The Impact of University Campus Design on Students’ Walkability: A Case Study

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To cite this article:

DOI: https://doi.org/10.51596/sjp2022.v3i1a1

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The Impact of University Campus Design on Students’ Walkability: A Case Study

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Abstract
Walking is an essential human activity that improves people's mental and physical well-being. It is vital to encourage this activity in our daily lives, including places of work and study. This includes universities, which help shape students' lifestyles. This study aims to investigate the impact of university campus design on students’ walkability. The study discussed the design aspects that encourage students to walk and the obstacles that repel them from walking. The study achieved this aim by conducting a case study analysis in Saudi Arabia using direct observation and a questionnaire. The study summarised ten design aspects that could be used to assess and improve walkability at university campuses. The study concluded that having a pathway system that encourages walkability is essential in university campus design. However, this could be enhanced using street furniture, elements of visual interest, and lighting elements along pedestrian pathways.

Keywords: campus design, hot climate, sustainability, walkability

1. Introduction
Universities can play a significant role in shaping students’ lifestyles as centres for capacity building and personal development. This includes encouraging walkability, which is believed to have a positive impact on students’ mental and physical health (Makki et al., 2012). Recently, Saudi Arabia has introduced the Vision 2030. One main aim of this vision is to boost the sustainable development of the country at all levels. This includes several aspects related to environmental, economic, and social sustainability. Municipalities across the country have implemented several projects to humanise cities and make them more walkable. However, there is a need to address this issue at universities, taking into account that walkability is a main aspect of sustainable university campus design (Southworth, 2005). Walking could effectively reduce our reliance on cars, which reduces air pollution and creates a healthy and more enjoyable urban environment. This also improves students’ quality of life and mitigates some health concerns, such as obesity and many other related health risks.

Thus, this paper aims to identify the main design aspects that make university campuses more...
walkable. The study considered the campus of King Fahd University of Petroleum and Minerals (KFUPM) in the Eastern Province of Saudi Arabia as a case study in this regard. The study was a field study that included direct observations and student surveys using a questionnaire. Several challenges should be addressed in this context, including the harsh climatic conditions. There are many design aspects that encourage students to walk on campus. These include:

1. **Sidewalks**: Sidewalks are paths that direct pedestrian movement, enhance connectivity, and promote walking (Ford, 2013). Poor sidewalks can be a major obstacle to walkability. Most people prefer wide and flat sidewalks (Zhang & Mu, 2019; Keat, Yaacob, & Hashim, 2016). Some studies suggest that sidewalks’ width should be between 1.8 m and 3.0 m in areas with high pedestrian traffic, such as campuses (Boodlal, 2004). The second design element is open spaces. University campuses should be designed for social and cultural activities that encourage pedestrian movement (Nassar, 2021). Outdoor open spaces, in general, and on campuses, in particular, can provide a social and intellectual environment that encourages gatherings and student activities (Salama, 2008). According to Abdullah (2020), pedestrian speed can significantly increase in open areas that have minimum intersections. Some crucial aspects that improve open space usability are shading elements and site furniture like seats and vegetation (Nassar, 2021).

Vegetation and green spaces are also primary factors that encourage walkability (Friedman, 2021). Effective landscaping can contribute to passive cooling in urban areas. Long trees and other types of vegetation can block solar radiation and generate shade in open spaces (Bowler et al., 2010). Furthermore, the presence of vegetation can improve the aesthetic value of sidewalks, which can significantly enhance the pedestrian walking experience. Another critical design element that improves walkability is campus and street furniture. Street furniture is a term used for public objects added or fixed in open spaces for public use. Furniture items can include road signs, benches, seats, bollards, public arts, fountains, and other visual objects. These objects have proven to be an important factor that encourages pedestrians to walk and form a unique identity on university campuses. Mobile urban furniture could also facilitate open space reshaping to be available for different uses (Nassar, 2021).

![Figure 1](image.png)

**Figure 1.** An example of the use of external shading elements to enhance walkability [1]

According to Dober (2000), students’ experience on campus can be significantly affected by its visual quality. This can effectively attract users to walk (Radwan & Morsy, 2016). A signage system is also one of the most essential elements of campus furniture. Good signs can ensure easy accessibility and save students time by providing clear directions (Yücel, 2013). Campus lighting is another factor that is recognised as critical, especially for nighttime walking. According to Llinares et al. (2020), lighting influences pedestrians’ comfort and safety by improving visibility, providing orientation, and reducing the possibility of crime. A study by Horacek et al. (2012) found that around 80% of the universities investigated had poor lighting on their campuses. Finally, shading elements should also be provided to enhance on-campus walkability. According to Khudhayer
et al. (2019), open spaces, including walkways, can be neglected as a result of heat stress in hot climate regions. External shading elements of different types, like eaves, awnings, and umbrellas, can be provided along walkways to mitigate this challenge. Figure 1 shows examples in this regard. However, shading elements might not be beneficial in situations of extreme hot climates.

2. Materials and Methods

The aim of this paper is to identify the main design aspects that are expected to improve walkability at university campuses, considering the hot climatic conditions. To achieve this aim, two research methods were implemented. First, urban analysis using direct observation at the KFUPM campus was conducted. This includes the current situation of sidewalks, open space, vegetation, elements of visual interest, street furniture, and street shading and lighting elements. The study then conducted a questionnaire survey of KFUPM students’ experience to determine the factors that encourage them to walk on campus. The sample size was found to be 96 sampling units, considering a confidence level of 95%, a confidence interval of 0.1, and a population size of 9300.

The questionnaire included 13 close-ended questions divided into two sections. The first section had three general questions about the respondents. The rest of the questions in the second section were mainly about campus design aspects that affect students’ walkability. A five-point Likert scale was used to measure students’ agreement levels in these questions. The survey was conducted from 12 to 15 December 2021. A total of 100 valid responses were collected by sharing the survey link on social media and distributing a printed Quick Response (QR) code of the survey among students from different levels and colleges. We used a T-test to determine whether students at KFUPM consider their campus pedestrian-friendly or not.

3. Results and Discussion

3.1. Walkability Design Elements

KFUPM accommodates about 10,000 students, most of whom are living in university dorms. Figure 2 shows a map of the KFUPM campus, where the students’ housing zone is located on the northern side of the campus, and academic buildings are located on the western side of the campus. Students need to move between these two zones using different means, including walking. Thus, this field study aims to observe the availability of some design elements that encourage walkability on campus, which were presented in the literature review.

Figure 2. KFUPM campus [2]
In general, the KFUPM campus is considered to be a car-oriented campus, where car movement is dominant over pedestrian movement. The university provides a free bus service between students’ dorms and the academic buildings. However, it was observed that KFUPM undergraduate students commute to their classes by additional means of transportation, such as walking and cycling. A considerable number of students have chosen bicycles to be their main means of transportation. Unfortunately, bicycle infrastructure at KFUPM is not appropriately provided, as we didn’t notice any designated lanes for bicycles.

Sidewalks are among the most important elements that affect students’ experience while walking on campus. Therefore, a careful analysis of the sidewalk condition at KFUPM is necessary. This includes width, state of repair, safety, aesthetic aspects, urban furniture, lighting, and shading elements. It was observed that most of the sidewalks around the dorms have a width of 1.8 to 3 m, which is considered sufficient to allow comfortable walking. Sidewalks at the campus are made from durable materials (mostly concrete), as shown in Figure 3. Consequently, most of them are still in good condition with no severe damage or interruption. However, there is a need to add designated lanes for bicycles to them.

Furthermore, most of the sidewalks have an apparent lack of shading elements. This significantly affects the potential of walkability, especially during summer. As for sidewalk aesthetics, an adequate amount of greenery, trees, and shrubs are planted in different locations around the campus and along most of the sidewalks. This makes sidewalks more interesting for walking. However, it was noticed that many of those trees are non-shading trees, such as palm trees. An excellent example of using sufficient shade trees can be observed along the academic belt surrounding the campus (Figure 4). There is also a need for more street furniture and elements of visual interest, such as benches, creative public seats, shading devices, signs, and maps along the sidewalks. Seats were found to be traditional and non-attractive.

![Figure 3. Examples of the sidewalks at the KFUPM campus](image)

As for open and public spaces, KFUPM has a noticeable amount of open spaces, such as plazas, squares, and the lakeside. Figure 4 shows some examples in this regard. These spaces provide a recreational environment that encourages pedestrian movement and activities. However, some of them are underused. The lack of sufficient urban furniture (mainly shading elements and adequate seats) could be the main reason in this regard. This is in addition to other elements of visual interest, such as artworks, sculptures, and fountains. This presentation of walkability design elements shows that the KFUPM campus generally has a decent pathway system that encourages walkability. However, walking paths in some sections require some upgrading.
and street furniture. Moreover, there is also a need to add more visual interest elements along pedestrian pathways.

3.2. Users’ Experience

The first part of the questionnaire included three general questions about respondents’ level of study, their most frequently used mode of mobility on campus, and their level of agreement with the notion that active mobility can increase peoples’ mental and physical health. The results of these three questions are shown in Figure 5. About a third of the sample were senior students (38%), followed by orientation students (21%). Results also show that walking is the most frequent mode of mobility among more than half of the respondents. This can indicate the importance of campus walkability to KFUPM students. This is related to the unique planning pattern of the campus, where a ring road surrounds the academic buildings. This increases the need for walking to access the different buildings. The third question shows that the majority of respondents (89%) believe that active mobility can improve their mental and physical health.

Figure 4. Example of utilising shade trees and open spaces at different locations at the KFUPM Campus

In the second part of the survey, a five-point Likert scale was used to measure students’ agreement with ten statements about design aspects that affect walkability. This was done with reference to the KFUPM campus. This included sidewalks, crosswalks, open and green spaces, bicycle lanes, lighting poles, shading elements, features of visual interest, street furniture, and climate. Table 1 shows some design aspects that affect students’ walkability at the KFUPM campus. Responses confirm the findings of the direct observation. For example, the respondents (mean = 3.54) believe that there is a sufficient amount of green and open spaces, such as gardens, plazas, courtyards, and squares, that encourage walkability on the KFUPM campus. They also believe (mean = 3.4) that sidewalks are pedestrian-friendly at the KFUPM campus. However, the issues most lacking were shading and visual interest elements. Respondents (mean = 2.33) disagree that a sufficient number of shading elements is provided around the campus. The same observation was recorded while conducting the direct observations study. Therefore, providing more shading elements along sidewalks and in open spaces is one of the measures that is highly recommended. Similarly, respondents don’t agree that there are a sufficient number of interesting features (e.g., artworks, sculptures, fountains) that make students more interested
in walking around the KFUPM campus (mean = 2.23). Also, respondents (mean = 4.26) believe that having designated lanes for bicycles is an important factor that makes them feel safe while walking on the sidewalks.

Responses were used to examine a null hypothesis suggesting that “students do not consider the KFUPM campus a pedestrian-friendly”. We used a one-sample T-test to examine this null hypothesis. Results showed that the Sig. value was greater than the considered significance level (0.05), which means that the null hypothesis can be accepted. This indicates that there is a need to improve walkability elements on the campus from students’ point of view.

Table 1. Respondents’ answers to part 2 of the questionnaire (design aspects that affect walkability)

<table>
<thead>
<tr>
<th>No.</th>
<th>Statement</th>
<th>Mean value (0-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sidewalks are considered to be pedestrian-friendly (safe and convenient) at KFUPM campus.</td>
<td>3.4</td>
</tr>
<tr>
<td>2.</td>
<td>Crosswalks are well-designed to allow safe passage for pedestrians at KFUPM campus.</td>
<td>3.32</td>
</tr>
<tr>
<td>3.</td>
<td>Having designated lanes for bicycles is an important factor that makes me feel safe while walking on the sidewalks.</td>
<td>4.26</td>
</tr>
<tr>
<td>4.</td>
<td>There is sufficient amount of light poles along walkways that makes night time walking safe and possible at KFUPM campus.</td>
<td>3.04</td>
</tr>
<tr>
<td>5.</td>
<td>There is sufficient number of shading elements (e.g. umbrellas, shade trees, awnings) along walkways.</td>
<td>2.33</td>
</tr>
<tr>
<td>6.</td>
<td>There is a sufficient amount of interesting features (e.g. art works, sculptures, fountains) in KFUPM campus, that make students more interested in walking around.</td>
<td>2.23</td>
</tr>
<tr>
<td>7.</td>
<td>Sufficient elements of seating furniture (e.g. benches, sitting places) are provided to encourage students walking around KFUPM campus.</td>
<td>3.09</td>
</tr>
<tr>
<td>8.</td>
<td>There is sufficient amount of green and open spaces (e.g. gardens, plazas, courtyards, squares) that encourage walkability in KFUPM campus.</td>
<td>3.54</td>
</tr>
<tr>
<td>9.</td>
<td>The climate of Dhahran encourages students to walk on campus.</td>
<td>2.47</td>
</tr>
<tr>
<td>10.</td>
<td>Most services (e.g. library, gym, mall, restaurant, markets,..) are within easy walking distance from my dorm.</td>
<td>3.15</td>
</tr>
</tbody>
</table>
4. Conclusion

Sustainable development includes a broad spectrum of aspects related to environmental, economic, and social sustainability. This includes walkability, which is an important issue in our urban environment. This has university campuses, where walkability is a central aspect of sustainable university campus design. This can play a significant role in shaping students’ lifestyles and improving their mental and physical health. This requires the implementation of several design aspects that encourage walkability on campus. In this context, this study has identified some of those aspects, taking the KFUPM campus as a case study. The survey carried out a field study using direct observation and a questionnaire directed to KFUPM students. This aimed to identify the most important factors that improve their walking experience. In general, the questionnaire results confirmed the findings of the field study observations. KFUPM campus generally has a decent pathway system that encourages walkability in addition to a sufficient amount of green and open spaces. However, walking paths at some sections require some upgrading to integrate street furniture and more elements of visual interest along the pathways. There is also a need to integrate shading elements along sidewalks and cycling lanes in order to improve students’ walkability and safety.

Acknowledgements

The author would like to thank King Fahd University of Petroleum & Minerals (KFUPM), Saudi Arabia, for funding this study.

Conflict of Interests

The author declares no potential conflict of interest was reported by the author.

Endnotes

This paper has been presented at the SPACE International Conference 2022 on Sustainable Architecture, Planning and Urban Design and selected to be published in this Journal.

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