opportunities for the user while walking. The social benefits of promoting walkability are building relationships by encouraging people to connect directly and increase social interaction. Additionally, walking as a green transport contributes to reduce noise, pollution and increase safety.

1.3 Design Factors influencing walking quality
The design quality of the built environment encourages people to walk by creating safe, comfortable path and providing walking friendly facilities. Researchers identify many influencing factors for the pedestrian friendly design such as accessibility, safety, connectivity and land use efficiency, which affect the walking quality of the built environment (Spoon 2005, Muhbach 2012, Choi 2012). There are other encouraging variables such as attractive nodes and parks. To this regards urban planners and architects have the significant role in creating walking friendly design to make walking safe, efficient and enjoyable by designing well safe streets sidewalks, well-maintained pavement, streets lighting, pleasant environment of sidewalks. Shay et al. (2003) identified five infrastructural factors of walkability; the first one is pedestrians facility, including sidewalks amenities; secondly are accessibility and convenience; the third factor is connectivity, measured by short distance and efficiency to destinations; then, the aesthetic aspect of walkability involves pleasant environment, attractive architecture, trees and landscaping of the sidewalks; the last one is street safety such as street lightings, curb extensions, street narrowing and sidewalk amenities. Ewing et al. (2006), on the other hand, studied the qualities of physical features and individual perceptions including safety and attractiveness as the major elements in the concepts of walkability. There are other elements influences the walking quality such as shading, trees and landscape, lighting and other pedestrian furniture (Petella 2009, Yeang 2000). The Austrians road guide to Road Design part 6A: Pedestrian and Cyclists Paths (Austroads 2009a) also identified five required key attributes of an environment to encourage walking as the 5Cs: Connectivity, Comfortable, Convenient, Convivial, and Conspicuous.

From the previous literature review the research concludes that there is a positive relation between the walking friendly design and the level of walkability. (Fig 1) shows some design features that increase walking quality. Using this framework this research evaluates the walking quality on university campus by measuring the quality of the physical elements of streets sidewalk and the individual perception of the students.
2. Case study

The University of Duhok (UoD) is a fast-growing institution in Duhok, Iraqi Kurdistan region. It is about 10 kilometers far from the city center of Duhok. The campus has an area of 3036 km². The total number of students that are currently studying in the campus is about (21,000) students. It has (1607) academic staff members and 2353 employees (Registration Directorate 2020). The area of the University Campus is equal to (1450) Acres. The main mode of movement on Duhok university campus is private car as a result of inadequate public transport as well as the inefficient sidewalk and pathway. Promoting walkability on university campus is an urgent need to create livability and enhance students social interaction on campus. (Fig2) shows the study area and the main gates with the high traffic at the pick work hours.

3. Research Methodology

The study approaches to answer the question, to what extent is the university campus safe and attractive for students to walk? The main objectives of the study are to assess the current situation of pedestrianisation on streets sidewalks in Duhok University Campus by identifying the main problems and provide guidelines and recommendation for improving the quality of walking. The research used mix methods and case study approach to achieve study objectives. The mix methods include onsite observation, visual survey and questionnaire. Furthermore, the survey used maps and photographic analysis to investigate the physical quality of streets side walk. The research focused on the most crowded streets sidewalk routes on the campus from college of education to the college of spatial planning and student center ended with the main entrance of the university campus as a case study.
Both sidewalks physical features and individual perceptions of pedestrians are studied. The direct observations focus on assessing the available physical features on the defined sidewalk route using the walking checklist and photographs. The research used qualitative assessment to evaluate sidewalks physical features for walking. The evaluation criteria based on four principles: pedestrians' facilities and safety, comfortable walking environment, walking connectivity and lastly the walking attractiveness. Each criterion has a set of sub criteria related to walkability concept (table 1). The questionnaire was conducted with 50 students, who were chosen randomly on the case study area, to find out their individual perception about the quality of walking on the campus. The questionnaire measures students satisfaction about the walking quality based on four basic elements: safety feeling, comfort feeling, connectivity and walking attractiveness.

Table 1: Research variables check list for evaluating walking quality (Author)

| Variables                      | Attributes related to the Variables                                      |
|--------------------------------|--------------------------------------------------------------------------|
| 1. Pedestrian facilities & Safety | • Sidewalk condition (pavement material and maintenance)                  |
|                                | • Sidewalk amenities (public garbage, cans, benches,                      |
|                                | • Sidewalk width                                                         |
|                                | • Sidewalk obstructions (Poles, Signs, Trees, Garbage cans)               |
|                                | • Lighting                                                               |
|                                | • Crossing walk lines are clear and available as needed                   |
|                                | • Safety feeling                                                         |
| 2. Comfortable walking environment | • Interesting buildings facades                                           |
|                                | • Greenery, shading, vegetation,                                          |
|                                | • Cleanness and maintenance                                               |
|                                | • Comfort and enjoying feeling                                            |
| 3. Walking Connectivity/ Accessibility | • Sidewalks completeness                                                   |
|                                | • Sidewalks continuity                                                   |
|                                | • Wayfinding signage                                                     |
|                                | • The accessibility of the sidewalk                                       |
4. Results and Discussion

4.1 Visual survey

The collected data from the visual survey and the walkability checklist are focusing on evaluating the physical features to measure the quality of walking on the defined sidewalks. The following part shows the finding discussion of research variables.

4.1.1 Pedestrian facilities and Safety

The results of the observation and checklist for the first variable (pedestrian facilities and safety) focus on evaluating the sidewalk condition, sidewalk amenities (public garbage, cans and benches), sidewalk width, sidewalk obstructions (poles, signs, trees, and garbage cans), lighting and crossing walk line availability. The findings are shown in (fig 4). The analysis of the data shows poor pavement quality and lack of efficient amenities. The sidewalk material conditions of 60% are completed with poor quality of pavement. There are many physical obstructions on the sidewalks such as signs and illumination structure. The crossing walk lines are not available as needed. As a result, the students cross the street irregularly and use street instead of the sidewalks. The sidewalks width is 2.40 m, but it is less in some places. The garbage cans are available, but the garbage is mostly located on the sidewalks and not in garbage canes. The lighting is a on the mid island of streets that disturbs the students from walking. There is a need to increase the safety level by improving physical features, sidewalks furniture such as the buffer space between street traffic and sidewalk. The buffer can be used as a planting strip to increase pedestrian perception of safety and provide nice landscape to the area. Furthermore, the walking safety can be improved through implementing better cross streets connection, decreasing traffic speed as well as clear signs such streets name, warning signs, which make students feel safer to walk between academic departments.

| Indicator         | Attribute                                                                 |
|-------------------|---------------------------------------------------------------------------|
| Pedestrian        | Sidewalk condition: Photos right show poor Pavement quality, many physical obstructions on the sidewalks |
| facilities & Safety | Sidewalk amenities: Photos right show inefficient design and lack of sidewalk amenities such as benches and seating places |
4.1.2 Comfortable walking environment

The results of the observation and checklist for the second variable; comfortable walking environment focus on evaluating the availability of: interesting buildings facades, greenery, vegetation and shading, cleanliness and maintenances, comfort and enjoyment feeling. The findings are shown in (fig 5). The built environment of the sidewalks near the college of education includes few interesting public spaces and greenery for the students to enjoy their walks, while there is lack of shading element and side walk furniture. On the other side there are many vacant lands, which can be designed as landscape area and create comfortable environment for pedestrians. The nodes are so crowded with cars and there is no separation between pedestrians and cars lanes. The comfort and enjoying feeling can be increased by implementing well-designed sidewalks furniture, promoting greenery and nice landscape.

Figure 4: The assessment of the first research variable: pedestrian facilities and safety. Photos (researcher 2020)
| Indicator                   | Attribute                                                                 |
|----------------------------|---------------------------------------------------------------------------|
| Comfortable walking        | Interesting building facade: Photos right lack of interesting building    |
| environment                | facades                                                                   |
|                            | Greenery, Shading and Vegetation: Photos right show inefficient           |
|                            | inadequate shading and more car oriented places, which cause more         |
|                            | pollution                                                                  |
|                            | Clearness and maintenance: Photos right show garbage on sidewalk and lack |
|                            | of maintenances                                                           |
|                            | Comfort and enjoying feeling: Photos right show lack of comfort as         |
|                            | result of the busy street and crowded nodes                               |

**Figure 5:** The assessment of research second variable: comfortable walking environment. Photos (researcher 2020)

### 4.1.3 Walking Connectivity/ Accessibility

The results of the observation and checklist for the third research variable; walking connectivity focus on the evaluation of the sub-variables: sidewalk, completeness, sidewalks continuity, way-finding signage and the accessibility to the sidewalk. The findings are shown in (fig 6). The sidewalk completeness is available near the college of education, but there are unpaved sidewalks near the college of planning. The sidewalks pavement is not completed as a result of construction or other physical barriers. The signs are not well placed, they cause visual and walking barrier for the students. Good signage along the walking routes should be available to guide the pedestrians to the desired destination.
4.1.4 Walking Attractiveness

The results of the observation and checklist for the fourth research variable; walking attractiveness focus on the evaluation of visual richness of physical environment, landmarks, public space for social activities, attractive sidewalk furniture (Fountains, landscaping), useful walking. The findings are shown in (fig 7). The finding shows lack of walking attractiveness such as landmark, interesting
landscape and sidewalks physical features. The attractiveness of a place depends on well-designed streetscape and the existence of sidewalk furniture, provision of shaded area and pedestrian facilities such as good walking routes, adequate seating and benches, greenery and well-designed landscaping.

| Indicator         | Attribute                                                                 |
|-------------------|---------------------------------------------------------------------------|
| Walking Attractiveness | Visual richness of the physical environment: Photos right show lack of architectural visual richness |
|                    | Landmarks: Photos right show lack of landmarks and interesting views. Mostly busy streets insufficient sidewalks |
|                    | Public plaza: Photos right show lack of well-designed social activities |
|                    | Attractive sidewalks furniture: Photos right show lack attractive sidewalk furniture (Fountains, greenery) |
|                    | Useful activity: Photos right show crowding, busy streets rather than useful walking paths including mixed used activities |

Figure 7: Assessment of the fourth research variable; walking attractiveness. Photos (Researcher 2020)

4.2 Students Satisfaction

The findings of the student's perception and their satisfaction about safety feeling, comfort and enjoying feeling, connectivity and walking attractiveness, show lack of satisfaction (Figure 8).
The sidewalks are not safe for pedestrians, since only 34% of the user feel safe by walking. The results find out that the sidewalks are very uncomfortable. 70% of the students do not enjoy walking due to the lack of pedestrian facilities, lack of pedestrian amenities as well as crowded street traffic and lack of separation between busy roads and sidewalks. Most of the pedestrians (66%) agreed that the sidewalks connectivity and accessibility is not as desired. The walking attractiveness is not sufficient, since more than half (62%) of the respondents are not satisfied. The finding of the questionnaire Figure out that there is an urgent need to increase pedestrian satisfaction by promoting the sidewalks design quality, providing well-designed sidewalks furniture, improving walking connectivity and increasing walking attractiveness.

5. Conclusion
The research studied the quality of walking on Duhok University Campus at the aim of creating attractive and healthy urban environment for students to study in. The car free learning environment with well-designed and safe comfortable sidewalk will help students to interact in various social activities and enhanced health benefits. The research used case study approach and mix-method of direct observation, visual survey and questionnaire to evaluate the walkability concept on Duhok University Campus. The research defined four variables that can influence the walking quality as: pedestrian facilities and safety, comfortable walking environment, walking connectivity and lastly the walking attractiveness. The research findings conclude that the walking quality on the campus is not satisfying for the students as a result of poor pedestrians' facilities such as sidewalk conditions, inefficient design of lighting and pedestrian's furniture, inadequate sidewalk amenities, lack of landscape and shading elements, lack of connectivity, inadequate way finding signage and lack of attraction vibrancy. The sidewalks pavement is not adequate as a result of construction or other physical barriers. The signs are not well placed, they cause visual and walking disturbs for the students. The built environment of the campus lacks of vegetation and trees, in spite of the large vacant land, which can be designed as attractive landscape area for the student to interact. The nodes in the case study area are so crowded with cars without any separation between sidewalks and car lanes, which decrease safety, comfort and enjoyment feeling of walking. The finding shows lack of walking attractiveness such as landmark, interesting landscape and sidewalks physical features. The study conclude that the University has the opportunity to create a vibrant learning environment for the students by adopting walkability concept and create a car free area by designing safe, comfortable and interesting sidewalks to encourage students to enjoy walking on campus.

6. Recommendation
The walking quality on university campus can be enhanced based on creating comfortable sidewalks with useful and enjoyable attractive physical features and landscaping. The following recommendation
can improve the walkability rate in the Campus with regards to research variables:

1. Increasing pedestrian Safety:
   - Provision of safe walking surfaces and various pavement materials and colors
   - Creating safe sidewalk design including space for signs, walking and buffer separating sidewalks from adjacent traffic such as providing planting strip
   - Providing crosswalk facilities as needed
   - Provision of pedestrian signages, speed humps and speed limits on the roads to control vehicles speeding on campus
   - Improving sidewalk lighting taking solar power and LED lighting in consideration

2. Increasing Comfortability
   - Improving the quality of the landscaping features, such as benches, greenery, to increase pedestrianization among the academic community.
   - Increasing walking enjoyment feeling by designing comfortable pavement, nice vegetation and shading features
   - Raising awareness to keep cleanliness and building maintenance
   - Encouraging free cars environment by designing comfortable and useful walking paths

3. Connectivity
   - Providing ease of access for mobility such as ramps and curbs to enable people using wheelchairs and crutches to access the sidewalk
   - Providing wayfinding signages according to sidewalks design standards
   - Improving streets sidewalks continuity between academic departments
   - Organizing useful public transport access to encourage students to use it instead of private cars

4. Increasing walking attractiveness
   - Increasing visual attractiveness of Building facades and maintenance
   - Provision of nice and enjoyable public spaces physical features such as plaza, fountains, greenery
   - Provision of interesting landmarks and mix-use activities to encourage students to enjoy a useful walking through academic community.

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