Axonometric Drawings as Exploratory Design Research Tools: A Case Study of the Social Production of Space of the Streets in the Baqaa Refugee Camp, Jordan

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Abstract

In recent times, there has been a growing interest in studying the gap between architectural education and architectural practice, reflected in the development of a design research academic agenda at postgraduate teaching and research levels. However, little is known about PhD research as part of education and its relation to practice. Therefore, this was a productive force to develop design research tools that aim to bridge this gap specifically within doctoral research. The study presented in this article is part of an ongoing doctorate research and learning process using design research tools, techniques, and methods combined with classical research methods.

The specific objective of this research is to investigate the social production of the street space of the Baqaa refugee camp in Jordan, using axonometric drawings as exploratory design research tools that represent this case study. These axonometric drawings used different layers of representation that are related to the Lefebvrian spatial triad and spatial thinking. This helps to frame real existing architectural problems by examining architectural theories informing the multi-dimensional process of production of spaces via social relationships and their resulting practices over time. Therefore, this research thematically analysed semi-structured interviews to depict the local inhabitant's narratives and their associated social practices, including detailed information about the living experience in the streets of refugee camps. These were then processed into successive and time-wise axonometric drawings to facilitate the understanding of the intangible real-life situation within the space of the camp over time.

This research found that the street space of the refugee camp went through three phases of living experience. When comparing these phases, it resulted in the exploration of refugee-led spatial and social transformations, which was successful in phase 2. Consequently, it helped to shift the understanding of social production processes in the streets in a deeper way than the classical thematic analysis would not explore. This approach of applying classical research methods to axonometric drawings helps students to systematically and theoretically address real-world architectural problems that can fulfil the student's design thinking and thus project design or planning in their future practice.

KEYWORDS Design-led research, axonometric drawings, blended methods, social production of space, community empowerment.

Design Research

There are numerous ways to interpret and comprehend research by design, and there is an active debate about the idea [1]. The Research Charter of the European Association for Architectural Education (EAAE) defines architectural research as a novel investigation that uses design as the fundamental element in the research process to produce knowledge, understanding, and insight [2]. This type of research generates critical enquiry during the design work and is referred to as design research, practice-based research, or research through design when used to produce academic information [3]. The role of research in architecture is to develop a body of knowledge that guides design decisions and leads to objectively better results [4]. The American Institute of Architects (AIA) presented a comprehensive research agenda in 2018 and encouraged investment in research and research literacy. Design is the essential mode of thought and method of generating knowledge in architectural research, and research findings can be obtained through projects, artefacts, and design processes [5]. AIA has emphasised that research on architecture and buildings is out of proportion to its impact on society and economies [6]. Consequently, architecture's response to substantial technical, environmental, and sociological transitions demands research efforts on par with their implications. Accordingly, there are three types of architectural research: fundamental research, applied research, and project-based research [7].
Recent studies have focused on architectural research and its aspects. Jeremy Till's paper [8] titled Architectural Research: Three Myths and One Model, asserts that architecture is a form of knowledge that should be developed through research, challenging the notion that practice is inherently a type of research by arguing that architecture knowledge is beyond the created object and that whatever knowledge a building may have, it is not clearly expressed. Prof. Wilfried Wang [9] distinguishes architectural research from empirical ideas and assumptions derived from daily practice by describing it as publicly transparent, scientifically analytical, and independently verifiable. However, Alain Findeli [10] emphasises that any design topic has a more fundamental research question at its core. Gregorowicz-Kipszak [11] highlights research via design as an approach to the design of urban space (socio-form), where design consists of a series of iterative activities done on a local urban redevelopment. Additionally, the recent dramatic increase in architectural research activity has led to the expansion and maturation of the range of research methodologies. Therefore, research conducted by Zboinska [12] looks more closely at the methods of architectural research activity, to analyse the methodological typologies used and to develop a framework for architectural research that combines various design-based approaches [13]. Therefore, Zboinska's research [14] aims to define and validate the singularity of these design-based research methodologies beyond the traditional qualitative and quantitative approaches. The article expands on ‘mixed methods’ approaches and proposes the ‘hybrid method’ of design research, which offers valuable opportunities for the production and communication of knowledge in architecture. Murray Fraser [15] also highlights the combinatory nature of design research methods in the introduction to his 2013 edited book, ‘Design Research in Architecture’.

> *“In this regard it could perhaps be seen as a happy hybrid of the dominant methodological approaches of, say, science and history, but on the basis that it is the design investigations which constitute the core of the process*.” [16]

The approaches of Groat and Wang (2013) to architectural research are influential and compelling in advancing the academic discourse on architecture. By integrating form, function, and culture, their research methods allow for objective investigation and evaluation of architectural designs, promoting creativity and participation in the built environment through critical thinking and the assimilation of diverse perspectives. Consequently, their methods demonstrate the significance of a

rigorous and multidisciplinary approach to architectural research [17].

Consequently, research occurs during the design process and influences the final product in architecture. This aims to achieve novel solutions through the application of factual and methodological knowledge that is experienced/tested and experimental/intuitive to specific questions and aspects, problems regarding human activities, and the physical and virtual realm in which they take place. This process involves systematic knowledge production and uses trial and variation to select a preferred solution based on reasonable and communicable criteria. Although the process may appear unstructured or random, it is an iterative reflective process that repeatedly analyses and questions the results. Research by design generates critical enquiry and can benefit the creation of new theories, insights, and conceptions [18]. Hence, design can be a system that articulates tacit background knowledge through feedback loops driven by perception. The physical object or the artwork can be analysed from a variety of angles, but the holistic perspective is more difficult to understand [19]. Importantly, through research by design techniques, identifying the solution reduced the amount of uncertainty, which allows for producing some generalisation of the findings while adopting the solution and critically analysing it produces new knowledge, unless the system has gone off track or behaved nonlinearly [20].

An important significance of architectural research is that it contributes to education both directly by training future architects in the research field, and indirectly through ensuring the discipline's ongoing development [21]. The development of a research mindset in students is important to be able to independently establish fundamental arguments, carry out critical analysis, conduct in-depth research, and develop syntheses if they want to become architects [22]. Importantly, training in ‘research by design’ appears to be supported by Polanyi's theory of tacit knowledge, which depends on implicit learning of complex knowledge [23]. However, architectural research faces complex and challenging problems that traditional research methods are not sufficient to address. Research by design, which involves experimenting, prototyping, and collaborating with multiple stakeholders, is a more effective approach. This method highlights the importance of involving architects in social, political, and ecological problems in their research and the value of interdisciplinary collaboration [24]. These problems, called "wicked problems," are unlike science problems that can be solved by theories under ideal conditions; wicked problems arise from practice and are anticipated to be solved by practice. Therefore, research by design is one of the methodologies to investigate, examine, and resolve wicked problems in architecture [25].

Consequently, there is still much uncertainty about how to conduct architectural research using methodologies that reduce the gap between pedagogy and real-world practice. Especially in doctoral research that might seem far from real-world practice and focused on classic research methods that would separate architectural problems from theories.

Leo Van Schaik's[26] essay discusses the Design Practice Research (DPR) method utilized in the ADAPT-r doctoral program, which combines design practice with research to produce new knowledge through the exploration of practical design problems. The DPR method is divided into three phases: problem framing, design testing, and reflection and articulation of new knowledge, to develop a rigorous and systematic approach to research in design practice. Similarly, Blythe and Van Schaik's [27] essay argues for the integration of design practice as a form of research in architecture, proposing a research framework called the "Design Practice Research Method" (DPRM) to capture the knowledge generated through design practice. Blythe [28] provides an overview of the key components of a successful practice-based PhD, emphasizing the importance of balance between theoretical and practical elements and the research question, methodological framework, and reflexive practice.

Methods

Case	Participant Age	No. Of Participants	
Al Baqaa Camp	Men > 50	7	26
	Women > 50	10	
	Men < 50	5	
	Women < 50	3	
	Camp Manager	1	

Table 1: Number of semi-structured interviews conducted in the Baqaa camp

This paper presents a compelling ongoing doctoral research project investigating the social production of the street space of the Baqaa refugee camp in Jordan; see Figure (1) [29], from a community empowerment perspective. The study utilizes a design-led research approach that employs blended methods for data collection and analysis, by using classic qualitative research methods, and axonometric drawings to explore theories in the literature within the case study.

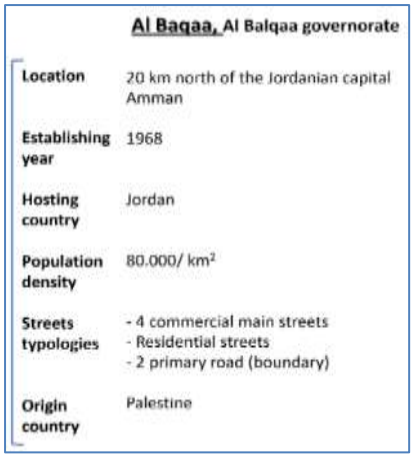


Figure 8: Characteristics of the Baqaa camp. Source: (UNRWA 2013)

This approach allows for the framing of real architectural problems by examining architectural theories that inform the multidimensional process of space production through social relationships and their resulting practices over time [30]. Therefore, semi-structured interviews were thematically analysed to uncover local inhabitants' narratives and common social practices [31]. Interviews aim at understanding the 'how' and 'why' to interpret different meanings in social research. it allows the emergence of new concepts within interviews rather than being limited to the designated concepts [32].

Accordingly, this study employed a combination of deductive and inductive approaches to explore the social production of community empowerment in the streets of the Baqaa camp.

The deductive approach involved an analysis of themes derived from existing literature, such as Sense of community, Identity and representation from the cognitive level, and Spatial action and Spatial appropriation from the structural level [33]. On the other hand, inductive themes were derived from data gathering through semi-structured interviews, such as the Produced living experience from the cognitive level and Design Issues from the structural level[34]. Furthermore, the study also introduced a new level to study from the inductive approach, the financial level, which focused on the financial situation as a key theme this will be further explained in the results section; see Figure (2).

Identification and analysis of these themes are crucial in understanding the processes of social production of street space over time and how changes in these themes influenced the

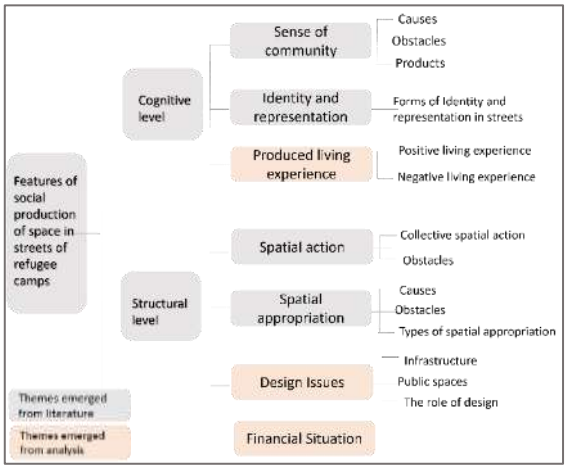


Figure 9: Levels of analysis and their related themes.

These narratives were then processed onto successive and timewise axonometric drawings, providing a deep understanding of the living experience over time.

According to Ching [35] axonometric drawings are a compelling tool to represent clear and detailed complex structures. Therefore, recently, the field of architecture and social research has had a growing interest in using axonometric drawings as a research method [36]. Hence, to demonstrate functionality and constructability in three dimensions, axonometry was the most preferred tool for technical explanations. Axonometric drawings and design thinking are so closely related that the former has taken on the role of the latter [37]. Therefore, it is a tool for representing, communicating, analysing, and producing social-spatial knowledge. It can reveal hidden relationships that may not be present in other methods of analysis.

Thus, the study collected 26 semi-structured interviews from the Baqaa camp, a Palestinian camp that gradually transformed into what is called a camp-city, through urbanisation processes over time [38]; Table 1 presents the Number of semi-structured interviews conducted in the Baqaa camp.

Research Results

This research aimed to understand the processes of the social production of community empowerment in the streets of the Baqaa camp by using a blended methods approach. This approach allowed classic research methods to work simultaneously with Architectural Design-Research (AD-R) tools, which facilitated the understanding of the literature theory within real-world urban phenomena under a timewise evolution.

Interestingly, the exploration of social production theory in the streets of refugee camps over time resulted in finding that refugees went through three phases of living experience throughout time. Figure (3) illustrates these phases within commercial and residential streets in general. These phases change over time not only on the structural level but also on cognitive and financial levels according to the changes in the factors mentioned before.

Data collection	Data Analysis	Approach	Aim
Semi-structured interviews	Thematic analysis	Study themes that are data and theory Driven	In-depth investigation of the social production of community empowerment within shared patterns of living experience.
Axonometric Drawings	Axonometric Drawings	Design research tool for processing and analysing (interview) data. Axonometric drawings for each	Mapping -Depict the processes of social production of community empowerment in streets.

Table 1: Summary of data collection & analysis methods

Axonometric drawings are used to depict the narratives obtained from semi-structured interviews with refugees on the residential and commercial streets. This allowed for the capture of the various moments in the refugees' lives that occurred over time on the streets of the camp. Building upon the explanation of feedback loops inspired by Pietrzyk 39 that were discussed in the literature review section, the data obtained from interviews were iteratively processed on layers of the streets to enhance clarity and understanding, Table 2 presents a summary of data collection & analysis methods.

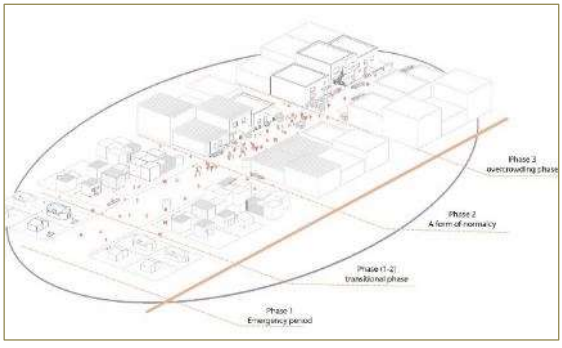


Figure 10: Phases of living experience resulting from interview data. Source: Researcher.

The procedure of processing data with axonometric drawings is an iterative process that involves presenting the data in the drawings, understanding them, and illustrating

the resulting knowledge back into these drawings. Subsequently, each phase of the living experience is illustrated in a separate axonometric drawing on the residential and commercial streets to explore it in more detail.

Residential street

Figure (4) presents phase 1 of the living experience named ‘the emergency period’ on a residential street, this phase lasted 3 to 5 years when everything in the camp was temporary and the refugees waited for their return home.

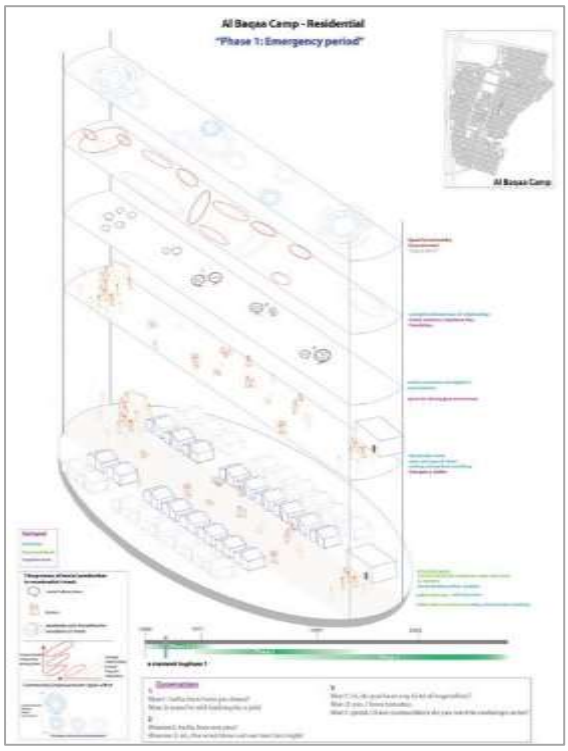


Figure 11: Phase 1 'the emergency period' in the residential street of the Baqaa camp. Source: Author

At the structural level, tents were living units, and other facilities such as kitchens and toilets, were public and communal. On the cognitive level, social relationships were restricted to family, relatives, and acquaintances. Furthermore, refugees lived on aid in this phase and were financially dependent.

Then the camp gradually urbanised and was continuously inhabited over time, and in phase two, which is named ‘A form of normalcy', the empowerment of the community was produced on the residential street; see Figure (5).

This can be explained as the camp developed over time at all levels of cognitive, structural, and financial. At the structural level, living units transformed into more durable buildings with two or three floors to accommodate the increase in population density. Furthermore, social relationships became stronger and larger within the street, creating a sense of community and a sense of belonging, which facilitated further development on the cognitive level.

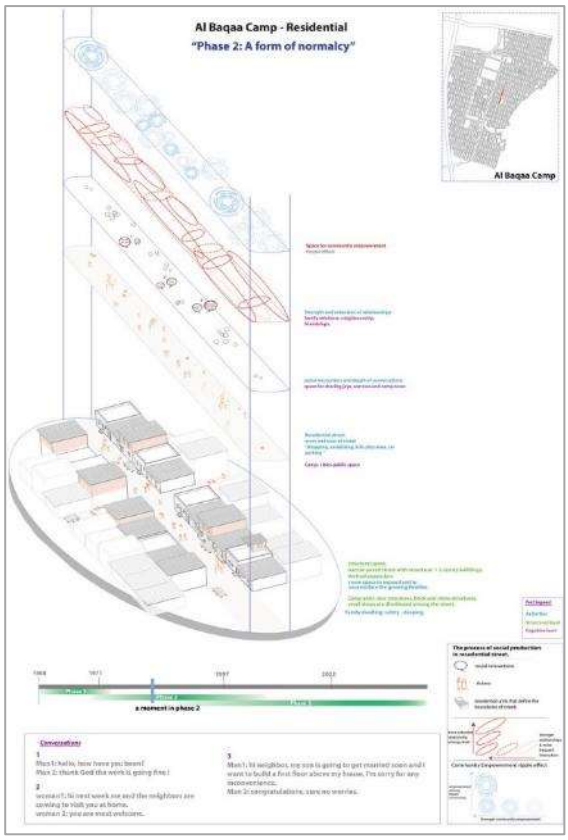


Figure 12: Phase 2 'A form of normalcy' in the residential street of the Baqaa camp. Source: Author.

Social relationships can play a crucial role in creating a sense of community and a sense of belonging. As people develop stronger and larger social networks, they become more embedded in their social environment, leading to a greater sense of connectedness with others. This sense of connectedness can foster feelings of trust, mutual support, and a shared sense of identity, which are essential components of community and belonging. Social relationships can provide individuals with a sense of stability, allowing them to feel grounded and secure

within their social environment [40]. On the financial level and with a sense of permanence, refugees started looking for jobs and became more independent.

Finally, Figure (6) illustrates phase 3 on the residential street of the Baqaa camp after more than 50 years of living in the camp within the same surface area and the huge increase in population density [41]. Therefore, this phase is named the 'overcrowding crisis', which was derived from the situation of small spaces that cannot accommodate more spatial expansions and the overcrowding of people within houses and streets. Therefore, the structural level of the camp spaces drastically deteriorated, and many violations such as building extension structures that encroach on streets were made. This led to the deterioration of the cognitive level of the camp space by leading to many social disputes between people over these violations and as a result of the narrow space within the streets.

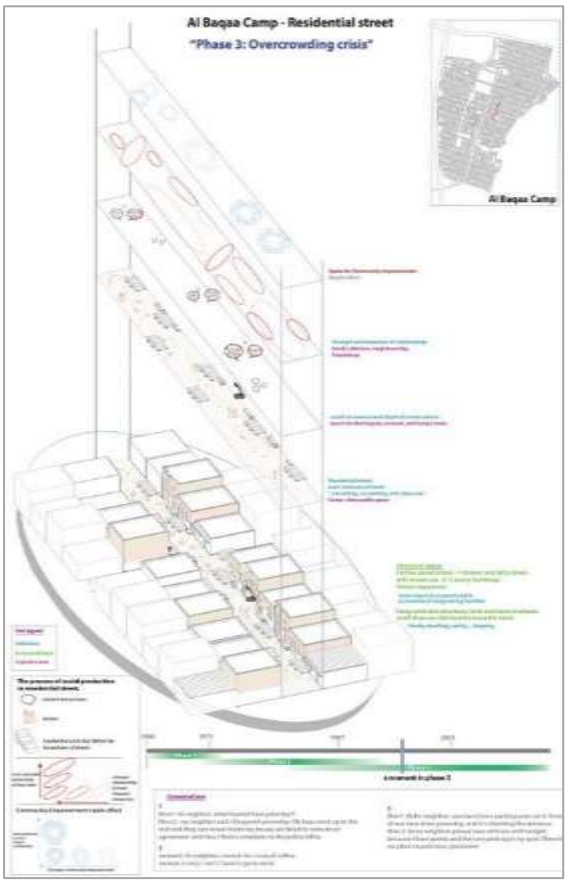


Figure 13: Phase 3 'overcrowding crisis' in the residential street of the Baqaa camp. Source: Author.

On the financial level, refugees also reported a decline in their financial situation; this will be explained further in the analysis of the commercial streets; see Figures (7,8,9,10).


7)

8)

Figure 14: Violations on residential streets in the Baqaa camp. source author.
Figure 15: Socialising on the streets- the Baqaa. Source: Author, Fieldwork.


9)

10)

Figure 16:Streets as playgrounds for children, the Baqaa. Source: Author, Fieldwork.
Figure 17: Seating area on the front of the house to socialise in the street, the Baqaa. Source: Author, Fieldwork.

Therefore, the residential street was found to be associated with the cognitive, structural, and financial levels, in which the improvement of the financial situation led to the enhancement of the spatial structure and ultimately improved the living conditions of the residents. As a result, stronger social relationships were developed, and vice versa, creating a cycle of positive reinforcement. This cycle allowed refugees to experience a sense of community empowerment within their living environment in the camp.

Commercial street

Similar to residential streets, commercial streets also have three distinct phases of living experiences. The first phase, depicted in Figure (11), is similarly called the "emergency period," which lasts an average of 3-5 years and is characterised by temporary structures in the camp. On the structural level, shops are in the form of stalls and are located on the main street in front of the tents, while facilities such as kitchens and toilets are communal. Social relationships are limited to the seller-customer

and to some neighbouring sellers, while refugees are financially dependent on aid during this phase.

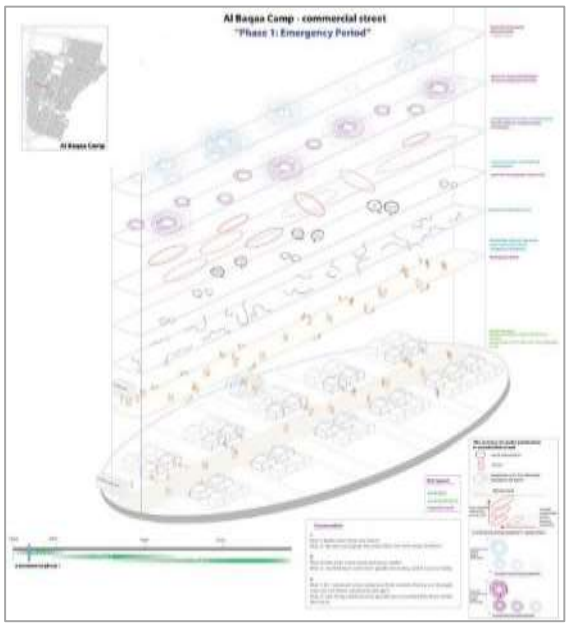


Figure 18: Phase 1 'The emergency period' in the commercial street of the Baqaa camp. Source: Author.

The second phase, illustrated in Figure (12) and named "A form of normalcy," marks the gradual urbanisation of the camp over time. Community empowerment is produced on the commercial street as the sales stalls are transformed into shops to accommodate the increase in population density. Social and commercial relationships developed over time and become stronger, fostering a sense of community and belonging, and refugees become financially independent with jobs outside the camp and their own shops within the commercial street. Thus, financial empowerment is produced within the commercial street space.

Finally, Figure (13) represents phase three, the "overcrowding crisis," which results from years of living in the same surface area and the consequent increase in population density and the related congestion at the urban and architectural levels. On the structural level, the spaces in the camp are significantly deteriorated and there are many violations, such as extending the stores with tables and stalls on the street. This leads to conflicts of interest and resulting social disputes among people due to the narrow space within the streets and the consequent is the decline in cognitive level. Furthermore, overcrowding also affects the financial situation of refugees, forcing many to move outside the camp and increasing living expenses. This overcrowding situation can be seen in Figure (13) captures the violations of the stalls and tables on the commercial street.

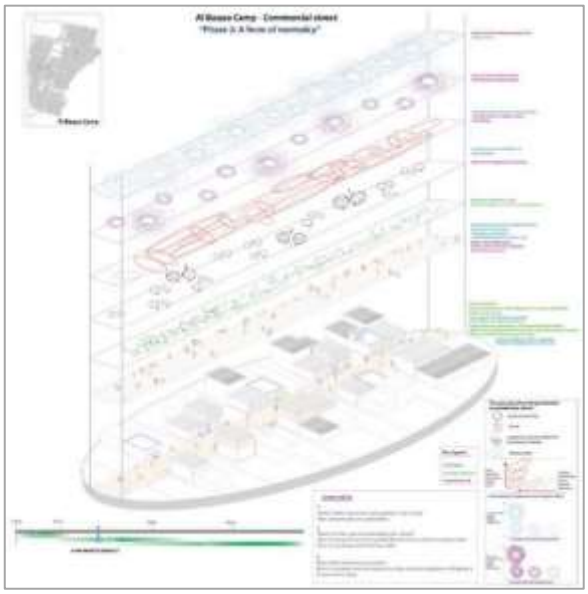


Figure 19: Phase 2 'A form of normalcy' in the commercial street of the Baqaa camp. Source: Author.

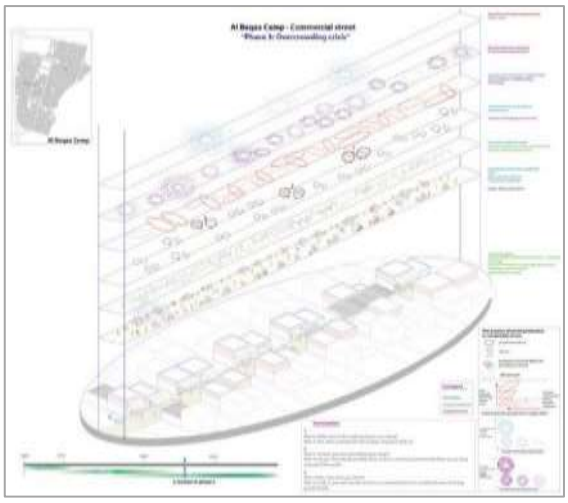


Figure 20: Phase 3 'overcrowding crisis' in the commercial street of the Baqaa camp. Source: Author.

This overcrowding situation can be seen in Figure (14) which captures the violations of the stalls and tables on the commercial street. The iterative processes of illustrating data in axonometric drawing and the feedback loops resulted in finding that refugees have generated

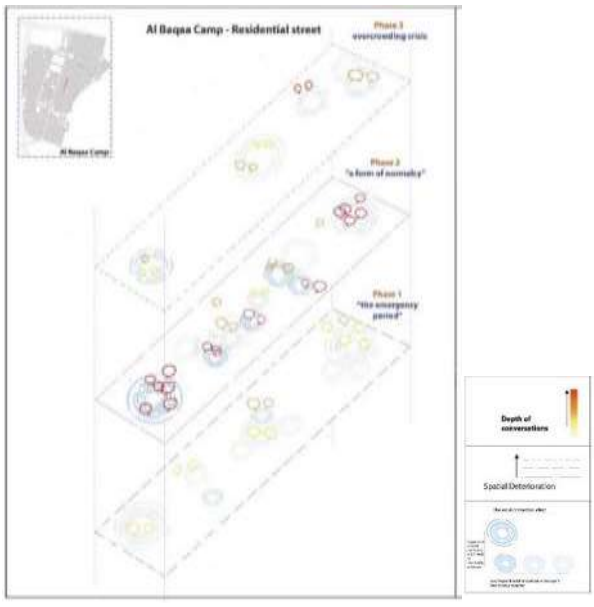
financial empowerment within the commercial streets and not only community empowerment. Therefore, this finding proved that the utilization of this blended method in the research facilitated a deeper understanding of the social production of space theory by revealing the complex dynamics and intertwined layers that constitute the commercial street that differs from the residential street under the lens of community empowerment.

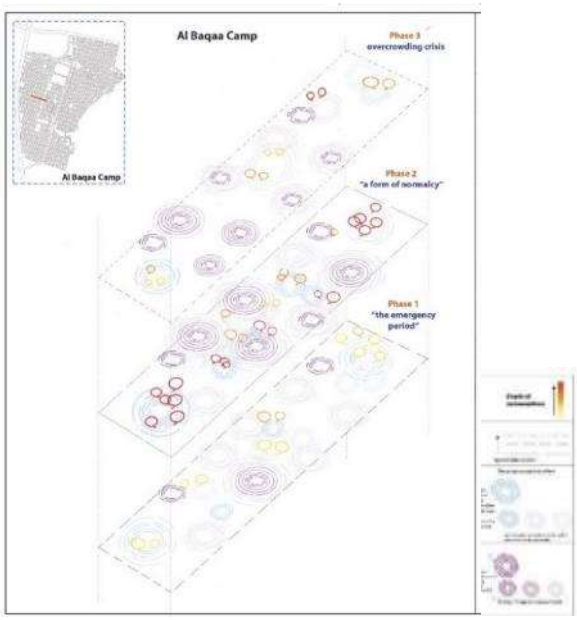
Importantly, from the iterative process of managing data, the research outcomes were explored through axonometric drawings that compare different phases and different street typologies, which were generated for a deeper understanding of the social production of community and financial empowerment in the streets.

Figure 21: overcrowding of people and stalls in the commercial street of the Baqaa camp. Source: Author, fieldwork.

Thus, the best social production of community empowerment and financial empowerment in space was generated in phase 2. This indicates that all structural, cognitive, and financial levels work simultaneously creating a synergy that has resulted in producing empowerment in space. Therefore, this approach enabled the understanding of architectural theories under the social production of space framework, that have been applied to real-world challenges such as refugee camps. Hence, this understanding would help architects, planners, and stakeholders to link theories to an innovative approach to practice, by an in-depth understanding and critical perspective of this theoretical framework applied to the complexities of real contexts. This Architectural Design-Research approach aims to learn critically from these theoretical frameworks and confront to complex and rapidly-evolving contexts of refugee camps, see Figure 15.

Figure 22 below: Axonometric drawings comparing the three phases of living experience within the same street and within residential and commercial typologies. source: Author..





Conclusions

In summary, the objective of this research paper was to examine the theory of social production of space within the challenging and rapidly-evolving complexity of the real-world scenario of refugee camps, by utilising a design-led research approach that incorporated blended methods for data collection and analysis. This approach combined design research tools, such as multi-layered and multi-dimensional axonometric drawings with their multiple relationships such as the three types of space and the three levels of analysis. Moreover, this has explored the themes from the classic qualitative research methods of thematic analysis within these multiple intertwined layers within the context of refugee camps streets. The study drew on the concept of social production of space and community empowerment, and by processing themes into multi-dimensional axonometric drawings, providing a detailed understanding of how different themes interact to shape the production of community empowerment in the streets of the Baqaa camp over time.

Furthermore, the study emphasised the importance of a comprehensive and multidimensional approach to fully comprehend the complex dynamics of producing community empowerment in informal urban settings like the Baqaa camp. The approach of blended methods introduced a new level of analysis, the financial level, which has demonstrated how the financial situation impacts the cognitive and structural levels of camps and their inhabitants and thus, the production of community empowerment on the streets of the camp. In this study, it was found that the iterative reflective process of managing data and generating knowledge by presenting data on axonometric drawings enabled the discovery that refugees produced both community and financial empowerment in commercial streets. The production of such empowerment was only possible through the everyday experiences of refugees' lives on these streets. Hence, the processes of social production of community and financial empowerment would not be understood within this level of complex dynamics that constitute it in classical research methods. on the grounds of this research findings, the need for a holistic approach to community empowerment interventions that would integrate financial empowerment strategies to achieve more sustainable outcomes over time when developing design strategies in the short, medium and longer terms.

Overall, this research project contributes significantly to the understanding of the social production of space under the community empowerment lens in refugee camps. By uncovering hidden relationships between themes that may not be present in classical research methods of analysis through the blended methods that were inspired by Zboinska's [42] approach which is beyond mixing classical research methods such as the qualitative/quantitative methods. Therefore, this approach allowed for testing and experiencing theory by the iterative reflective process and feedback loops, which is a system for producing architectural knowledge by testing architectural design research scenarios and refining them in multiple versions according to the research outcomes thus produced. Therefore, it bridges the gap between research and practice, providing valuable insights for policymakers, urban planners, architects, and researchers interested in designing for community empowerment in informal urban settings.

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