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The Impact of Accessibility on Walkability to Enhance Social Interaction in Mixed-Use Streets

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ABSTRACT

The design and quality of urban streets significantly influence accessibility, determining how easily pedestrians—particularly those with mobility challenges—can reach essential services, amenities, and social opportunities. While prior studies have established accessibility as a key factor in promoting walking, the relative importance of specific accessibility indicators remains unclear. There is also uncertainty about how much each of these factors actually influences people's decisions to walk. Improving these accessibility factors not only makes walking easier but also enhances social interactions, as walkable streets encourage people to meet, engage, and spend time in public spaces. This study addresses the question: What are the most important accessibility indicators of walkability that influence social interaction in mixed-use streets? Identifying the main accessibility factors of walkability that affect social interaction in mixed-use streets is the objective of this paper. The aim of the study is to design a walkability model that explains how accessibility influences social interactions in mixed-use streets. The study distributed 400 Likert-scale questionnaires (1=strongly disagree to 5=strongly agree). It used SPSS (for statistical analysis) and Smart PLS (for structural equation modeling) to process and design the model. The analysis revealed strong model fit (GoF=0.69), emphasizing that perceived accessibility of walkability plays a crucial role in shaping social interaction. The study concluded that the indicators contributing to ease of walking such as street configuration, obstruction-free, sidewalk levels and condition, curb ramps, crosswalks, signage at night were among the most influential in making the street environment more encouraging for pedestrians.

Keywords:

Accessibility; Walkability; Mixed-use Street; Social interaction.

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1. INTRODUCTION

Walking is the primary and simplest transportation for people moving in space [1-6]. The term ''Walkability'' derives from combining "walking" and "ability," refe4rring to the capacity of individuals to move on foot. Recently, walkability has emerged as a rapidly expanding and much-discussed topic within the fields of urban design and city planning Recently, walkability has emerged as a rapidly expanding and much-discussed topic within the fields of urban design and city planning [1]. However, some researchers contend that a major deterrent of walking is the lack of access within the built environment which frequently characterizes many cities [7].

In addition, walkability, considered a particular form of accessibility, describes how easily individuals can move around an area on foot and reach desired destinations [8], [9]. Golbally, perceived walkability, i.e. how easy people find it to walk (in an area or to destinations), has only received limited attention [9]. Moreover, There has been limited exploration of the link between activity participation and social exclusion through perceived accessibility [10]. While globally many researches like [11-13] explore how the accessibility and design of public places impact social interaction, user experience and community perception, there have not been any research studies in Iraq that have developed or specifically examined a model explaining how walkability affects social interaction in mixed-use streets. Furthermore, even internationally, most walkability models have only considered a small selection of factors related to accessibility, rather than including a comprehensive set of indicators. Few studies have designed broader or more detailed models that fully explore how accessible urban environments support or limit social interaction, especially in the context of mixed-use streets. Hence, this research attempts to address existing shortcomings and construct a thorough model. This model aims to incorporate a broader spectrum of accessibility indicators to clarify social interaction dynamics within mixed-use streets, specifically within the environment of Iraq.

Social interactions can be enhanced by walkable areas [14]. All individuals gain advantages from walking [15]. Walking is environmentally, socially, and economically beneficial for individuals because it provides a variety of opportunities for enhancing individual and community well-being. In addition to the environmental and social benefits of walking, numerous studies demonstrate that walkable communities also promote healthy behaviors, encourage social interactions and community connection, enhance physical health (fitness), provide opportunities for inclusion, and improve quality of life and urban livability.

The scope of the study is limited to examining indicators related to perceived accessibility in mixed-use streets. It is concerned with micro-scale levels of street space as this influences how people access and travel through the street space, and the features (elements), equipment (facilities) and services that contribute to accessibility, and aid in creating an environment for social interactions among those who use the street. The research does not rely on the results of special instruments or large amounts of data; but instead relies solely upon a survey of street users.

Hence, the aim of the study is to design a model that demonstrates how accessible walking influences how people interact with one another on mixed-use streets. The study aims to investigate whether different indicators of accessibility (26 items) are related to social interaction (23 items), and users' overall perception (4 items) on Al-Masaref Street in Mosul City, Iraq. By analyzing these relationships, the research examines the impact of accessibility in shaping social interaction and perception on mixed-use streets.

2. ACCESSIBILITY DEFINITIONS

Accessibility in urban environments is a multifaceted concept that varies across different contexts and studies like [16-33]. Each study provides a unique perspective on accessibility, reflecting the diverse ways it can be defined and measured.

Accessibility (or just Access) refers to the ability to reach desired goods, services and activities [16], [17], [32]. It is a crucial component that contributes to a walkable environment [18]. It refers to streets that allow the users to access, enter, use and walk to wherever they wish to go; streets that can be easily accessed offer local services and amenities, are conveniently interconnected to each other (persons, services, resources, activities, location indicators and directories), have broad, flat pathways and safe ground level pedestrian crossings with adequate signal controls [30], [34], [35]. Accessibility is a fundamental aspect of the street and an essential performance element of urban space and the people that use it [19], [20], [23], [34], [36]. [37]in page 302 defines 'accessibility' as a matter of public access to places along the street by intersecting or crossing streets or public ways. Pedestrian accessibility also refers to the ability of pedestrians to reach destinations or opportunities, with respect to a time or distance cost [38], [39].

3. ACCESSIBILITY IN RALATIONSHIP WITH WALKABILIY

Walking is essential for basic mobility, particularly for transportation-disadvantaged groups such as the elderly, disabled, children, and low-income individuals. Poor pedestrian infrastructure exacerbates social exclusion by isolating these vulnerable populations economically, physically, and socially. Hence, pedestrian access to public transport significantly enhances overall accessibility [16].

Inclusive Street Design Dimensions by Wang in (2020) [40], identify accessibility as a category of inclusive street design. Accessibility addresses access to streets, transit nodes and includes a variety of elements for users with physical disabilities. These include; roadways, transit nodes, car parks, pedestrian ways, bike paths, bike racks, and universal design [40].

Accessibility ranked third among walkability factors, with comfort and safety being the first two according to [21] who identified three key elements that determine accessibility: (1) permeability/directness of paths; (2) ease of movement along those paths; and (3) access to buildings/other facilities [21].Trees in a strategic planting arrangement can provide pedestrian routes through streets in addition to defining the spatial boundaries of the walking route; they can also create canopy and trunk barriers that block pedestrians from seeing traffic overhead and define the walking route. These spatial definitions will enhance the accessibility of the walking route, guide pedestrian sightlines, and facilitate movement and activity. Additionally, clear signage and an adequate connection between all major campus facilities and sidewalks will greatly contribute to the accessibility of the entire campus. Thus, it is essential for all campuses' primary destinations (i.e., residential halls, classroom buildings, public transportation stops) to be easily accessible and connected to other areas of the campus via pedestrian-friendly routes in order to maximize the overall street accessibility of the campus.

Accessibility principles can help to provide for a more walkable environment with factors such as placing parking closer to public access points. Public transit stops should be placed at locations that are easily seen and provide an easy route of travel for pedestrians [18].

Loo in (2021) [41], states that convenience in the sense of mobility and access is vital for people who want to travel easily and quickly from one place to another, but this is a broader concept than access and is concerned more specifically with how easy it is for people to reach certain places and do certain things. Access to the public environment is essential if all pedestrians -- regardless of whether or not they have special needs -- can fully participate in society. The paper also points out that individuals with varying degrees of mobility, need, and preference exist among pedestrians and therefore should not be treated as an undifferentiated mass. A number of important variables will be employed to assess the walkability of areas: clear directional signage; continuity and obstructions; traffic signal cycles; the number of vehicular lanes on roads; the degree of directness/connectedness of routes; and the proximity between key destinations. Each of these variables is assessed based on its own set of criteria, for example: the clarity of directional signage; the existence of obstacles on the sidewalks; the pedestrian-friendliness of crossing locations; the number of vehicle lanes on the street; the degree to which a route has been designed to promote directness; and the degree to which an area is densely populated. An assessment of walkability in Hong Kong will use this framework to evaluate cases where approval was granted to build footbridges. The framework could be modified in the future, depending on preferences expressed by local citizens and/or new directions in strategic walking policy [41].

According [26], pedestrian walkability of any street is greatly increased by the presence of safe, comfortable, and accessible infrastructure for walkers. The accessibility of a location includes elements of how easy it is to reach a destination (ie., ease of access), the distance to the desired destination, physical barriers to walking and/or perceived barriers to walking, and connectivity of land uses. Indicators used to measure these elements include walkway widths, broken pavement surfaces, obstacles (such as utility poles), uneven grade changes, and feeder road connections.

Accessibility, is important to both the selection of routes by pedestrians, and the overall comfort of pedestrians; therefore, an effective connected street network, and suitable pavement connections between all destinations, public areas, and transportation systems are important to pedestrian accessibility [22], [39], [42]. Pedestrian accessibility can be classified into four types of pedestrian accessibility categories: functional walking, access sub-mode, recreational walking, and circulation exchange mode [20], [23]; in addition, [20], [23] indicate that there are three main elements of accessibility: physical, visual, and symbolic; furthermore, the authors emphasize the importance of sidewalk connections as a method of providing physical accessibility to all buildings and businesses (i.e., barrier-free).

Design elements of a pedestrian environment that provide accessibility include a flat surface, a guide rail that can be touched by hand, sufficient disabled parking spaces, a slope or incline that will allow a person to walk easily on it, and a ramp to enable people who are unable to use stairs to have access to the area. [29] and [30] recommend that the footway be at least 2m wide so that all pedestrians may safely move about in this area. A change in grade is also an obstacle to wheelchair users and older pedestrians, and therefore, reducing the number of these obstacles to zero is important for these groups.

Zakaria and Ujang (2015) [24] indicate that the main advantage of accessibility is to provide each individual with an equal opportunity to walk on foot. Parking spaces may limit or even deny pedestrian access as a result of poor design, therefore, in order to minimize pedestrian-vehicle conflict, they should be located near buildings, have safety measures, and minimize conflicts [37], [43], [44]; clear signage with reference points (landmarks) will aid pedestrian's ability to understand their space and navigate it [38]; and wide enough pedestrian corridors without obstructions will allow for "barrier-free" walking.

Pratiwi et al. (2015) [27] identify three important factors to be considered when evaluating the accessibility of pedestrians to event spaces; namely, the amenities available to pedestrians, their level of safety, and the ability to travel about

[27]. The study identified that the presence of adequate restroom facilities, greenery, building design, crime prevention measures, and adequate pathway capacity all contribute to pedestrian comfort and satisfaction [27]. In addition to these amenity-based issues, [31] identified a number of physical characteristics of streets that enhance the walkability of an area. The authors conclude that high levels of connectivity, well-designed intersections, and adequate pathways all contribute to vibrant cities, which are both safe and aesthetically pleasing, and allow people to interact with one another.

According to [45], the dimension of accessibility is subjective and objective. The subjectivity of a place in terms of being an accessible one can be found in the pedestrians' experience, their feeling of security, and in the physical condition of the facilities. The objectivity of accessibility relates to the characteristics of the physical environment, such as the mixed land use, the proximity to public services (for example, schools, healthcare services), and the adequate allocation of green spaces. Moreover, [46] indicates that accessible community areas, such as plazas and community centers, are fundamental for increasing the social interaction among inhabitants and, therefore, for improving the livability of neighborhoods. Finally, [47] highlights the importance of creating shared streets that allow for all types of users, especially people with disabilities, to move easily around the city by means of specific design elements, such as tactile walking indicators, clearly defined pedestrian zones, and designated crossing points.

In addition to accessibility, Da Silva (2008) [48] identified the need for physical and visual connections between the various components of an urban area to create unity and simplicity for pedestrians. Visual continuities provided through such physical design elements as tree-lined walks, crosswalks, and continuous sightlines can enhance the perceived visual cohesion and provide a sense of fluidity to pedestrian circulation patterns, thereby creating a cohesive urban environment [48].

Building on previous studies, the current study has developed a list of 26 accessibility indicators that have the potential to either increase or decrease social interaction and the users' perceptions of public spaces, as seen in Table 1. These indicators will be included in the survey instrument as part of the proposed accessibility model to investigate their relationships. The results of the study will enable the collection of data to evaluate how the accessibility features of the physical environment affect how individuals interact with one another and their perceptions of the usability and quality of the space.

Table 1: The indicators of accessibility in relating to social interaction and user perception, Source: by the authors.

Main Variable	Sub-Variables	Indicators	[18]	[21]	[22]	[24]	[26]	[27]	[29]	[30]	[40]	[41]	[45]	[46]	[47]	[48]	[49]
Accessibility	**Access to facilities**	Inclusive social spaces															
		Public transportation															
		Playground facilities															
		Parking and drop-off															
		Accessibility options															
		Accessible destinations															
	Ease of movement (For abled people)	Street configuration															
		Obstruction-free															
		Sidewalk Levels															
		Sidewalk condition															
		Curb ramps															
		Crosswalks															
		Signage at night															
		Signage															
	Ease of movement (For physical, visual, auditory, and cognitive impairments)	Signage															
		Tactile															
		Signals															
		Curb ramps															
		Visual clutter or obstructions															
		Wayfinding															
	Directness	Trees															

4. THE ROLE OF ACCESSIBLE WALKABILITY IN ENHANCING SOCIAL ACTIVITY, USER EXPERIENCE, AND USER PERCEPTION

Accessible walking is becoming an important factor in designing better urban areas. This is due to it being an important driver for creating a socially active environment, improving the user experience, and creating a positive user experience when interacting with public spaces. Accessible means that it is easy to reach, enter, and move around within a given space. It is also closely related to walkability, which is about ensuring that pedestrians feel safe, comfortable, and connected while using the street or public space. Studies have shown that by making cities' streets and public spaces walkable and accessible creates an environment that encourages socialization, increases enjoyment, and builds a positive perception of the space among users [13], [50], and [51]. As such, how easily people are able to access public spaces is essential to promoting social interaction and community building [52] as the way in which we live, work, and interact with one another is largely influenced by how well designed our surroundings are.

The researchers in [53] indicate that pedestrian-friendly areas within urban environments are critical to creating opportunities for interaction among citizens as well as developing a sense of "community" among residents. Walking is the most social form of transportation since it provides opportunities for pedestrians to interact with others and to engage in conversation while on their way to somewhere. In addition to the benefits that pedestrian-friendly communities provide for the environment and the local economy, the ability of individuals to interact with one another will enhance social cohesion [53]. The researchers further state that when a neighborhood offers easy walking access to shops, residents are more likely to use their feet to get what they need on a daily basis. This research also shows that proximity to basic services, including shops that are close enough for individuals to walk to (200-500 meters), enhances the likelihood of pedestrians choosing to walk rather than drive.

In addition to enhancing social activity through increased mobility, fostering a sense of community and lingering, creating an environment where public interaction is encouraged promotes a range of social interactions. When public places are made more accessible to visitors, social atmosphere increases which may lead to a greater variety of activities occurring between individuals [54]. As indicated by [13] higher levels of walkability are positively correlated with higher levels of social interaction (casual conversation, group gatherings, etc.) and social activity (events). Some examples of activity types facilitated by accessible streets include: window shopping; street market visits; participation in physical activity/fitness programs; attendance at local events; and socializing in cafes or outdoor seating areas [23]. Without the comfort and restriction of pedestrians, these activities would be impossible. Social activity was defined by [35] as typically occurring within the context of collective/festive environments and [55] included contextual elements of social activity including individual participants, time, photographs, comments, and the social network of those involved. For purposes of this study, social activity is considered to be a discretionary engagement that brings individuals together in public or semi-public spaces to enjoy a meal together, listen to music, and participate in cultural/religious celebrations.

Empirical studies confirm that streets that are more easily accessed by people provide greater opportunity for a higher frequency and variety of social interaction [56], and [57]. For instance, [50] studied the social impact of an urban square in a well-designed city and found that users engaged in increased social contact (e.g., meeting with friends, speaking with others they did not know previously) and participated in community events because of the street design characteristics (e.g., wide sidewalks, no physical barrier to access, clear signage, comfortable amenities) which directly affect the amount and quality of social activity [19], [51].

Users' experiences in urban spaces are comprised of many different types of reactions that can be described as both rational (cognitive), emotional, and/or physical (sensory) that include: interest; enjoyment; discovery; practicality; aesthetic appeal; sense of belonging; and, physical satisfaction. The walkability of areas where there is high accessibility for all users allows them to interact with the three main attributes of the street (physical - architecture & landscaping; social - activities & culture; natural - trees & fountains), which increases the stimulation and enjoyment from each visit [50].

Carmona et al. (2010), report that practical factors (sidewalks, signalized crosswalks, etc.) have a direct impact on user satisfaction and experience [51] and that the aesthetic/sensory factors (landscaping, public art, ambient smells/hearing, etc.) will positively affect user satisfaction [13] and provide users with an opportunity to discover new areas/experiences throughout their travel/urban journey. Walkability is also accessible and provides users with opportunities to find new areas/experiences through travel and exploration [60], and spatial user experience can be significantly affected by the various intervention factors in the space (seating, lighting, landscaping, signage, public art, architecture, etc.).

Inclusive design is also important in terms of inclusiveness: environments which provide for people with disabilities, children, and the elderly will create a greater sense of community and equality and therefore support a better user experience [19], [58]. Research has shown that individuals tend to perceive their experience more positively when they have felt safe, comfortable, and able to find out something new during their walk [59], [60]. According to [60], the user experience is based on the usage of a product, as well as usage of the public and urban area, and this should be interesting, enjoyable, and pleasant. This implies that an effective design of a product and/or urban area goes beyond developing its form and function; rather, it develops a sense of experience for the user through emotional factors such as enjoyment, comfort, feelings, clarity, etc. An ultimate goal of designing urban areas and products is to develop products that meet the users' functional needs, while creating a unique and memorable experience that creates a strong identity for that particular location. Creating a strong sense of connection for the user to the environment, as well as being inviting and distinctive, are key elements in establishing a sense of place and creating an environment that supports a strong connection to that location.

User perceptions reflect what people believe and think about a public area — such as an attraction to a place; whether they perceive a place to be safe; whether they would return to a place; and whether they would suggest it to friends or family. Perception (how we see things) is a product of three types of qualities — physical, functional, and social qualities [36], [51]. Accessibility and walkability can improve users' perceptions of aesthetic appeal/attraction and emotional attachment. Users tend to be more attracted to, have a higher level of attachment to, and want to return to areas that are easier to walk, visually appealing, and full of life/activity [50]. Social perceptions can also be improved through increased interaction among users, shared experiences, and feelings of belonging to a community in accessible environments [13], [56]. [57] found positive associations for perceptions of safety, social connections, and place attachment in relation to accessible parks and streets in Malaysia. Similarly, [19] found strong correlations between enhanced pedestrian accessibility and favorable perceptions of city streets in Middle Eastern cities.

5. CONCEPTUAL FRAMEWORK

Building on the walkability literature, this research proposes that accessibility, viewed as a multi-faceted factor, precedes both social interaction and how users perceive mixed-use streets (visualized in Figure 1). Building on earlier findings, we define accessibility through three interconnected groups tied directly to walkability, as outlined in Table 1: (i) access to facilities (e.g., inclusive social spaces, public transportation, playground facilities, commercial facilities); (ii) the ease of getting around (e.g., street configuration, obstruction-free, sidewalk levels, sidewalk condition); and (iii) inclusive provisions for people with disabilities (e.g., clarity of signage, tactile, audible signals). Our theory, therefore, is that enhancements within these areas of accessibility stimulate social interaction – which we see as a higher-level concept comprised of social activity (e.g., repeat visitation, friends on the street) and social contact (e.g., window shopping, engagement with vendors and cafés, casual conversations, fitness, everyday trips). In turn, increased social interaction is theorized to positively shape user perception (for instance, the street's attractiveness, the frequency of visits with friends, regular engagement, and sharing of knowledge). Aligning with existing proof demonstrating how walkable, mixed-use areas encourage frequent encounters, robust social connections, and positive evaluations of urban settings, the proposed framework highlights direct positive impacts stemming from each accessibility group on both social interaction and user perception, along with an indirect (mediated) path demonstrating accessibility's effect on user perception through social interaction, as shown in the conceptual model.

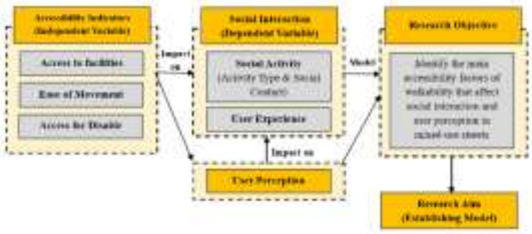

Fig. 1 Conceptual Framework of the Study

6. RESEARCH HYPOTHESIS

Promoting walking as a means of local travel can enhance opportunities for informal social interactions and foster vibrant community connections [61]. Hence, this paper suggests two hypotheses presented below are grounded in extensive literature that explores the relationship between accessibility and its impact on social interaction and user perception.

H1: There is a positive relationship between accessibility and social interaction (social activity and user experience) in mixed-use streets.

H2: There is a positive relationship between accessibility and perception of users in mixed-use streets.

H3: there is positive relationship between social interaction and perception of users in mixed-use streets.

Hence, the theoretical framework that addresses the concepts that lead to the development of dependent and independent variables to achieve the study objectives ca be shaped. As a result, all environmental attributes, activity values, and investigation outcomes influence overall social interaction (user experience and social activity) and user perceptions in urban places. Accessibility (independent variable) can influence social activity, user experience, and perception (dependent variable) of the user to investigate the level of association between the main variables.

7. CASE STUDY

Al-Masaref Street, located in the city of Mosul, Iraq, was selected as the case study site for this research (Fig. 2). The street extends for approximately one kilometer and was chosen due to several distinctive characteristics. Notably, it features wide sidewalks on both sides, enhancing pedestrian accessibility. Additionally, Al-Masaref Street has an extensive variety of health services and pharmacies in addition to various medical clinics and laboratories. Therefore, this street can have a wide range of users such as patients, people who have disabilities, elderly people etc. So the research will not be confined to one type of users however it will evaluate accessibility to all categories of users therefore it can be said that the results would be fair and unbiased regarding demographics.

A

B

Fig. 2 Al-Masaref Street as the Case Study, Google Maps: https://maps.app.goo.gl/UfeKQbJMLRM-pibCQ8 , and photos by the corresponding author.

8. ADOPTED METHODOLOGY

This study is to design a walkability model that explains how accessibility influences social interactions in mixed-use streets (See Fig. 3). This can be done by examining the relationship between accessibility aspects, social interaction (social activity and the user experience) and user perception of social environment on mixed-use street.

The study utilizes quantitative method which involves the use of structured questionnaires to gather numerical data from participants. These questionnaires were designed based on a Likert scale, allowing respondents to express their opinions or experiences on a scale ranging from 1 (strongly disagree) to 5 (strongly agree). The research gathered questionnaire surveys information from every street user—static and mobile as stated in many references such as [62], [63], [64] .

The study used a cohort of 400 participants and based the choice of size on an estimate of a 95% confidence level with a 5% margin of error as described in [65]. Additionally, the authors followed the guidelines as given in [66] that recommended a sample of 384 participants when estimating parameters from population sizes above 100,000 in order to provide both reliable and precise results.

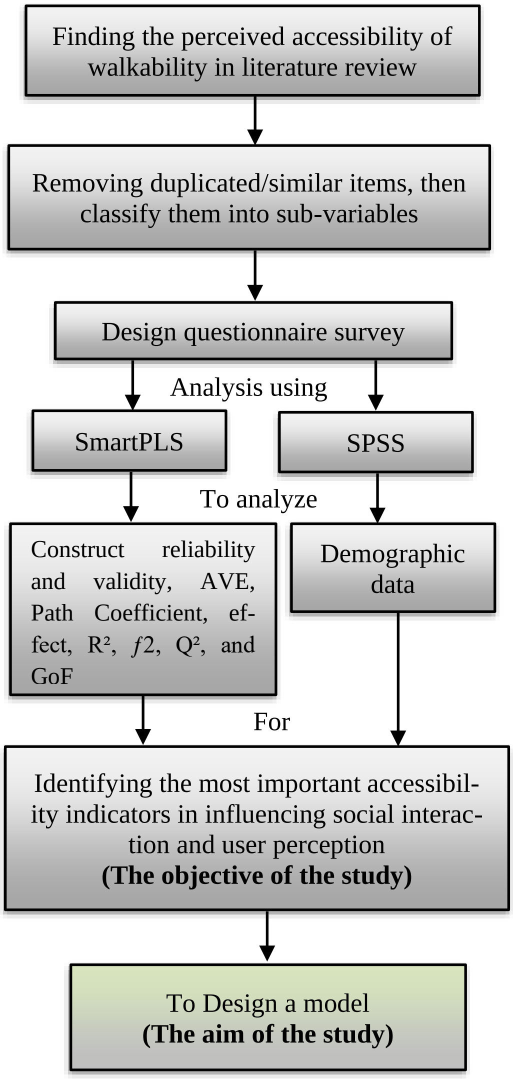

Fig. 3 The Design of the Study.

The population of Mosul is expected to be approximately 1,904,140 by 2025. As such, both recommendations were applicable to the project. This was a deliberate selection of the larger sample size to improve the study's representational quality and to improve the validity of measurement [67]. To achieve these goals, the study followed De Vaus' recommendations. A slightly larger sample has better statistical reliability; it will produce more comprehensive and stronger findings from the study.

The research study utilized SmartPLS [35], [68], a software program frequently used for Partial Least Squares Structural Equation Modeling (PLS-SEM), to analyze the collected questionnaire information from participants. SmartPLS was used to create a theoretical model in which the variables connected to the independent variable (accessibility) and the dependent variable (social interaction) were represented as interconnected elements. PLS-SEM enables the researcher to establish models that represent complex cause-and-effect relationships among multiple constructs, numerous indicators, and many possible paths. The PLS-SEM methodology can be used for predictive modeling and for developing theories. Additionally, its applied nature produces results that are useful for policy-makers, managers, and designers for making decisions about interventions [69], [70].

The research applied several rigorous statistical measures to evaluate the model and its relationships:

- **R-squared (R^2)**: Measures the strength of the predictive power of independent variables on dependent variables.
- **rho-c and rho-a**: Reliability measures assessing the internal consistency of the constructs in the model.
- **Average Variance Extracted (AVE)**: Determines how much variance is captured by a construct in relation to the variance due to measurement error.
- **Outer Loadings**: Indicate the relationship strength between observed indicators (questions/items) and their respective constructs.
- **Path Coefficients**: Evaluate the strength and direction (positive or negative) of relationships between different variables in the model.
- **F-squared (f^2)**: Measures the effect size, indicating the practical significance of relationships between variables.
- **Q-squared (Q^2)**: Assesses predictive relevance, determining how well observed values are reconstructed by the model.
- **P-values and t-values**: Statistical significance tests, confirming whether observed relationships between variables are statistically meaningful.
- Standard **deviation**: Quantifies the variability or dispersion within the data set.

In addition to examining the measurement and structural aspects of the model using the statistical methodologies described in this research, an analysis of the Goodness of Fit (GOF) is conducted to determine the degree of alignment between the proposed conceptual model and the actual data collected. GOF is a geometric mean of two primary components: average variance extracted (AVE), and the mean r-squared (r2) value for each of the endogenous variables; AVE represents communality while r2 represents explanatory power. GOF scores are generally classified as either small (0.10), medium (0.25), or large (0.36 or greater); when a GOF score approaches 1 it indicates the model provides a very accurate representation of the data set, and therefore provides a high degree of explanatory power regarding the relationships observed in the data.

9. RESULTS AND DISCUSSION

The analysis of the 400 respondents' socio-demographic data shows a sample skewed toward males (72.3% men, 27.8% women) (Table 2). As a result of religious beliefs and cultural-social practices that exist at the level of community and neighborhood, most women declined to answer the survey questions regarding the use of Al-Masaref Street. Accordingly, the proportion of men to women in the study population may or may not be representative of the actual distribution of users of the street. In terms of their ages, 71% of the population sampled were younger adults (18-39), which indicates a significant number of young adults using the street. Regarding their health status, the vast majority of respondents indicated they had no health problems (83%). Nevertheless, a small percentage of the respondents (16%) identified hearing problems, while an additional 5% noted mobility problems, which illustrates the necessity of designing areas for everyone. The principal reasons for crossing the road appear to be primarily based on necessity rather than leisure. This is supported by the fact that many residents have high levels of use of the area for doctor's visits (62%) and pharmacy visits (38%) as well as for shopping (36%), indicating that it functions as an important hub for services and daily needs. The data indicate that there was far less evidence of uses associated with leisure time, such as spending time with friends (20%) or engaging in recreation (11%), but some evidence of leisure time uses for women, including exercise (11%). Overall, it appears that the street has a greater emphasis on the movement for and delivery of basic necessities than the potential for leisure time/socialization. Any changes made to increase accessibility will likely provide for improved ease of access for routine day-to-day tasks while also providing new and increased opportunities for social interactions.

Table 2: Socio-demographic Indicator Dimension, the field of questionnaire surveys.

	Category	Male number	Male %	Female number	Female %
Gender	Total	289	72.25%	111	27.75%
Age	18-29	117	29.25%	57	14.25%
	30-39	83	20.75%	26	6.50%
	40-49	49	12.25%	13	3.25%
	50-59	27	6.75%	6	1.50%
	60 and above	13	3.25%	9	2.25%
Health problem	No health problem	240	60.00%	92	23.00%
	Has health problem	49	12.25%	19	4.75%
	Mobility impairment	11	2.75%	8	2.00%
	Visual impairment	4	1.00%	0	0.00%
	Hearing impairment	46	11.50%	19	4.75%
Purpose of visiting the Street	Shopping	103	25.75%	42	10.50%
	Visiting doctor/pharmacy	178	44.50%	71	17.75%
	Leisure time	33	8.25%	11	2.75%
	Going to work	114	28.50%	36	9.00%
	Going to mosque	19	4.75%	3	0.75%
	Meeting friends	66	16.50%	14	3.50%
	Walking to a bus / Taxi stop	9	2.25%	3	0.75%
	Walking to exercise	26	6.50%	17	4.25%
	Walking to deliver someone	21	5.25%	7	1.75%
	Walk for other purposes	2	0.50%	2	0.50%

The analysis of summary statistical data of the 53 items that assess the three areas (accessibility, social interaction, and user perceptions) of Al-Masaref Street were found to be very useful in terms of providing meaningful insight into how respondents perceive this street. As displayed in table 3, the average (mean) value and the standard deviation of the data for each indicator. Overall, the findings of the study demonstrate a predominantly positive perception of the physical attributes of accessibility, with many of the items being rated higher than 4.00 on a five point likert scale, which shows that most people approve of their presence or effectiveness.

Table 3: Mean and Standard Deviation of the Accessibility, Social Interaction, and User Perception Indicators, source: by the authors.

Question no.	Code	Questions	Mean	Standard deviation
1	**AC1**	Inclusive social spaces	2.808	0.816
2	**AC2**	Public transportation	2.04	0.555
3	**AC3**	Playground facilities	2.027	0.54
4	**AC4**	Commercial facilities	3.058	0.533
5	**AC5**	Parking and drop-off	3.067	0.518
6	**AC6**	Accessibility options	4.03	0.542
7	**AC7**	Number of destinations	4.05	0.563
8	**AC8**	Variety of destinations	3.058	0.552
9	**AC9**	Street configuration	4.043	0.535
10	**AC10**	Obstruction-free	3.01	0.538
11	**AC11**	Sidewalk Levels	4.058	0.524
12	**AC12**	Sidewalk condition	3.035	0.514
13	**AC13**	Curb ramps	2.02	0.533
14	**AC14**	Crosswalks	2.027	0.512
15	**AC15**	Signage at night	4.053	0.557
16	**AC16**	Signage at daytime	3.027	0.531
17	**AC17**	Sign and direction	3.035	0.528
18	**AC18**	Street intersection	4.037	0.525
19	**AC19**	Trees	4.03	0.547
20	**AC20**	Clarity of Signage	3.067	0.564
21	**AC21**	Tactile	4.058	0.547
22	**AC22**	Audible Signals	4.045	0.527
23	**AC23**	Visual clutter or obstructions	3.06	0.535
24	**AC24**	Wayfinding	3.083	0.53
25	**AC25**	Accessible pedestrian signals at signalized crossings	4.067	0.559
26	**AC26**	Crosswalk mark	4.072	0.559
27	**UP1**	Overall, I am attracted to this street	4.067	0.527
28	**UP2**	I visit this street with most of my friends	3.062	0.533
29	**UP3**	I regularly come here and talk with people	3.1	0.561
30	**UP4**	I share my knowledge and experience with other people in this street	3.05	0.532
31	**AcT1**	I visited the street more than three times.	3.042	0.53
32	**AcT2**	I have many friends in the street.	2.038	0.58
33	**SC1**	Window Shopping	4.04	0.528
34	**SC2**	Street Markets and Vendors	4.03	0.499
35	**SC3**	Exercise and Fitness for health	2.795	0.89
36	**SC4**	Casual Conversations	3.053	0.538
37	**SC5**	Local Events	2.752	0.903
38	**SC6**	Cafes and Outdoor Seating	3.06	0.516
39	**SC7**	Residential Interaction	3.792	0.839
40	**SC8**	Waiting to socialize	4.095	0.525
41	**SC9**	Entertainment	2.783	0.908
42	**SC10**	Company	3.075	0.524
43	**SC11**	Transportation	4.06	0.562
44	**SC12**	Going to work or school/university	4.075	0.533
45	**UE1**	The architecture and buildings in this street capture my interest.	4.037	0.525
46	**UE2**	The natural attributes (tress, fountains) and others in this street capture my interest.	4.01	0.529
47	**UE3**	The social attributes (activities, culture) in this street capture my interest.	3.78	0.776
48	**UE4**	Enjoyment	4.037	0.53
49	**UE5**	Discovery	3	0.566
50	**UE6**	Practicality	4.03	0.556
51	**UE7**	Aesthetics	3.987	0.55

52	**UE8**	Belonging	4.008	0.536
53	**UE9**	Sensory Experience	3.01	0.897

The three most highly rated items were waiting to socialize (SC8), with an average rating of 4.095; Going to Work/School/University (SC12), which had a score of 4.075; and Crosswalk Mark (AC26) had a score of 4.072. Other high rated items included Accessible Pedestrian Signals (AC25), Street Transportation (SC11); and General Street Attraction (UP1). All items exceeded an average rating of 4.06. These items support the notion that users perceive the street as being both functionally and experientially valuable for their daily travel needs and casual interactions.

On the other hand, the least highly rated indicators can be seen as potential shortcomings of the universal design and the social engagement opportunities. In particular, Playground facilities (AC3) and Crosswalks (AC14) were rated, on average, at 2.027; and Curb ramps (AC13), Public transportation (AC2), and Having friends on the street (AcT2) had mean ratings very close to 2.0. The fact that the above indicators have such low mean ratings implies that these features do not exist or that they do not fulfill users' expectations, especially regarding social infrastructure and accessible pedestrian amenities.

The next sections will provide a detailed description and analysis of the results obtained by using SmartPLS for assessing the accessibility model in relation to social interaction and user perceptions.

9.1. Construct reliability and validity

Construct Reliability and Validity Analysis provides support for the Accessibility Measurement Model's robustness in terms of achieving high levels of internal consistency, where Composite Reliability Values (rho-c and rho-a) for all of the constructs are at or greater than the suggested minimum of 0.7 (see Table 4; [69]), which supports the concept that measurement items are internally consistent and indicate that the measurement items successfully capture the core aspects of accessibility. In addition, the AVE (Average Variance Extracted) scores of .658, .716, and .763, all of which are greater than .5, provide evidence that each construct demonstrates sufficient Convergent Validity because each construct is able to explain a significant proportion of variance from its measurement items [71].

Table 4: The Model Assessment for All Study Aspect. Checking the Factor Loading and Construct Reliability and Validity (Before Deleting), source: by the authors.

in Construct	**Main Variables**	**Sub-Variables**	**The main indicators items**	**Outer loadings**	**(rho_a)**	**rho_c)**	**(AVE)**
Walkability	Accessibility	**Access to facilities (AccA)**	**AC1 <- Access to facilities (AccA)**	0.611	0.929	0.939	0.658
			AC2 <- Access to facilities (AccA)	0.824			
			AC3 <- Access to facilities (AccA)	0.838			
			AC4 <- Access to facilities (AccA)	0.842			
			AC5 <- Access to facilities (AccA)	0.837			
			AC6 <- Access to facilities (AccA)	0.85			
			AC7 <- Access to facilities (AccA)	0.84			
			AC8 <- Access to facilities (AccA)	0.822			
		Ease of movement (AccB)	**AC9 <- Ease of movement (AccB)**	0.858	0.96	0.965	0.716
			AC10 <- Ease of movement (AccB)	0.832			
			AC11 <- Ease of movement (AccB)	0.863			
			AC12 <- Ease of movement (AccB)	0.859			
			AC13 <- Ease of movement (AccB)	0.856			
			AC14 <- Ease of movement (AccB)	0.835			
			AC15 <- Ease of movement (AccB)	0.831			
			AC16 <- Ease of movement (AccB)	0.834			
			AC17 <- Ease of movement (AccB)	0.854			
			AC18 <- Ease of movement (AccB)	0.848			
			AC19 <- Ease of movement (AccB)	0.837			
		Importance of Unavailable elements (AccM)	**AC20 <- Importance of Unavailable elements (AccM)**	0.885	0.948	0.958	0.763
			AC21 <- Importance of Unavailable elements (AccM)	0.867			
			AC22 <- Importance of Unavailable elements (AccM)	0.854			
			AC23 <- Importance of Unavailable elements (AccM)	0.863			
			AC24 <- Importance of Unavailable elements (AccM)	0.866			
			AC25 <- Importance of Unavailable elements (AccM)	0.89			
			AC26 <- Importance of Unavailable elements (AccM)	0.889			

User Perception	Social Environment		**UP1 <- User Perception**	0.798	0.818	0.88	0.646
			UP2 <- User Perception	0.773			
			UP3 <- User Perception	0.832			
			UP4 <- User Perception	0.811			
Social Interaction	Social Activity	Activity Type	**AcT1 <- Activity Type**	0.922	**0.597**	0.769	0.632
			AcT2 <- Activity Type	**0.643**			
		Social Contact	**SC1 <- Social Contact**	0.85	0.922	0.92	0.502
			SC2 <- Social Contact	0.747			
			SC3 <- Social Contact	**0.457**			
			SC4 <- Social Contact	0.814			
			SC5 <- Social Contact	**0.531**			
			SC6 <- Social Contact	0.792			
			SC7 <- Social Contact	**0.49**			
			SC8 <- Social Contact	0.799			
			SC9 <- Social Contact	**0.46**			
			SC10 <- Social Contact	0.779			
			SC11 <- Social Contact	0.807			
			SC12 <- Social Contact	0.783			
	User Experience		**UE1 <- User Experience**	0.838	0.916	0.928	0.62
			UE2 <- User Experience	0.764			
			UE3 <- User Experience	**0.62**			
			UE4 <- User Experience	0.794			
			UE5 <- User Experience	0.828			
			UE6 <- User Experience	0.785			
			UE7 <- User Experience	0.807			
			UE8 <- User Experience	0.82			
			UE9 <- User Experience	**0.477**			

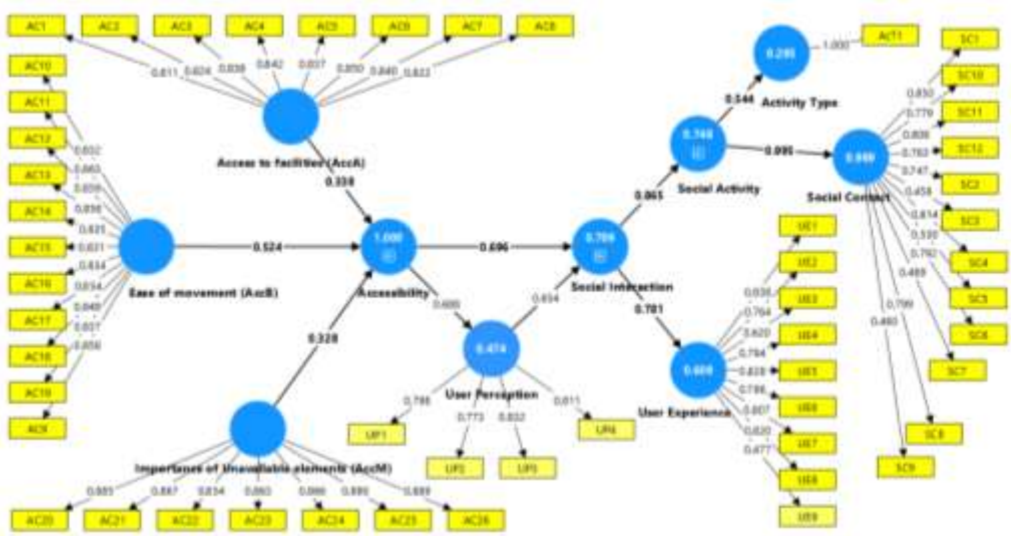

Fig. 4 The proposed model and the outer loading for the accessibility aspects items after removing items below the threshold using Smart PLS 4.1.1.2 software, source: by the authors

Retention of items with outer loadings between .4 and .7 is acceptable if excluding them does not significantly enhance the composite reliability or AVE as described by [72]. Similarly, [69], in their revised version, emphasize that items loaded as low as .4 can remain in the model if they have acceptable reliability and validity at the construct level. [73] further suggests that the decision to remove an item should not be based solely on a threshold for loading but rather on whether there will be an improvement in the construct-level reliability.

Wong (2013) recommends that if an indicator's loading is less than 0.7 but has acceptable Composite Reliability (CR) and Average Variance Extracted (AVE), it can remain in the model [74]. Therefore, whether to keep or drop is based upon the trade-off between how well each individual item performs and how well the entire construct performs as a whole. Items that are slightly under .7 (i.e., ~.6-.69) are typically kept when the construct metric values are at acceptable levels. The AcT2 item will be dropped from the model due to having a very low loading, and as such, it will lower the composite reliability (and therefore rho_A, which measures the internal consistency reliability of the construct) (Fig. 4). Dropping this item will increase the reliability of the overall measurement model. However, items with factor loadings under 0.70, like AC1, SC3, SC5, SC7, SC9, UE3, and UE9, will be retained since they will not adversely affect the composite reliability (rho_A or CR) or the AVE, and retaining these items will help preserve the content validity of the construct.

The construct reliabilities and validity analyses show that the measurement model for the accessibility aspects was robust and valid in that it met the necessary criteria for all three constructs (see Table 3.0). The composite reliabilities were found to be sufficiently high as indicated by the values of rho-c and rho-a, with values exceeding .70 for all three constructs. Therefore, the evidence provided by these composite reliabilites confirmed the internal consistency of the constructs and demonstrated that the constructs are measuring what they purport to measure (i.e., the underlying dimensions of accessibility), consistently over time. In addition, the AVE values (i.e., .658, .716 and .763) are greater than .50 and therefore confirm that the constructs have sufficient convergent validity, and that each construct captures a significant portion of variance from their respective indicators. Collectively, the data presented above provide strong empirical support for the measurement model used to assess accessibility, and provides assurance that the constructs will be theoretically meaningful and statistically sound for use in subsequent structural analyses.

9.2. Discriminant Validity

As illustrated in Table 5, the use of the Fornell-Larcker method demonstrates that all of the dimensions of the model are empirical, separate from one another, and have discriminant validity. The square root of the AVE for Accessibility was .709; for Social Activity, it was .693; for User Experience, it was .757; and for User Perception, it was .804. Each of these values is higher than the inter-concept correlation coefficient values. Therefore, this study has met the requirements for discriminant validity as described in [71] because each dimension measures different variance and therefore can help to reduce the possibility of multicollinearity and ensure that the latent variables are both statistically and conceptually independent. These results further enhance the quality of the measurement model, which provides a strong base for the subsequent structural analyses and increases the validity and credibility of the study's conclusions.

Table 5: Discriminant validity for the accessibility and social interaction constructs by the Fornell-Larcker Criterion, source: by the authors.

	Accessibility	Social Activity	User Experience	User Perception
Accessibility	***0.709***			
Social Activity	0.578	***0.693***		
User Experience	0.572	0.362	***0.757***	
User Perception	0.688	0.675	0.688	***0.804***

9.3. Path coefficient of the structural model

The structural model analysis reveals that all hypothesized relationships are statistically significant and supported at the p < 0.01 level, underscoring the strength and reliability of the proposed framework. Accessibility exerts a moderate but significant direct effect on social interaction (β = 0.246, t = 6.566, p < 0.001), highlighting its role in shaping the social dynamics within urban environments (Table 6). More notably, accessibility strongly influences user perception (β = 0.688, t = 24.313, p < 0.001), indicating that improvements in accessibility greatly enhance how individuals perceive and experience their surroundings. In turn, user perception significantly predicts social interaction (β = 0.654, t = 18.193, p < 0.001), suggesting that positive perceptions foster increased social engagement.

Table 6: Path Coefficient of the Research Study for The Structural Model, source: by the authors.

	Path Co-efficients	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Decision
Accessibility -> Social Interaction	0.246	0.037	6.566	0	Supported**
Accessibility -> User Perception	0.688	0.028	24.313	0	Supported**
User Perception -> Social Interaction	0.654	0.036	18.193	0	Supported**

Significant at p**= < 0.01, p* <0.05

These findings demonstrate that user perceptions are a key mediator in how users perceive their experience of social interactions within public spaces as well as an indicator of perceived accessibility (or lack thereof), as such providing significant information for both urban planners and policy makers seeking to design socially active and accessible public spaces. Overall, the results strengthen the structural model, thereby increasing the validity of the study and providing guidance for designers of future urban designs.

Based on data presented in Table 7, the results of the mediation analysis clearly show that there is a statistically significant intermediate role for user perception between accessibility and social interaction. The t-statistic for the indirect effect of .45 is statistically significant at $p < .001$ (t = 14.561), and the 95% confidence interval around the estimate (.390 to .510) is entirely above zero, which supports the stability of the mediation pathway. Together these findings show that accessibility has an additional positive indirect effect on social interaction beyond its direct effect, by affecting users' perception of their environment; that is, when accessibility improves, users' positive perceptions of their environment increase, leading to increased social engagement.

Table 7: There is an effect between the accessibility and social interaction through the user perception, source: by the authors.

	Path a	Path b	Indirect effect	T-value	2.5%	97.5 %	Decision
H	0.688	0.654	0.45	14.561	0.390	**0.510**	mediation

This finding highlights the crucial role of perceptual factors in translating physical design elements into social outcomes, emphasizing the need for urban planning and design strategies that prioritize both infrastructural quality and user experience to cultivate vibrant, socially connected communities.

9.4. R-square of dependent variables

R squared (R^2) is a statistical value of how near the data be to the fitted regression line. The definition of R-squared is the percentage of the response variable variation that a linear model explains. R^2 additionally recognised as the coefficient of determination, or the coefficient of multiple determination for multiple regression [69]. The study used this measurement to indicate the total impact of the aspect that contained multiple variables.

According to [75] from literature, R-squared values below 0.10 are unacceptable unless the model is improved. Values from 0.10 to 0.50 are acceptable if key variables are significant, while values from 0.51 to 0.99 are acceptable if significant variables dominate and no major issues like multicollinearity arise. R-squared values exceeding 0.67 are regarded as high, values ranging from 0.33 to 0.67 are considered moderate, and values between 0.19 and 0.33 are classified as weak [68]

Based on the results shown in the Table 8, social activity (R^2 = 0.748) has the highest explained variance, indicating that the independent variables account for ~74.8% of its variability, a strong predictive outcome. Social interaction (R^2 = 0.709) also shows high predictive accuracy. User experience (R^2 = 0.609) and user perception (R^2 = 0.474) are in the moderate range, meaning the model explains a moderate proportion of variance for these constructs.

Table 8: R-square proportion of variation in the dependent variables, source: by the authors.

	R-square	**Result**
Social Activity	0.748	High
Social Interaction	0.709	High
User Experience	0.609	Moderate
User Perception	0.474	Moderate

Overall, the structural model demonstrates solid explanatory power, especially for the key social outcomes.

9.5. $f2$ and the Stone-Geisser's Q^2

Table 9 presents the effect size (f^2) values between the main constructs, revealing varying degrees of influence among the variables [70]. The relationship between Accessibility and Social Interaction had an almost negligible influence of Accessibility upon Social Interaction, as shown by the f2 = .11. This indicates that there are effects of Accessibility on Social Interaction but they appear to be relatively small. However, Accessibility appears to exert a large effect on User Perception (f2 = .90) indicating a substantial role for Accessibility in forming user perceptions of the environments they inhabit. Also, User Perception exerts an extremely strong effect on Social Interaction (f2 = .774) indicating a strong mediating role for User Perception in helping users engage in social interactions. Therefore, collectively, these results suggest while physical accessibility may not provide a significant amount of facilitation for social interaction when considered independently of other factors, Accessibility can greatly enhance the potential for positive social interaction when viewed through the lens of User Perception as suggested by the theoretical paths outlined in the conceptual model.

Table 9: The effect size $f2$ between the main variables of the study, source: by the authors.

	F-square	**Result**
Accessibility -> Social Interaction	0.11	small
Accessibility -> User Perception	0.9	Large
User Perception -> Social Interaction	0.774	Large

The Stone-Geisser Q^2 statistics shown in Table 10 serve as measures for assessing predictive validity of the endogenous constructs in the model [76]. Results indicate Social Interaction (Q^2= 0.483) and User Perception (Q^2 = 0.471) have the largest predictive relevance values from the model, providing support for the predictive capabilities of the model for these constructs. Results for Social Activity (Q^2 = 0.332) and User Experience (Q^2 = 0.324) indicate moderate levels of predictive relevance for the model with respect to these constructs; indicating that the model has sufficient predictive capability for these constructs but to a somewhat lower degree than for Social Interaction and User Perception. Since [69] indicates that a Q^2 statistic greater than 0 is evidence that a model is predictive relevant, and that a value of 0.35 or higher indicates the model has strong predictive ability, these results support the notion that the model can meaningfully predict many of the critical factors associated with how users interact within this framework.

Table 10: Examine Stone-Geisser's Q^2 value, source: by the authors.

Construct	Q-square
Social Activity	0.332
Social Interaction	0.483
User Experience	0.324
User Perception	0.471

9.6. Goodness of fit (GoF)

The Goodness of Fit (GoF) index is frequently applied in PLS-SEM studies for summarizing model adequacy. Originally proposed by [77], GoF captures both the predictive strength of the model (as expressed by the average R-squared of all principal endogenous variables) and the quality of construct measurement (through AVE, for all constructs with indicators).

While GoF provides a straightforward way to report the holistic quality of PLS-SEM models, current literature [78], [79] urges researchers to complement GoF results with a more nuanced evaluation of measurement validity, reliability, and predictive relevance. Therefore, this study employs GoF as supportive role in reporting model fit.

As outlined by [80], several thresholds were established to interpret the Goodness of Fit (GoF) index in PLS-SEM, enabling researchers to classify models as having poor, small, medium, or substantial fit on a global scale. Researchers suggested that a GoF less than 0.1 represents insufficient model fit, scores between 0.1 and 0.25 are interpreted as low, the range of 0.25 to 0.36 indicates moderate adequacy, and any value above 0.36 is considered high or excellent.

Applying cutoffs mentioned by [77], [80] to the current study, it reveals that the GoF of the study is around 0.69 which clearly places the current model in the "large fit" category, supporting its adequacy and confirming that the global validity of the PLS model is acceptable (Table 11).

Table 11: The Goodness of Fit (GoF) of the study, source: by the authors.

Construct		R^2	AVE
Accessibility	AccA	1	0.658
	AccB		0.716
	AccM		0.763
Social Interaction		0.709	
Social Activity		0.748	0.632
User Experience		0.609	0.62
User Perception		0.474	0.646
Total Average		**0.70775**	**0.6806**
GOF			**0.694**

10. CONCLUSIONS

The objective of this research was to develop and assess an accessibility-based walkability model aimed at exploring the impact of accessibility as a significant factor of walkability on user perception and social interaction in mixed-use urban settings. Supported by comprehensive theoretical foundations and rigorous methodology, the research employed Smart PLS structural equation modeling (PLS-SEM) to evaluate the interplay among 26 indicators of accessibility, 23 dimensions of social interaction, and 4 variables related to user perception.

Regarding survey gathering, the research finds that the gender distribution of participants might not mirror individuals' real presence on the street, since when surveys were given to women, many refused to partake. Various aspects could clarify this. Firstly, the questionnaires were carried out in Mosul, an Arab community shaped by Arab and Islamic customs and traditions that typically deter women from conversing with strangers, especially while in public spaces. Secondly, numerous women go to the street with a companion—frequently a father, brother, son, or another male relative—who tries to answer for her and does not permit direct interaction. The same pertained to patients: it was hard to acquire their opinions because a lot were in critical or fragile health and incapable of answering. Thus, the study deduces that sampling women in Arab and Islamic settings—and sampling patients—may not entirely represent what occurs in public areas, especially streets.

The results clearly confirm that the study successfully achieved its objectives and answered the primary research question: What are the most important accessibility indicators of walkability that influence social interaction in mixed-use streets? Besides, the accessibility influence on both user perception and social interaction was validated, thereby strengthening the conceptual structure of the study.

All hypotheses put forward within the research were empirically tested. H1, which stated that there was a positive relationship between the users' level of accessibility to an e-learning system and their levels of social interaction, was proven through a statistical significance ($\beta = .246$, $p < .001$) in its path coefficient. Likewise, H2, which predicted a correlation between accessibility and the users' perceptions of the quality of the learning environment, was found to be true with a higher coefficient value ($\beta = .688$, $p < .001$) than that of H1. Additionally, H3; which identified user perception as a predictive variable for the amount of social interaction occurring on the site, also showed a high coefficient value ($\beta = .654$). The results of the mediation model demonstrated that user perception acted as a mediator in the relationship between accessibility and social interaction (indirect effect = 0.45, t = 14.561).

The ease of movement sub-variable (AccB), which contains the factors of a good street layout, absence of physical obstacles, same level sidewalks, quality of pavement, availability of curb ramps, crosswalks as part of the design, visual signs at night and day for direction, directional guides, well-constructed intersections, and street trees and other greenery in the right of way, is the factor that most significantly defines a pedestrian friendly and accessible walking environment. Therefore, it was an even larger factor than both access to amenities (AccA) and lack of available amenities (AccM). Therefore, the first steps to make a greater contribution to creating a better walkable environment are to work seriously on improving the two areas listed above.

The results from our research support the conclusions of [52], and [54] on the potential for improving the sociability of a public space through enhanced accessibility of the space; and thus increase the activity level within the space and create greater social interaction. Results of this study show the need to have accessibility provisions (parking & drop off; commercial amenities; playground amenities; a variety of destination options; etc.) in place when developing public spaces that are designed to remove barriers and be totally inclusive for everyone including those with disabilities as suggested by [47].

The Model had Strong Explanatory Power for Social Activity ($R^2 = .748$), Social Interaction ($R^2 = .709$) and Moderate Values for User Perception ($R^2 = .474$) and User Experience ($R^2 = .609$). The Goodness-of-Fit (GoF) Index was also .694 and as such provided additional evidence of the model's theoretical validity and empirical reliability in addition to its goodness of fit.

These findings collectively indicate that street conditions and user perceptions in mixed-use street environments are greatly influenced by how accessible a user finds their environment to be. The study's findings highlight both the physical characteristics of an environment as well as perceptual factors contributing to making the environment socially connected and inclusive. As such, these studies contribute to the body of literature on urban walkability and offer practical application to those involved with designing spaces (urban planners, architects) or in making decisions regarding social connection through design.

11. RECOMMENDATIONS

a. **Model Enhancements:** This study designs a model of perceived accessibility of walkability and its impact on social interaction.. It suggests developing models that also integrate additional walkability aspects—like connectivity, and safety—and analyzing their impacts on social engagement.
b. **More Methodological Techniques:** The data collection used in this study was based exclusively on the distribution of a questionnaire. A broader research approach should include methodologies like structured observations and interviews with subject experts. Subsequently, it's suggested that investigators measure differences and find correlations by comparing the outcomes of those varied approaches to those of the original survey. On the other hand, for women in Arab and Islamic contexts (e.g., Iraq), we recommend gender-sensitive fieldwork—employ female enumerators and recruit respondents at educational and service institutions they frequently visit the case study area.
c. **Applicability to other street types:** The research was conducted on a mixed-use street. Another street typologies like reseidential and recreational street are recommended to choose for the case study to generate broader findings.
d. **Geographic Area:** The specific location for the analysis was Al-Masaref Street, located in Mosul. Further research efforts should analyze additional streets throughout Mosul, extending into other areas of Iraq as a whole. Researchers are encouraged to then undertake cross-comparison, using key parameters and factors to find the most influencial indicators of accessiblity within walkability for enhancing social interaction and user perception.

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