Article

Design With, Not For, Local Community: Utilizing e-Participation Tools in the Design of Socially Sustainable Vertical Emirati Public Housing

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Abstract: The United Arab Emirates (UAE) is slowly transitioning from traditional single-family public housing to a ‘vertical’ typology to meet the increasing demand on public housing, solve the problem of the scarcity of land in urban areas, and contribute to achieving its local agenda for sustainable development goals. However, the direct involvement of Emirati residents in the design process of the recently developed limited number of vertical public housing projects has been missing. This research aims to involve a sample of Emirati residents, representing the targeted category for vertical public housing, in the pre-occupancy evaluation of the design of Al Ghurfa, the very recently developed vertical public housing project, focusing mainly on assessing the attainment of social sustainability in this design. The research method included four phases, including initiating a conceptual framework from relevant literature reviews, digitalizing the case study design, developing the conventional and e-Participation interview scenarios and scripts, and selecting a sample of Emirati young citizens who participated in the study. The results of the study successfully highlighted the participating residents’ preferences and concerns regarding the design of the investigated pioneering vertical public housing project. The findings revealed the interviewed citizens’ perceptions of the investigated social sustainability principles in the vertical housing design pertaining to mixed-use development within and outside the vertical residential building, social integration among neighbors of the building, vertical and horizontal accessibility inside and outside the building, security measures for the residents of the buildings and their privacy, design measures of the high-quality living environments, the user-responsive design of the housing units, and the importance of their involvement in the design. This helped propose a set of recommended design actions for attaining social sustainability in vertical housing design tailored to the specific needs of Emirati residents. The research has also revealed the successful merger between the conventional and advanced e-Participation tools in involving the residents in assessing the professional design of vertical public housing as a new emerging typology that is expected to prevail in the near future.

Keywords: e-Participation; social sustainability; virtual reality; metaverse; vertical housing; public housing; community design; community participation; smart design; UAE

1. Introduction

In its simplest definition, social sustainability is perceived as a measure of community well-being as it emphasizes the flourishing and the pursuit of optimal lifestyles. Social sustainability entails engaging stakeholders and fostering strong organizational relationships. Globally, the focus on social sustainability in the domains of housing and local communities is noticeably growing in a way that promotes socioeconomic thriving, connectedness, and identification with the place [1]. Assessment of the attainment of social sustainability principles in urban housing contexts involves several aspects including social interaction and integration, community networks, safety, and sense of
security. When considered in the design of housing developments, these elements help build social capital through trust and shared values, enhance equity, and create livable environments [2,3].

The quality of social life in vertical public housing, in particular, extends beyond physical developments, as it encompasses social interactions, community participation, and local policymaking, within each specific sociocultural contexts [4]. Achieving measures of social sustainability in the design of the vertical housing has been reflected in many projects in the developed and developing countries. For example, in the developed countries, the vertical housing project by Stefano Boeri Architect in Eindhoven, Netherlands known as the “Trudo Vertical Forest” contains 125 public housing units over 19 floors. The main social sustainability aspect of this project is represented in the high-quality living environment attained through the inclusion of shrubs and trees on the vertical forest balconies that enabled residents to feel connected with nature [5].

Designed in 2000, the “Elephant & Castle Eco-residential Towers” in London, the UK, is another important example. With its three towers, the project encloses mixed types of housing unites including studios, two-room apartments, and penthouses [6]. This creates a healthy mix of residents of different ages, occupations, and family structures. Also, the privacy of residents was carefully considered through the spatial progression from public open spaces (referred to as ‘parks in the sky’) to semi-private areas (entrance courts), and finally to private open spaces, like balconies. Other examples of vertical housing designs that considered social sustainability aspects in the developed countries include the “8 House” mixed-use building by architect BIG—the Bjarke Ingels Group in Copenhagen, Denmark comprising 476 housing units across 61,000 sq.m [7]. The project design caters for social interaction by including two interior courtyards at the center, resembling a bowtie shape, and roof gardens to increase social interaction among residents. Moreover, the Vertical Village housing in France that consists of 18 floors and 190 apartments is another example that considered social integration through retail spaces on the ground floor and a sky community roof garden where residents can socialize [8].

On the other hand, many vertical public housing projects in the developing countries have also considered social sustainability measures in their designs. Among these projects is the vertical Kampung housing project located in Choa Chu Kang town, Singapore. The project comprises a 10-story residential block linked to a six-story commercial block [9]. The project has diversified functions besides housing such as community plazas, retail shops, a polyclinic, and outdoor spaces. Furthermore, the ‘valley-like’ setup links the two blocks and encourages residents’ interaction. Another vertical public housing project is designed by MAD Architects near the CBD (central business district) in Beijing, China. The project is divided into six blocks, comprising 12 residential buildings for 4000 households [10]. The central avenue of the project hosts a variety of commercial and convenience spaces, including shops, cafes, restaurants, kindergartens, pharmacies, bookstores, and elder care facilities. This fosters a vibrant and open urban life throughout the neighborhood. Additionally, there is a second-level park and a rooftop area, ensuring that residents can enjoy a holistic environment with strong connections to nature and the outdoors.

Other examples of vertical public housing projects in developing countries that considered social sustainability in their designs include the project designed by architects Meir Lobaton + Kristjan Donaldson in Mexico City. This project consists of a 36-story residential tower in which each apartment has its own backyard garden [11]. Also, the Linked Hybrid high-rise mixed-use development designed by Steven Holl Architects in Beijing, China that was completed in 2009 is a vertical housing complex comprising eight 22-story asymmetrical towers connected by a network of enclosed pedestrian bridges. In addition to its 644 apartments, it includes public green spaces, commercial zones, a hotel, a cinematheque, a kindergarten, a school, and underground parking [12]. The mixed-use ground level offers several open passages for all residents to walk through, while the
design of public spaces of the project promotes interactive relations among its residents, and the multifunctional series of large sky bridges located between the upper floors of the 14 to 21 stories are conceived as a continuous ring of public zones.

Locally in the United Arab Emirates (UAE), since the early 1970s, the federal and local governments have initiated public housing programs aimed at providing socially responsive accommodation for citizens on low income [13]. These initiatives were crafted to ensure equitable access to essential services and to uplift the overall living standards of the UAE citizens. Established in 1999, the federal Sheikh Zayed Housing Program (SZHP) has played a pivotal role in satisfying housing needs, and it was recently merged with the Ministry of Infrastructure, forming the UAE’s Federal Public Housing Authority [14,15]. Additionally, since 2007, almost all the seven Emirates of the UAE have initiated their local public housing programs, including the Abu Dhabi Housing Authority (ADHA) in Abu Dhabi Emirate, the Sheikh Mohamed Bin Rashid Housing Establishment in Dubai, the Housing Program in Sharjah, and the Sheikh Saud Housing Program in Ras Al Khaimah Emirate [16,17].

Initially, the constructed public housing models predominantly consisted of single-family dwellings built on one or two floors within urban neighborhoods exclusively allocated for Emirati citizens. With the recent statistical figures indicating a significant increase in the demand for public housing from 5612 houses annually in the 2010–2020 decade to the expected average of over 9000 houses in the current 2020–2030 decade, there has been a persistent need for a more economically (and environmentally) efficient typology of public housing in the UAE [18]. In response, starting in 2005, the convectional single-family public housing model that used to be constructed on a plot of a spacious area ranging between 2000 and 3000 m$^2$ was significantly shrunk to approximately 750 m$^2$ or less to accommodate this rising demand due to Emirati population growth and to cope with the limited land and resources [13]. In line with this trend, very recently, the federal and some local public housing authorities in the UAE have begun transitioning from a single-family housing typology to vertical housing purposely designed to accommodate the younger generations of newly married Emirati residents on low income. This recent shift has been motivated not only by the need for more efficient land use with higher densities but also by the desire to adopt efficient and sustainable housing development approaches resonating with the country’s commitment to achieving the 17 Sustainable Development Goals (SDGs) by 2030, particularly Goal 11 (Sustainable Cities and Communities) and Goal 13 (Take Urgent Action to Combat Climate Change and its Impacts [19].

This very recent significant transition to vertical public housing is represented so far in only two pioneering projects: the Dibba Al-Hosn vertical public housing project in Sharjah Emirate and the Al Ghurfa vertical housing project in Fujairah Emirate [20], as shown in Figure 1. Introduced in 2014, the Dibba Al-Hosn project was envisioned as a remarkable step toward environmentally sustainable public housing design that also considers the sociocultural values and needs of the Emirati family [21]. Similarly, the Al Ghurfa vertical public housing project, designed in 2014 by the Sheikh Zayed Housing Program, aimed to incorporate the unique social and cultural characteristics of Emirati people, especially privacy, through the division of each flat into three levels distinguishing between the family, guests, and service zones [22].

In reality, the designs of these two vertical public housing projects were professionally developed for Emirati citizens without directly involving them in any stage of the design process. This is despite the global advocacy for the importance of engaging residents in the design process, as it fosters sociocultural sustainability by more credibly addressing their specific functional needs and sociocultural values. It is widely acknowledged now that empowering residents with control over design decisions enables them to address their actual needs, thus shaping their housing built environment more effectively. Residents’ participation in the design of their houses fosters a stronger sense of responsibility, belonging, and satisfaction among them toward their local housing context [23].
So, the absence of the direct engagement of residents in the design process of this pioneering vertical public housing leaves one uncertain about the actual societal acceptance of the emerging model design, especially from a social sustainability point of view, for a wider population. One way to check that is to survey Emirati residents from the targeted category of younger generations in the marriage age to assess the social sustainability aspects of this new model design of vertical public housing, creating a ‘pre-occupancy’ evaluation of this newly emerging design typology. Pre-occupancy evaluation was selected as the involvement method because it plays a crucial role in assessing housing designs’ responsiveness to residents’ needs during the design phase and before it is too late to amend the design after the construction of the project. By exploring residents’ satisfaction regarding the design aspects and modifying it accordingly before construction begins, the costs and time associated with later adjustments to unresponsive designs are significantly reduced [24].

According to a study by Moloney et al. [25], the pre-occupancy evaluation method has been proven to be a design evaluation tool that effectively enhances communication between designers and residents.

Figure 1. (a) Three-dimensional (3D) perspective view of the Dibba Al-Hosn vertical public housing project; (b) 3D perspective view of the Al Ghurfa high-rise social housing project (source: the authors).

So, the concern now is how to effectively conduct such a pre-occupancy evaluation process of the design, especially with the well-known shortcoming of the conventional methods. Here, the e-Participation method emerges as a promising tool, meaning the utilization of advanced digital Virtual Reality (VR) techniques. Leveraging these advanced technological tools enables people to engage with design concepts and provide informed feedback for their residential environment. VR has become a crucial tool across various industries, including housing, architecture, and urban planning, offering immersive experiences and enhancing collaboration and decision-making processes [26,27]. VR allows users to interact with computer-generated simulations, offering a realistic perception of spaces and designs [28]. Utilizing specialized equipment, such as VR headsets, VR creates a sense of immersion by engaging multiple senses [29]. On the other hand, the concept of the “metaverse”, which blends the “Meta” (as beyond) and the “universe”, has recently gained huge momentum, serving as a virtual realm where users interact, transcending physical boundaries into digital realms [30]. In the collaborative metaverse sessions that involve both professionals and residents, participants can address their real needs and ‘virtually’ contribute to shaping their housing environment [31,32].

Accordingly, the research poses these three main questions: first, apart from the very few numbers of families already living in the Al Ghurfa vertical residential building, and to facilitate the pre-occupancy evaluation, how do those in the younger Emirati generation, who might be allocated a housing unit in a vertical residential building, perceive the social sustainability indicators in the design of this ‘model’ pioneering project that most likely will be repeated in other cities? Second, what are the design measures that should be considered to make the design of vertical public housing more socially sustainable for Emirati residents? Third, how successful is the utilized advanced e-Participation tool
in directly involving the Emirati residents in the pre-occupancy evaluation of the social sustainability principles in the design of this ‘model’ vertical public housing project? To answer these questions, the following section states the adopted method and the utilized investigation tools.

2. Research Method

This research analysis was conducted using a qualitative case study method as the most appropriate method to probe deeply into the Emirati residents’ pre-occupancy evaluation of the investigated vertical housing design case study. The Al Ghurfa vertical public housing project design was selected as a case study to undertake the research investigations, because it is the most recent pioneering vertical public housing design out of the only two newly developed vertical public housing projects in the country so far. Also, its design was developed by the SZHP federal housing authority, which makes it more subject to repetition in other locations and cities in the UAE. The Al Ghurfa project design consists of 12 vertically arranged “houses” each with an area of about 300 m$^2$.

The ground floor of this vertical building is allocated for only entrances and car parking. To more resemble the ‘house’, each apartment is divided into three levels (Figure 2). The entrance level contains the male guest room (majlis), a dining room, a kitchen, a storage area, and a guest toilet. The upper level includes a master bedroom, a family living room, a kitchenette, and toilets. The lower level consists of two bedrooms with attached bathrooms, a maid’s room with a toilet, and a laundry room.

Then, to facilitate our investigation, the research followed a four-step process, which each had detailed actions related to the objectives leading to the answers of the main research questions (Figure 3).

In the first step, a conceptual framework was established based on reviewing literature related to the principles of social sustainability in vertical housing design. In the second step, the selected ‘professional’ design of the Al Ghurfa vertical public housing project was ‘digitally’ prepared to be ready for the following investigation steps. While in the third step, the VR-Metaverse tools of the in-depth interviews before and during the e-Participatory sessions were defined. The last step was data collection through these defined investigative tools, which was followed by the analysis and discussion of the collected data. The following sub-sections summarize these steps.
Figure 3. The research design following a four-steps process and the detailed actions.

2.1. Initiating a Conceptual Framework for Social Sustainability Principles in Vertical Housing Design

According to the studies conducted by Bojago [1] and Shehab and Kandar [3], social sustainability can be defined as the measurement and enhancement of human well-being for present and future generations. Therefore, for housing, social sustainability emphasizes the consideration of human needs and the improvement of the quality of the housing built environment. Researchers such as Mohamed et al. [2] and Abdulrahman and Motlak [4] have defined the generic principles of social sustainability in the housing built environment, which work for both ‘horizontal’ and ‘vertical’ housing environments, to include functional mixed-use, social interactions, accessibility, security, privacy, and community participation. The following section summarizes the measures of these and other related social sustainability principles in the design of vertical residential buildings as follows:

First is the design for mixed-use vertical housing development. Mixed-use development generally means the integration of various uses within a single area or a complex [33]. By blending residential, commercial, and public amenities, mixed-use developments contribute to sustainable urban growth by optimizing space use and enhancing energy efficiency while mitigating traffic congestion [34]. Moreover, mixed-use development caters for diverse needs through offering integrated environments where people can live, work, and socialize, thereby fostering a sense of community [35]. Second is the design for social interaction. According to Nguyen et al. [36], social interaction plays a crucial role within urban residential communities by facilitating interactions that encourage residents to engage in various shared social activities beyond their private spaces. Social interaction encompasses various forms of engagement, from playful activities to conversations, impacting individuals of all ages, as highlighted by Abdullah and Ahmad [37]. Social interaction intensifies the vitality of the vertical residential community, as it plays an essential role in fostering cohesion, communication, and well-being [38].

Third is the design for accessibility. Designing for accessibility involves ensuring that vertical residential buildings provide easy movement for all users, including those with physical disabilities, through features like ramps, stairs, and lifts [39]. This involves easy physical access to shared facilities within and outside the residential buildings [40]. By incorporating accessibility principles into design, residential buildings can become inclusive environments that foster a sense of belonging for all residents. Fourth is the design for security. Designing for security in vertical housing should encompass a range of conventional and advanced measures, including lobby concierge services, CCTV systems, access control, and visitor screening [41]. Environmental security and individual safety directly influence the design and planning of residential built environments with factors
such as the selected building location, visibility, electronic safeguards, and fencing playing pivotal roles in enhancing residents’ security [42].

Fifth is the design for privacy. Privacy is a fundamental human right that should be secured by design, especially within one’s residence [43]. The design of vertical residential buildings plays a crucial role in shaping privacy with internal spaces organized into zones based on a hierarchy of privacy levels. These zones usually include the private zone, such as bedrooms; the semi-private zone, like living and dining areas; and the public zone for entertaining guests. This reflects the concept of territoriality, where each zone serves different levels of personal or communal use [44,45]. Sixth is the design for a high-quality living environment. Designing a high-quality residential environment is essential for promoting well-being and satisfaction among residents. Health considerations are deeply intertwined with the concept of the quality of life. Therefore, the indoor environmental quality (IEQ) plays a pivotal role at the apartment scale, which is achieved through the provision of sufficient daylight, views, comfort, and good air quality. This makes the effective design strategies, such as natural ventilation, sufficient daylight, and solar shading through windows, essential for maintaining comfortable conditions and the overall IEQ [40,46].

Seventh is the design for user-responsive housing units (within the vertical residential buildings). Recent studies emphasize the significance of user-responsive housing design in addressing human needs, as acknowledged in numerous international human rights instruments. So, recognizing the relationship between housing design and human needs is critical [47]. Prioritizing user needs in the design is essential, as the enhanced residents’ satisfaction and property desirability foster a strong sense of community among residents. Achieving this requires thoughtful planning and a deep understanding of human needs in the design [48]. Eighth is the residents’ participation in the design. Involving residents in the housing design processes is crucial at its various decision-making stages [49]. According to Kosk [50], involving residents in the housing design process positively impacts both the architecture of the design itself and the relationships among those involved in the design process. This collaborative design approach enhances residents’ sense of belonging to their residential living spaces. By involving all parties throughout the design process and establishing clear deliverables early on, designers can streamline residents’ interactions, gaining valuable insights into their preferences and vision [51]. Table 1 summarizes the conceptual framework of the above-mentioned eight social sustainability principles in vertical housing design.

Table 1. The conceptual framework defining social sustainability principles in vertical housing design.

<table>
<thead>
<tr>
<th>Social Sustainability Principles</th>
<th>Design Measures</th>
</tr>
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<tbody>
<tr>
<td>Mixed-use development</td>
<td>Integrating residential, commercial, and public amenities within the same location/building(s).</td>
</tr>
<tr>
<td>Social interaction</td>
<td>Facilitating cohesion, communication, and residents’ well-being.</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Providing easy movement for all users, in vertical housing including convenient means of vertical circulation to facilitate access to different levels and shared facilities.</td>
</tr>
<tr>
<td>Security</td>
<td>Including various security measures such as lobby concierge services, CCTV systems, access control, and visitor screening.</td>
</tr>
<tr>
<td>Privacy</td>
<td>Considering the hierarchy of spaces in both the housing units and the overall vertical building, encompassing private, semi-private, and public zones.</td>
</tr>
<tr>
<td>High-quality residential living environment</td>
<td>Provision of daylight and ventilation in the housing units and the vertical building designs.</td>
</tr>
<tr>
<td>User needs</td>
<td>Satisfying residents’ needs in the design.</td>
</tr>
<tr>
<td>Residents’ involvement in the design</td>
<td>Involving residents at all decision-making stages of the design process through advanced technologies such as VR.</td>
</tr>
</tbody>
</table>
2.2. Preparation of the Case Study

2.2.1. Digitalization of the Design Drawings of Al Ghurfa Vertical Housing Project

The design drawings of the Al Ghurfa vertical public housing project were obtained as images from limited media resources. So, to facilitate the research investigations, these design drawings were first accurately digitalized into 2D CAD plans using the Autodesk AutoCAD 2023 application and then modeled into a 3D BIM model for the whole Al Ghurfa residential building using the Autodesk Revit 2023 application (Figure 4a). Meanwhile, as shown in Figure 4b,c, a detailed model for a typical housing unit with its three levels showing all habitable spaces, each with full furniture, was prepared to later help the interviewed Emirati residents comprehend the design.

![Figure 4. Digitalized design of Al Ghurfa vertical housing project: (a) showing 3D BIM model for the whole building (b) showing a section view for the unit’s entrance level with the upper level, and (c) showing section view of the unit’s entrance level with the lower level (source: the authors).](image)

2.2.2. Selecting the VR-Metaverse Tools Kits

For the hardware, the Meta Quest Pro device developed by Reality Labs, a division of Meta Platforms headquartered in Menlo Park, USA, was selected. Unveiled in 2022, Meta Quest Pro is currently the most advanced VR-Metaverse device in the market. This device not only allows users to navigate a 1:1 virtual model of the digitalized housing unit and the whole vertical residential building but also enables collaboration between the researchers (as the interviewers) and the participants (as the interviewees) by allowing an immersive presence for both parties in the created Metaverse environment [52,53]. The settings of this device were adjusted on a ROG STRIX VR-ready laptop with a powerful AMD Ryzen 9 5900HX board and high GPU specs, manufactured by MSI a registered trademark of Micro-Star Int’l Co., Ltd, in New Taipei City, 235 Taiwan. For the software (applications), Enscape v4 developed by Chaos in Karlsruhe, Germany, was selected to convert the created 3D BIM model of the Al Ghurfa building into a 3D VR-ready model. On the other hand, the Prospect by IrisVR v2.13 application developed by the Wild in San Francisco, CA, USA, was utilized, as it is the most efficient and affordable Metaverse navigation application on the market. Also, through its most advanced software tool, IrisVR seamlessly integrates VR into the design’ workflow by compressing 3D renderings into VR-viewable files with a one-click extension [54,55]. Both applications are easily installed as plug-ins for Autodesk Revit 2023 installed on the VR-ready laptop.

2.2.3. Preparation for E-Participation Sessions

The BIM model of Al Ghurfa building was first converted into a VR-ready version using the Enscape3D plug-in (Figure 5).
Figure 4. Digitalized design of Al Ghurfa vertical housing project: (a) showing 3D BIM model for the whole building (b) showing a section view for the unit’s entrance level with the upper level, and (c) showing section view of the unit’s entrance level with the lower level (source: the authors).

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Figure 5. VR-ready perspective views for the Al Ghurfa vertical housing project: (a) human eye perspective view: (b) bird’s eye perspective view (source: the authors).

Subsequently, a virtual walkthrough scenario for virtually visiting the housing unit and the whole building in the Metaverse was created through the IrisVR application.

2.3. Defining Investigation Tools

2.3.1. Pre-E-Participant Interviews

In the pre-e-Participation interviews, eight open-ended questions were asked to the participants to document their opinions about 6 of the 8 investigated social sustainability principles in vertical housing design, in general, especially as they used to live in single family housing (Table 2). Each of these questions was linked to a relevant social sustainability principle. The first two questions aimed to gauge their willingness to live in an apartment, delving into reasons for acceptance or refusal, or preferences if the apartment was provided by the government, including what features they would want this flat to have. Subsequently, four questions were asked regarding the significance of social interaction, mixed-use facilities, accessibility, and high-quality living environments in vertical housing. The final two questions aimed to explore the significance and methods of community participation in the design process of apartment blocks, as perceived by the interviewed Emirati citizens.

Table 2. Open-ended questions asked in the pre-e-Participation interviews and their relevant social sustainability principles.

<table>
<thead>
<tr>
<th>Question</th>
<th>Social Sustainability Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you agree to live in an apartment? Why?</td>
<td>User needs</td>
</tr>
<tr>
<td>If the only option for you is to get an apartment from the government, what do you want this apartment to functionally include?</td>
<td>User needs</td>
</tr>
<tr>
<td>Do you think social interaction among neighbors is important in residential buildings?</td>
<td>Social interaction</td>
</tr>
<tr>
<td>Do you think that the provision of different services and facilities is important within apartment blocks (such as supermarkets, prayer rooms, kindergarten, café shops, etc.)?</td>
<td>Mixed-use facilities</td>
</tr>
<tr>
<td>Do you think that it is important that the inside and outside residential building facilities be easily connected to apartments?</td>
<td>Accessibility</td>
</tr>
<tr>
<td>If you live in an apartment, do you think that a ‘green’ balcony would be important?</td>
<td>High-quality residential living environment</td>
</tr>
<tr>
<td>Do you think residents’ participation is important in the design process of residential buildings? Why do you think so?</td>
<td>Residents’ involvement in the design</td>
</tr>
<tr>
<td>If you think residents’ participation is important? How could this participation in the design process be done in your opinion?</td>
<td>Residents’ involvement in the design</td>
</tr>
</tbody>
</table>
2.3.2. E-Participation Interviews Utilizing VR-Metaverse Tools

During the e-Participation interviews in the VR-Metaverse tour of the Al Ghurfa building and one of the typical housing units, six questions, related to the virtually visited locations, were asked to explore the participants’ opinions regarding their satisfaction about 3 out of the 8 investigated social sustainability principles in the design of the Al Ghurfa residential building (Table 3). These e-Participatory open-ended questions were linked to the defined sequence of the virtual tour in the Metaverse, starting from outside the building, then inside the building’s reception on the ground floor, and a detailed VR tour in the typical housing unit with its 3 different levels. The first question was about the interviewees’ opinion about the external architectural style of the building. The second question was about the preference to have mixed-use facilities serving the residents of the whole building on the ground floor (the building’s entrance lobby level). The third question was about the participants’ satisfaction about the availability of their functional needs in the design of the housing unit itself on the unit’s entrance level (the entrance hall, the majles (males’ guest room), and the dining room) considering aspects such as the size, spatial organization, and adequacy of daylight inside these spaces. The fourth question was related to the quality of the living environment through the provision of a balcony as the linkage to outside natural light, natural ventilation, and the living environment. The fifth and sixth questions were about the satisfaction about the functional needs in the family zones located on the upper level (the family hall, the master bedroom, one bedroom) and lower level (two bedrooms and the maid’s room) in terms of their sizes, spatial organizations (locations), and adequacy of the level of daylight inside these spaces, in addition to asking them whether they want to have extra bedrooms in these levels or not (Table 3).

Table 3. Open-ended questions of the interviews during the e-Participation session.

<table>
<thead>
<tr>
<th>VR-Metaverse Location</th>
<th>Question</th>
<th>Measured Social Sustainability Principle</th>
</tr>
</thead>
</table>
| **External 3D view: Façades.** | 1. While you are looking at the building façade:  
- Are you satisfied with the external architectural style of the building? Why? | User needs |
| **Building entrance’s level: Reception on the Ground Floor.** | 2. Now you are at the main entrance lobby of the building, and you see the elevators and the staircase. This is the only public space in the building:  
- Do you think that the area of the reception and the locations of both the elevators and the staircase are appropriate?  
- Do you prefer that other public mixed-use services are provided on the ground floor of the building, such as shops, café, restaurant, etc.? | Mixed-use development |
| **Housing unit’s entrance level: Entrance lobby, Majles room with dining and kitchen.** | 3. This is the entrance level of the housing unit:  
- Are you satisfied with the sizes, locations, and the levels of daylight, of the entrance hall, the majles (males’ guest room), and the dining room? | User needs |
| **Housing unit’s entrance level: Balcony.** | 4. This is the balcony of the housing unit:  
- Are you satisfied with its size?  
- Would it be better if the area of the balcony increased, and plantations were added to it? | High-quality living environment |
| **Housing unit’s upper level: Family hall and master bedroom.** | 5. This is the family zone on the upper level:  
- Are you satisfied with the sizes, locations, and the levels of daylight, of the family hall, the master bedroom, and the other bedroom?  
- Do you prefer having extra bedrooms at this level? | User needs |
| **Housing unit’s lower level: Bedrooms with maid’s room.** | 6. This is the family zone on the lower level:  
- Are you satisfied with the sizes, locations, and the levels of daylight of the two bedrooms and the maid’s room?  
- Do you prefer having extra bedrooms at this level? | User needs |
2.4. Data Collection and Analysis

Due to the nature of the qualitative investigations of the research through the in-depth open-ended questions and the expected to be lengthy pre-e-Participation and e-Participation interviews, a sample of 50 youth Emirati citizens from the UAE University community, comprising senior students and staff who were either newly married or about to get married, were invited to participate in these in-depth interviews. The reason for this is that the UAE vertical public housing is largely different from that in other Western contexts. In the UAE, the vertical public housing units are exclusively allocated to newly married young citizens who usually fall within the age range of 20 to 30 years. As a federal higher educational institution, the UAE University has students and staff from all over the Emirates, so this makes its community a good milieu for the sample population. In total, 32 participants agreed to be interviewed, which represents an acceptable number for this type of investigation. Still, expanding the sample population out of the UAE University would be advantageous in further research, which will need more time, effort, and a team of researchers, especially with the new employed VR-Metaverse techniques. Table 4 shows the demographic information for the 32 interviewed Emirati citizens including data about their gender, occupation, age, and educational major, besides their prior experience in using VR systems. All participants’ responses to the questions asked during the pre- and e-Participation sessions were manually documented for later analysis. The demographic information shows the balance between gender, targeted age groups, occupation (students–staff), and educational majors (as much as possible, the interviewed students came from various colleges including Engineering, Information Technology, Medicine, Business Administration, among others). Also, for the VR experience, more than half of the participants were first-time VR users, which required more time for them to become used to the VR immersive experience. The pre- and e-Participation interviews with each participant lasted about 40 min apart from the time needed to prepare the VR-Metaverse system itself.

Table 4. The participants’ demographic and VR experience information.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Description</th>
<th>No. of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>18</td>
</tr>
<tr>
<td>Occupation</td>
<td>Undergraduate students</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Staff</td>
<td>16</td>
</tr>
<tr>
<td>Age Group</td>
<td>21–24</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>25–28</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>29 and above</td>
<td>2</td>
</tr>
<tr>
<td>Educational Major</td>
<td>Engineering</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Information technology</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Medicine</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Business and administration</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Science</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>3</td>
</tr>
<tr>
<td>Virtual Reality Experience</td>
<td>First-time VR user</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>VR user</td>
<td>13</td>
</tr>
</tbody>
</table>

3. Results and Discussion

3.1. Design for Mixed-Use Development

The results of the pre-e-Participation interviews showed that a significant number of the interviewees (26 out of 32) preferred having mixed-use services within the vertical resi-
dential buildings, emphasizing convenience and easy access to essential services. However, a minority of them (6 out of 32) expressed concerns about noise and violated privacy that might be caused by having mixed-use facilities inside the building itself and suggested instead a separate but easily accessible building in the development site accommodating these mixed-use services. Meanwhile, the results of the e-Participation interviews revealed that the majority of the interviewees (25 out of 32) preferred mixed-use services on the ground floor of the vertical residential building for easy access to their daily needs. For example, one participant stated that, “having mixed use will make it easier to reach our needs, and sometimes I want to sit in the café and talk with my friends”.

In contrast, seven interviewees suggested a separate building for these mixed-use services. So, these investigations revealed that the interviewed Emirati citizens generally supported having mixed-use services in the ground floor of the residential building. Still, the concern raised by some of the interviewees, albeit few, about the possible produced noise and violation of the residents’ privacy should be considered while integrating mixed-use services in the vertical public housing design. So, in general, the interviewed Emirati citizens could be considered in agreement with Generalova and Generalov [56] and other scholars who advocate for designing mixed-use vertical housing developments integrating a diverse mix of functions including, besides the residential apartments, local shops and recreational facilities on the ground and maybe upper floors. This has not been considered in the Al Ghurfa project.

3.2. Design for Social Interaction

During the pre-e-Participation interviews, almost all of the interviewees (30 out of 32) emphasized the importance of social interaction with neighbors, highlighting its sociocultural significance and benefits, such as fostering the sense of community, seeking assistance when needed, and establishing social connections with neighbors. Several participants stated that “Emirati citizens are very socially active people” and “sometimes we need help from our neighbors”. Only two participants assumed that not everyone may desire ‘extensive’ social interaction with neighbors. With the absence of any social interaction space in the Al Ghurfa building design, e-Participation was not utilized in investigating this principle. So, in general, the interviewed Emiratis have maintained the importance of social interaction in creating a supportive and socially connected local community within the vertical public housing building, with preferences for various suggested communal spaces, but with a notable emphasis on shared sky gardens, preferably located on the first floor, and accommodating children’s play areas, seating benches, and walking tracks, due to their convenience and perceived safety. This came in agreement with the extensive literature highlighting the significant influence of social interaction on residents’ daily lives, well-being, and happiness [57,58].

3.3. Design for Accessibility

In the pre-e-Participation interviews, all the interviewees agreed that the means of vertical circulation in the building design should provide easy vertical movement for all users through speedy and spacious passenger elevators to access the different levels within the building and to the common space on the ground floor. Also, the majority favored convenient pedestrian pathways and green corridors for enhanced connectivity with other surrounding vertical buildings and shared facilities on the site of the residential complex. So, the interviewed Emirati citizens welcomed the consideration of accessibility to all housing units and to the provided facilities within the vertical housing buildings, which aligns with the literature highlighting the necessity for convenient access to shared facilities within the vertical housing building and outside it as well, i.e., to ground or sky levels and green spaces through pedestrian pathways, bridges, and green corridors [59]. The design of the Al Ghurfa project provides easy and convenient vertical access among the housing units, but it lacks shared open spaces or amenities, as mentioned above. Also, it does not consider accessibility to outside residential buildings and the surrounding spaces and facilities.
3.4. Design for Security

In the pre-e-Participation interview, when asked about the preferred security measures in the vertical housing building, all the interviewees expressed a preference for, and acknowledged the significance of, both conventional security measures and smart technologies, such as a lobby concierge, CCTV camera systems, and smart access control, for attaining security within these buildings. An interviewee mentioned that “for me, I would like to have smart technology system and a guardian at the reception”. This matches the preference for security measures in vertical residential buildings in the literature [41,57].

3.5. Design for Privacy

Before the e-Participation interviews, all of the interviewees highlighted the importance of considering their privacy as an inherited sociocultural value. Most of them emphasized achieving privacy in the vertical housing design through measures such as access control, separate entrances for families, individual floor access to each housing unit, and maybe separate buildings for mixed-use facilities in addition to the inclusion of plantation and trees on balconies to prevent visual corridors from facing buildings. While in the initiated conceptual framework (see for example: Tomah et al. [45]) and fieldwork, findings agree on the importance of privacy and the need for distinctive zones and separation methods in design, there is a notable discrepancy between the global perspective and local Emirati residents’ preferences that prioritize privacy needs in the design. Some of the preferred and recommended privacy measures have been considered in Al Ghurfa design, while other suggested measures are not, especially avoiding visual corridors form balconies.

3.6. Design for High-Quality Residential Living Environment

The pre-e-Participation interviews revealed that all interviewed citizens stressed the importance of having a balcony, mainly serving as a garden in their housing units, and for proving natural ventilation, when weather permits, outdoor views, and psychological well-being. During the e-Participation interviews, 29 out of the 32 participants expressed dissatisfaction with the balcony size, suggesting an increase in space and the incorporation of greenery for improved well-being and connectedness with nature. The importance of green elements for mental well-being was emphasized. One participant stated, “I need outdoor space because it is important for feeling good and getting positive energy”. Another one mentioned that “I feel like living in a villa, where I can gather with my family and enjoy fresh air”. Overall, there was a consistent emphasis on the significance of ‘green’ balconies for better living environments, despite concerns about the size, required maintenance, and insects. This resonates with the literature advocating for the design of a high-quality living environment that should involve integrating elements like the provision of daylight, natural ventilation, and greenery, as suggested by Astarini and Utomo [40].

While the Al Ghurfa design managed to provide enough daylight and natural ventilation, as seen in Figure 6, it has small balconies that lack greenery.

![Figure 6. Examples of the scale 1:1 ‘virtual’ interior spaces for a typical housing unit in the Al Ghurfa vertical housing project: (a) majles room, (b) family living room, and (c) the master bedroom (source: the authors).](image-url)
3.7. Design for User Needs (In the Housing Units within the Vertical Residential Buildings)

In the pre-e-Participation interviews, almost half of the participants (15 out of 32) expressed their preference for living in single-family houses, citing privacy and larger spaces as the main reason for their preference. Meanwhile, around one third of the interviewed citizens (10 out of the 32) showed a positive attitude toward living in housing units in vertical residential buildings, justifying that with the independence and convenience of these housing units. One of those stated that “in apartments we will live close to each other, and it is easy to clean and maintain. Also, I consider it appropriate for me to start an independent life”. The remaining interviewees (7 out of the 32) stated that their preference would depend on the availability of specific amenities and the suitability of the design. For example, one of the interviewees mentioned that “we like to live in apartments with large spaces for halls and rooms as well as greenery”.

In the subsequent e-Participation interviews, the majority of the participants (25 out of 32) expressed satisfaction with the external architectural style of the Al Ghurfa building, while some of them suggested potential improvements (Figure 5). As for the habitable spaces of the housing unit within the vertical residential building (Figure 6), while the interviewees were generally satisfied with the housing unit’s entrance lobby and the designated three levels of the unit itself, still some raised concerns about the possible negative impact of having steps separating these three levels. On the other hand, most interviewees (29 out of 32) expressed preferences for more spacious living areas, especially the need for a larger reception area. Additionally, 15 participants expressed satisfaction with the family hall and master bedroom on the upper floor (Figure 6) with some suggesting minor improvements in furniture and sizing. Lastly, while the majority (28 out of 32) expressed satisfaction with the size and number of bedrooms on the lower floor; still, some desired additional bedrooms. Daylight was considered sufficient in the main rooms.

Overall, these findings underscore the specific needs of the Emirati families in their vertical housing unit design, specifically emphasizing larger receptions, bedrooms, and living rooms as well as preserving the privacy achieved in the Al Ghurfa design in terms of the appropriate spatial organization of the habitable spaces, with separate majlis rooms, family rooms, and private entrances. When comparing the preferences with global (mostly Western) literature (see, for example, Itma [47]), a critical mismatch arises between the two parties.

3.8. Residents’ Involvement in the Design Process (Through Advanced E-Participation Tools)

In the pre-e-Participation interviews, all participants stressed the importance of being involved in the design of the vertical residential buildings, emphasizing securing their satisfaction and the considerations of their inherited sociocultural values. Similarly, in the e-Participation interviews, almost all participants (31 out of 32) found the applied e-Participatory method utilizing the VR-Metaverse systems (Figure 7) to be a beneficial tool for clearly visualizing the whole building and the apartment designs.

Figure 7. The VR-Metaverse e-Participation interviews; (a) interviewing a staff member, (b) interviewing a female senior student, and (c) interviewing a male senior student (source: the authors).
They highlighted that these systems enabled them to have a true-scale and realistic ‘virtual’ experience which ultimately gave them a better understanding of the design of the housing unit with its leveled zones. Even those initially opposed to live in apartments (15 out of 32) or were reluctant to do so (7 out of 32) changed their minds after undergoing the e-Participatory process through the VR-Metaverse experience. Overall, residents’ involvement in the vertical public housing design in general, and via the utilized e-participatory techniques of the advanced VR-Metaverse systems in particular, were strongly recommended by the interviewed Emirati residents for the attainment of socially sustainable designs.

4. Conclusions

This research has provided valuable insights into the social sustainability of the recently emerging vertical public housing projects in the UAE. It has also emphasized the importance of considering local perspectives and involving Emirati residents in the design process to ensure that housing developments meet their needs and contribute to the well-being of the community. The research first identified eight main principles of social sustainability in vertical housing designs based on the conceptual framework derived from an intensive and critical review of relevant literature and case studies in both developed and developing countries. These principles include designing for mixed-use high-rise development, social interaction, accessibility, security, privacy, a high-quality residential living environment, user needs consideration in the housing units’ design, and residents’ involvement in the design process.

In the research, the main questions posed tackled the perception of the younger Emirati generation of the social sustainability principles attainment in the design of the pioneering vertical public housing project of Al Ghurfa, the design measures that should be considered to make vertical public housing more socially sustainable for Emirati residents, and the degree of success of the utilized e-Participation with its advanced VR-Metaverse tool in directly involving the Emirati residents in the pre-occupancy evaluation of the social sustainability principles in the design of this vertical public housing project.

The pre-occupancy evaluation of the design of the vertical public housing project of Al Ghurfa in Al Fujairah Emirate was conducted through conventional in-depth interviews (pre-e-Participation interviews) and e-Participatory interviews utilizing an advanced VR-Metaverse with a sample of Emirati residents from a similar age group usually acquiring vertical public housing units from the public housing authorities in the UAE. The interviewees managed to give meaningful feedback about the investigated social sustainability principles of the existing Al Ghurfa vertical public housing design. This helped redefine the preferred design measures that would achieve the defined set of principles of social sustainability in vertical public housing design in the UAE reflecting the actual preferences and needs of the (interviewed) Emirati residents. The main design measures as per these social sustainability principles could be stated as follows:

- For the mixed-use in public vertical housing buildings, it is recommended to have the daily uses on the ground floor but with cautionary measures to avoid associated noise and possible violations of privacy. Other mixed uses could be accommodated in a separate building or zone near the residential buildings within the housing complex.
- Social interactions among the residents of the same public housing building should be encouraged in the design through the provision of various social interaction hubs, especially shared sky gardens on the first floor, as well as other outdoor public open spaces outside the building.
- Design for accessibility to the housing units, the provided mixed-use facilities, and the shared sky garden, etc., within the building should be considered through convenient means of vertical circulation, mainly elevators. Also, accessibility to other facilities in other surrounding vertical housing buildings or outside in the housing complex site should be considered through sky bridges, pedestrian pathways, and green corridors.
- It is important to incorporate both conventional security measures and smart technologies to enhance security in the vertical public housing buildings, such as a lobby concierge, CCTV camera system, and smart access control.
- Privacy is one of the most significant principles for Emirati residents, and it should be addressed through multiple measures including individual floor-access, visually separating the three zones of majlis, family, and service, in the housing unit, and incorporating plantation and trees in the (green) balconies to prevent direct visual corridors inside the balcony and the housing habitable spaces.
- Design for a high-quality living environment through integrating green balconies to work as a link with nature for the vertical housing units. This will optimize daylight and natural ventilation, but measures need to be applied for insect control and maintenance.
- Emirati family needs should be considered in the design of the vertical housing unit by identifying three activity zones, providing suitable areas for habitable spaces, especially for majlis and family living, and prioritizing a separate entrance for the majlis.
- Residents’ involvement in the design process is crucial, as it allows Emirati citizens to participate in the design process of public vertical housing through the utilization of advanced e-participatory tools for VR and the Metaverse, such as Meta Quest Pro. These advanced VR-Metaverse e-Participatory tools allowed the residents to express their thoughts about the design of the Al Ghurfa project and enabled them to give meaningful feedback about the investigated social sustainability principles in the design of the pioneering vertical public housing project. So, this pinpoints the high potential of the utilization of these advanced technologies for involving residents in the design process, enabling them to effectively navigate and explore habitable spaces and to express their opinions about the design before starting the actual construction.

Finally, Table 5 summarizes these recommended actions.

Table 5. Social sustainability principles and their recommended design measures in vertical public housing design in the UAE.

<table>
<thead>
<tr>
<th>Principles</th>
<th>To Be Achieved through the Following Design Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design for mixed-use development</td>
<td>In addition to the housing units, each vertical public housing building accommodates some convenient mixed-use facilities on the ground floor including daily uses such as a supermarket, a coffee shop, etc. Additionally, outside the vertical residential building, a dedicated building/zone for other mixed-use facilities could serve the whole housing complex.</td>
</tr>
<tr>
<td>Design for social interaction</td>
<td>The establishment of shared sky community gardens on the first floor of the vertical housing building, featuring children’s playgrounds, seating benches, and walking tracks, along with public open spaces outside of the apartment building.</td>
</tr>
<tr>
<td>Design for accessibility</td>
<td>Having easy vertical access to all spaces, shared facilities, and housing units through appropriate means of vertical circulation, in addition to pedestrian pathways and green corridors linking the building to outside spaces and facilities within the residential complex.</td>
</tr>
<tr>
<td>Design for security</td>
<td>Implementing a combination of both traditional measures and advanced security systems for both the building and its individual housing units.</td>
</tr>
<tr>
<td>Design for privacy</td>
<td>Providing individual floor access for each housing unit, possible separate buildings for mixed use, and incorporating plantations and trees on balconies to prevent visual corridors inside the housing units.</td>
</tr>
<tr>
<td>Design for high-quality residential living environment</td>
<td>Incorporating green balconies, with cautious measures for insects’ prevention and required maintenance. Also, considering the provision of sufficient daylight and natural ventilation in the design.</td>
</tr>
<tr>
<td>Design for user needs</td>
<td>Separate zones for male guests, family, and service, along with private entrances and dedicated balconies/sky gardens for each housing unit.</td>
</tr>
<tr>
<td>Community involvement in the design of the high-rise development</td>
<td>Involving residents in the design process through e-Participation method utilizing the advanced VR-Metaverse tools.</td>
</tr>
</tbody>
</table>
As for the utilized e-Participation method that incorporated advanced VR-Metaverse tools, the interviewed Emirati residents apparently preferred VR methods over the conventional surveys and 3D design, especially with the somehow complicated designs with multiple levels such as those of the Al Ghurfa project. While this aligns with the emphasis in the literature that residents’ participation in the design process is essential for sustainable housing, especially when utilizing technologies like Virtual Reality (VR) [60,61], still some technical issues were encountered during the e-Participation session interviews while using the advanced VR-Metaverse tools as follows:

- Sometimes, the Meta Quest Pro headset device did not work properly as it needed to be updated and required a restart.
- The Prospect by IrisVR v2.13 application did not appear on the VR-ready laptop as an application due to connectivity interruptions. To solve this issue, it was necessary to turn off the Wi-Fi network and then reconnect it again!
- Sometimes, the controllers of the Meta Quest Pro did not work because their drivers need to be updated.
- Eye-level perspective issues arose during the experiment because the interviewer was seated, and the interviewee was standing. So, it turned out that both the interviewer and the interviewee should be either seated or standing to maintain consistency.

So, based on the findings of this research, the public housing authorities in the UAE on both the federal and Emirates levels, as well as the public housing developers, should consider these defined sets of the UAE citizens’ preferred design measures to help achieve social sustainability principles when designing vertical public housing for Emirati residents. Designers should also take into consideration involving the targeted residents in the design of vertical public housing projects utilizing advanced e-participatory VR-Metaverse technologies.

On the other hand, the results of this research should be viewed within the declared limitations. These limitations include, first, the low number of participants (32 Emirati residents). Still, this was an acceptable number in light of the in-depth series of interviews conducted with each participant. Second, the technical issues faced the utilization of the used VR-Metaverse systems which might affect, to some extent, the efficiency of the VR-Metaverse experience. In addition, the suggestions for further research include enlarging the sample of the interviewed Emirati citizens and applying the e-participation method on the urban scale of vertical housing schemes, besides the individual buildings. Finally, applying the same methodology to study other emerging vertical public housing projects in the UAE could provide valuable insights for the future development of this important public housing typology.

**Author Contributions:** Conceptualization, K.G.A.; methodology, O.S.M.S. and K.G.A.; software, O.S.M.S.; validation, O.S.M.S. and K.G.A.; formal analysis, O.S.M.S.; investigation, O.S.M.S.; resources, O.S.M.S. and K.G.A.; data curation, O.S.M.S. and K.G.A.; writing—original draft preparation, O.S.M.S.; writing—review and editing, K.G.A.; visualization, O.S.M.S.; supervision K.G.A.; project administration K.G.A.; funding acquisition, K.G.A. All authors have read and agreed to the published version of the manuscript.

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References


15. MoEI. MoEI Ministry of Energy and Infrastructure in UAE; MoEI: Abu Dhabi, United Arab Emirates, 2024.


29. Mystakidis, S. Metaverse. *Encyclopedia* 2022, 2, 486–497. [CrossRef]


44. Park, J. The Role of Apartments Interior Design on Individual Privacy: Residential Buildings in Erbil as a Case Study. *Habitat Int.* 2016, 53, 1–7. [CrossRef]

45. Tomah, A.N.; Ismail, H.B.; Abed, A. The Concept of Privacy and Its Effects on Residential Layout and Design: Amman as a Case Study. *Armid.* 2018, 3, 1–6. [CrossRef]


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