

# Structural qualities of urban space revealed by spatial representation and intelligibility readings: the case of Setif City, Algeria

*As qualidades e estruturais do espaço urbano, reveladas pela leitura representação espacial e inteligibilidade, o caso de Sétif na Argélia*

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## Abstract

This article discusses urban expansion in Setif, Algeria, with a periphery that lacks the spatial quality of what constitutes the city. Despite the presence of services, commerce, housing, and brand-new modern architecture, this periphery is not perceived as the city. The current study addresses the issue by combining two qualitative-quantitative techniques: spatial representation using sketch maps and syntactic analysis via space syntax. The findings were acquired using two software programs; SPSS 23 and Depthmap X. The performance indicated that the city center is the best representation of the city. To elucidate the structural characteristics that give birth to this representation, the space syntax is applied to two samples: the city center and El Hidhab. The intelligibility of the spatial arrangement, the spatial component, and the structuring features are the primary outcomes of spatial qualities. This study serves as a reference for other studies addressing the same issue. It may also serve as a guide for restructuring and projects aimed at creating what constitutes the city.

**Keywords:** Urban Space. City. Representation. Intelligibility. Spatial Qualities.

## Resumo

Este artigo trata da questão da expansão urbana da cidade de Setif na Argélia, com uma periferia que sofre com a falta de qualidade espacial do que a cidade representa; embora esta periferia tenha serviços, comércio, habitação e arquitetura moderna totalmente nova, não é considerada a cidade. Nosso artigo aborda o assunto com a combinação de dois métodos quali-quantitativos: a representação espacial por

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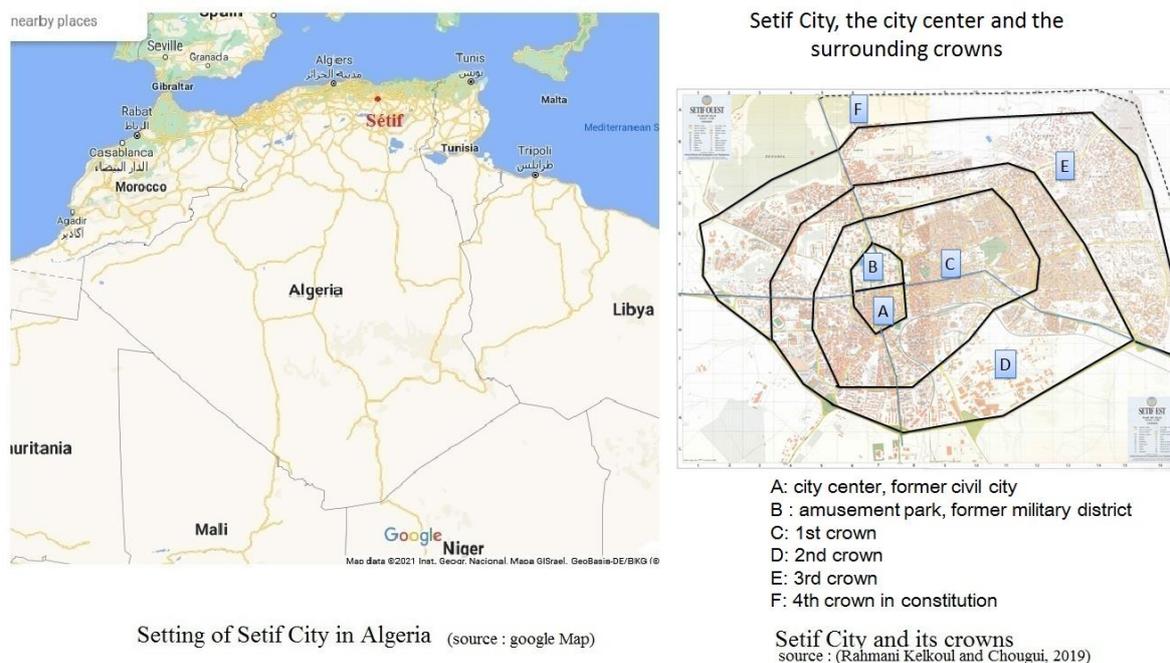
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sketch Map e a análise sintática pela sintaxe espacial. os resultados são obtidos usando dois softwares, o SPSS 23 e o Depthmap X; o desempenho mostrou que é o centro da cidade que representa a cidade. Para revelar as qualidades estruturais que deram origem a esta representação, duas amostras são apresentadas pela sintaxe espacial, o City-center e El Hidhab. Os principais resultados das qualidades espaciais são: a inteligibilidade da configuração espacial, a componente espacial e as características estruturantes. Este estudo pode ser referência para outros estudos com o mesmo problema; também pode orientar de forma sustentável reestruturações e projetos, cujo objetivo é criar o que a cidade representa.

**Palavras-chave:** Espaço Urbano. Cidade. Representação. Intelligibilidade. Qualidades espaciais.

## Introduction



**Figure 1** – Location of Setif city and the city center and the crowns of urban growth. Source: Authors (2021).

Setif is a city situated 300 kilometers east of Algiers. It has an area of 127.30 kilometers square and has a population of 290,000 (2008 census). The urbanized area has increased tenfold, from 338 hectares in 1966 to 3377 hectares in 2008. Hence, the strong spatial dynamics have resulted in significant land consumption: 1092 hectares between 1998 and 2008 and 1014 hectares between 2008 and 2014 (Master Plan of Development and Urbanism, 2010-2011; Kebiche, 2017).

Setif urban space is composed of a central area and three urban crowns comprised of distinct neighborhoods, each representing a distinct phase of growth associated with distinct urban policies. The word crown designates a surface of neighborhoods surrounding the center. An urban crown contains several neighborhoods (Rahmani Kelkoul & Chougui, 2019).

The urbanization process has been shaped by four distinct eras: The center and its first crown, which contains colonial-era private housing estates (from 1847 to the 1960s). The second crown came forth as a consequence of the post-independence era. It is defined by the communist period's "planned communal housing" complexes (from the 1970s to the 1980s), to which enormous swaths of housing and promotional estates were annexed along the boulevards. This movement occurred due to the critical period's transition from socialism to liberalism (from the mid-1980s to the 1990s). The third crown came about as a consequence of economic liberalism, institutional and legal reforms: Individual housing estates

and communal housing adopted a variety of formulae, including The National Agency for Housing Improvement and Development (AADL), Participatory Social Housing (LSP), Promotional Public Housing (LPP), and promotional housing with amenities programs (from the end of the 90s to the first decade of the 2000s). The fourth crown is an expansion of the constitution's third phase of housing (from the second decade of the 2000s) (Figure 1).

Despite this diversity of programs and spaces, this expansion lacks the spatial and structural qualities associated with the city. In previous research by Rahmani & Chougui (2019), the city center was identified as the city's representative. This study was conducted with a sample of 160 people distributed across the various crowns and using a quali-quantitative interview to address several questions, one of which was about the representation of the city. This study revealed that what the inhabitants consider to be a city is the city center. This point of view was also demonstrated by Bousnina & Omari (2018).

The question that arises is why, despite the vastness of the urban environment, the city center is what defines Setif as a city.

This representation is not due to commercial, administrative, or functional centralizations (Rahmani Kelkoul & Chougui, 2019); rather, since the liberal era, centralizations have been created in abundance throughout the city. Similarly, in the early 1990s, local communities and authorities, being aware of consumed sprawl, engaged in a new discourse on the city through the project to create new polarities. The research was commissioned by the center of studies and realizations in the urbanism of Setif (URBASE) as part of the modification of the Urban Director Planning in which the researcher has participated. URBASE advocated the establishment of a new urban centrality in the city's north-eastern outskirts, with the goal of relieving the city center and balancing its impact.

Currently, this centrality is evident in the fresh modern volumes coated with glass and metal that house the many facilities that define the section known as El Hidhab. This part of the city has expanded, comprising the habitat, commerce, and various services. Despite this fact, El Hidhab has not been selected as the city's representative. This is not due to the city's position or accessibility since, on the city's Axial map, the most integrated area is Tandja (Yahiaoui district) rather than the city center (Zerouati, 2020). Tandja is a popular area with a plethora of commerce and habitat, but it does not adequately reflect the city; it lacks the necessary infrastructure and public places.

Although there could be numerous reasons for this representation, this paper hypothesizes that it is the urban space itself, its urban language and vocabulary: avenues, streets, alleys, squares, plazas, their layout and placement within the urban structure, and its structural characteristics that contribute to an urban center's perception as representing the city.

The aim of the research is to understand how residents conceptualize the city spatially and what spatial elements, or in other words, spatial qualities, have favored this representation.

To address this question and test the hypothesis, the current paper uses a quali-quantitative methodology that combines two approaches: Spatial representation through sketch maps and space syntax using UCL Depth map x.

Spatial representation is a qualitative method that has been investigated innumerable times and in a variety of ways by a large number of scholars (Kim, 1999; Haq & Giroto, 2003; Moser & Weiss, 2003; Penn, 2003; Marchand, 2005). It enables to understand how residents perceive their place and evaluate its qualities (Moser & Weiss, 2003).

It provides data that can be used to improve the urban environment by creating places that residents value. It is one of the approaches to promoting a sustainable city (Kim, 1999; Moser & Weiss, 2003; McCunn & Gifford, 2018).

For its part, space syntax analysis seeks to comprehend this representation and elucidate the factors that favored it. Architectural and urban space, according to space syntax, has a communicative language.

It self-constructs as a system. Its components interact with one another as well as with the society that frequents and occupies it (Hillier & Hanson, 1984; Hillier, 2008).

Space syntax is a socio-spatial theory that connects spatial characteristics with their social interpretations (Hillier & Hanson, 1984). To accomplish this, it developed a unique language and vocabulary based on the spatial configuration, reflecting qualitative and quantitative content measured using mathematical formulae. The qualitative vocabulary includes concepts like integration, connectivity, intelligibility, entropy, etc. It can be determined if a location is integrated, segregated, connected, disconnected, intelligible, or unintelligible by examining these features. The reading variables are selected in accordance with the study's purpose.

Conroy and Bafna (2003) identified a link between spatial representation and space syntax in their reinterpretation of Lynch's study for Boston (Lynch, 1960). Similarly, Long and Baran (2011) examined the effect of neighborhood spatial configuration, as measured by intelligibility, on legibility, as measured by sketch maps. In a similar study, Haq & Giroto (2003) established a correlation between the intelligibility of sketch maps and real configuration for two hospitals in the United States of America. Kim (1999) examined this relation for the case of two neighborhoods at Hampstead suburb in the north of London.

The current study seeks to understand how residents describe the urban space and which locations are included in this depiction. How can we comprehend this representation using a syntactic interpretation of the spatial configuration, more precisely using the intelligibility criteria and its components? The spatial syntax elucidates the spatial traits and components chosen to represent the city. This study focuses on Setif, where there is a lack of research using these qualitative-quantitative approaches.

This research has implications for comprehending what the city represents to its inhabitants and the structural qualities of the space that has generated it. Moreover, it aims to orient the restructuring process in order to make an urban center intelligible and representative of the city. Additionally, it may be used as a design tool to build urban cores that exhibit the structural characteristics of the metropolis.

## Methodology

### Background

Urban space is a lived, perceived and produced space (Lefèbvre, 2001). It constitutes a source of our spatial knowledge experience. Questioning this experience makes it possible to understand how one should act; because the experience of this world constitutes a knowledge which in turn allows other experiences (Kim, 1999; Haq & Giroto, 2003).

How do inhabitants perceive their living space? How do they conduct themselves? What are their needs and demands? How do they want their environment to be? These inquiries provide a source of knowledge and apprehension about lived and perceived space in and of themselves. These qualitative approaches emerge before urban planning and design, and are subsequently adopted by them (Lynch, 1982; Kim, 1999; Moser & Weiss, 2003; McCunn & Gifford, 2018; Rahmani & Chougui, 2019).

Spatial knowledge is externalized via verbal, written, and graphic expressions and behaviors (Lynch, 1960; Hart & Moore, 1971; Kim, 1999; Moser & Weiss, 2003). Externalization through graphic and verbal representation is a kind of spatial representation.

Regarding the meaning of **representation**, Shi & Zhu (2018) have stated the following:

The Shorter Oxford English Dictionary suggests two relevant meanings [...]: the first is to represent something, to describe or depict it, to call it up in the mind by description or portrayal or imagination; to place a likeness of it before us in our mind or in the senses; the second is to

represent and to symbolize, stand for, to be a specimen of, or to substitute for. (Shi & Zhu, 2018, p.227-228).

In summary, representation is the process of presenting some things using the features and qualifiers that one deems appropriate for expressing it. The synonyms of "representation" include: Rendering-characterization-description-likeness-drawing-sketch-reproduction... (Google Search - Definition of Representation, n.d.).

Two types of spatial representations are distinguished: Socio-spatial representations, which interpret spatial representation data in terms of affective, social, historical, and psychological factors; and spatial representations, which aim to read spatial representations in terms of the space itself, its visual and aesthetic qualities, atmospheres, as well as formal and structural characteristics (Kim, 1999; Haq & Giroto, 2003; Moser & Weiss, 2003).

The data is gathered via the presence of relevant elements and their frequency of occurrence in the sketch maps. Even if they include errors and distortions, they provide a wealth of information about people's spatial knowledge (Kim, 1999; Haq & Giroto, 2003; Moser & Weiss, 2003; Marchand, 2005).

Lynch pioneered the representation of urban space in order to read its legibility, which he defines as the quality that enables the understanding of a whole from its constituent five interconnected elements: path, edge, district, node, and landmark (Lynch, 1960). Numerous researchers have been inspired by Lynch's work, which remains a reference in the field.

However, one of the reproaches leveled against Lynch was the inability to provide information on the connection that connects the five constituent elements of the legible city, although this link seems to be a necessary condition of legibility. This issue is due to the methodologies used up to this point, which prevent it from being deciphered (Kim, 1999; Conroy & Bafna, 2003; Long & Baran, 2011).

Conroy and Bafna (2003) reinterpreted Lynch's analysis for the Boston example using space syntax. They argue that although the visual component is pervasive in the memorization of places and the five elements, the structural linkages of the urban area contribute to the formation of the whole and connect the five critical elements of legibility (Conroy & Bafna, 2003). This relationship between the parts and the whole is referred to as "intelligibility" in space syntax theory (Hillier & al, 1987). Similarly, Long & Baran (2011) examined the effect of spatial configuration, as measured by intelligibility, on legibility, as measured by sketch maps: They read the link between the five elements of legibility using space syntax and demonstrated that the intelligibility of the neighborhood configuration affects their legibility.

**Intelligibility** is defined by Cambridge online dictionary as "the quality of being possible to understand".

In space syntax, **intelligibility** is defined as understanding the configuration as a whole system from local characteristics (Hillier & al.,1987). It is "When looking at complex buildings or urban areas, we need to understand the way a part is located within a global structure" (Kim, 1999, p.48).

Similarly, scholars have defined intelligibility as follows "Intelligibility is a static second-degree characteristic, obtained by correlating local and global measures connectivity and integration" (Hillier & al., 1987, p.236). Scholars have further proffered:

**Connectivity** measures the number of immediate neighbors that are directly connected to a space. This is a static local measure. **Integration** is a static global measure. It describes the average depth of a space to all other spaces in the system. The spaces of a system can be ranked from the most integrated to the most segregated (Björn, 1993, p.2).

If locally well-connected lines are also integrating lines, then the correlation will be strong and the system will have "intelligibility". The whole can be read from the parts. Conversely, if well connected lines are not also integrating lines, then the correlation will be poor, and the whole will not be readable from the parts. [the system will be unintelligible] (Hillier & al., 1987, p 235-236).

Intelligibility “expresses the clarity of the global spatial configuration to its users or facilitates the understanding of the global structure from a given local position (Al Sayed, 2014)” (Zerouati & Bellal, 2020, p. 44).

According to Penn:

The intelligibility ratio is represented as a diagram. The determination coefficient ( $R^2$ ) is calculated. The system is considered intelligible if this coefficient is greater than 0.50 and the resulting point cloud is near a 45 line. The entire system becomes legible from its component parts. The system is considered unintelligible if  $R^2$  is less than 0.50. The correlation between local and global configurational variables is a measure of spatial pattern intelligibility for the people who use it (Penn, 2001). in (Zerouati & Bellal, 2020, p 44).

Kim considers intelligibility as essential interphase in understanding behavior. Intelligibility is primarily addressed to the mind and cognition (Kim, 1999; Penn, 2003). Cognition is concerned with perception and spatial knowledge. Each of us has a cognitive map of the world in which we live (Garling et al., 1981; Kim, 1999; Haq & Giroto, 2003; Penn, 2003). This map is constituted by experience, which is fed by mental representations of the world. Referring to several studies conducted (Piaget & Inhelder, 1956; Hart & Moore, 1971; Heft & Wohlwill, 1985; Golledge, 1993), Kim (1999) considers that:

Spatial knowledge acquired through spatial learning may be categorized as simple **quantitative** or complex **qualitative** knowledge. The former refers to the amount of information included in each element without regard for its organization, while the latter relates to how this information is interlinked to create an understanding of the built environment. Both spatial knowledge and spatial layout reasoning are related to the degree of complexity or coherence of spatial element configurations (Kim, 1999, p.20).

As previously stated, the most developed spatial knowledge is "knowledge of the configuration or the survey" or "the sketch map" (Kim, 1999; Haq & Giroto, 2003; Penn, 2003). As with spatial learning, spatial representation consists of **quantitative and qualitative elements** (Kim, 1999). These components chosen to represent the space in question are referred to as spatial qualities. If urban space representation can identify and quantify the elements that appear in sketch maps, specifically their appearance and frequency, space syntax, on the other hand, can quantify the qualitative aspect of the link that connects the elements in sketch maps to those in real space; for example, intelligibility, which is a quality that connects the part to the whole, or the local to the global (Hillier & al., 1987; Kim, 1999; Haq & Giroto, 2003; Penn, 2003). Haq and Giroto (2003) examined the correlation between the intelligibility of a sketch map and the actual configuration of two hospitals in the United States of America. One hospital has an intelligible structure, and the other has an unintelligible one. After a first visit, the authors requested individuals from outside the two institutions to sketch their plans. After digitizing the sketch maps and conducting a syntactic analysis of their intelligibility, researchers discovered a correlation between the intelligibility of real space plans and of its representation sketch maps. When a hospital's structure is intelligible, its sketch maps are also intelligible; when a hospital's structure is unintelligible, its sketch maps are unintelligible. For urban space, Kim (1999) conducted a study on two neighborhoods in the Hampstead suburb of north London. One has an intelligible structure, while the other has a less intelligible structure. He reached the same conclusion as Haq & Giroto (2003). The district with an intelligible configuration was represented by intelligible sketch maps, while the district with an unintelligible configuration was represented by unintelligible sketch maps.

Kim believes that "the cognitive approach reveals gaps in our knowledge of human spatial experience without elucidating the likely effect of spatial configuration on that experience" (Kim, 1999, p.25). Thus, he emphasizes the **structural qualities** that facilitate intelligible representation, such as the organization of the main axes and the distributive integration core.

In the context of the current research, participants were asked what the city signifies to them and how they represent it. Then, the output has been synthesized. Moreover, space syntax was used to evaluate the actual space using the intelligibility criteria. Lastly, a comparison of the two tools has been conducted to determine if there is a correspondence or not. If there is a correspondence between the elements in the sketch map and the spatial characteristics analyzed by space syntax (identification, location, relationship), the elements in the sketch map represent the structural qualities of urban space that contribute to its representation of what the city is.

## Methods

This work has undergone two phases: the first phase entails sketch maps, while the second examines the spatial structure of two samples: the city center and El Hidhab.

### Spatial representation by sketch maps

Spatial representation consists of producing sketch maps with the locals to find out what their representation of the city is. It also aims to assert if the data are consistent with the findings of the qualitative interview, which indicated that the city is represented by the city center (Rahmani Kelkoul & Chougui, 2019). As mentioned before, Setif consists of a center and three urban crowns of neighborhoods. For this purpose, a sample of 30 individuals from Setif city were chosen randomly in the directions of north, south, east, and west, and from among those who responded to the request (Figure 2). The sample of 30 people invited to represent the city was set in reference to Kevin Lynch (1960), who interviewed 15 people to draw Jersey, 15 people to draw Los Angeles, and 30 people to draw Boston. Hence, 30 participants were selected, which is the biggest number. Although this number seems insignificant, it gives convincing results. Participants from the center were excluded as they would naturally have a biased opinion of the city center as center, as confirmed by the interview. Some participants declined the invitation because they were either unavailable or because they did not know how to draw. The sample consisted of a mix of gender, ages, and professional profiles. The researcher supplied the participants with an A4 white paper sheet. The question was simple and straightforward: "Can you draw the city of Setif?" addressed in everyday language. No further guidance has been given in order to avoid the subjective influence of the researcher. Participants were at ease and took time to think and memorize before beginning the drawing. Sketching took place between March and April of 2017 between 10 a.m. and 5 p.m. The time slot was selected to ensure the availability of the participants. The data of the profile and age were reported by the researcher on the back of the draw. The results were analyzed in accordance with the objective of identifying nominal qualitative variables. This included identifying the spaces that appear in the drawings and their frequency of appearance. Each variable was considered independently. For example, if the appearance of an item of a space or equipment in a plan is located, it is considered a variable. Moreover, in each sketch map where it appears, it is reported on the software table. Similarly, if it does not appear, it is not reported. The results report was carried using the IBM SPSS 23 software, which allowed having the final results (appearance of spaces and their frequency).

## Space syntax analysis of the city center and El Hidhab neighborhood

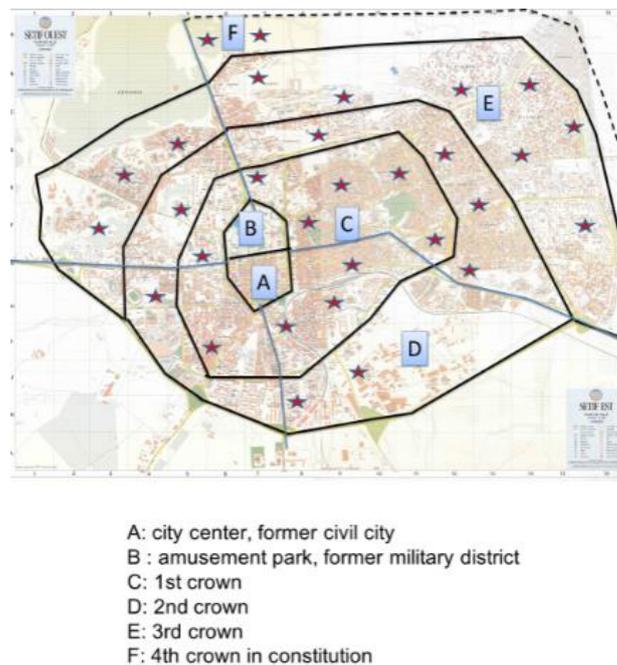
This phase analyzes the syntactic structure of two samples: The city center and El Hidhab. The city center was selected because it appeared on the survey and sketch maps as reflecting the city, while El Hidhab was picked to serve as a focal point for the city's north-eastern extension (Figure 5). The two samples, taken in their immediate environment, comprise administrative, socio-educational, commercial, and leisure facilities, as well as private and communal houses with a variety of architectural typologies (Figure 5, 6, 10). The methodology of space syntax was used to perform the syntax analysis. The example plans were digitized using AUTOCAD software and saved as DXF files. Data were then read using UCL Depthmap X 10 software, which used the Axial map as a reading medium. The Axial map illustrates the fewest possible axial lines encompassing all convex areas and their connections in a plan (Björn, 1993). Axial map analysis has been confirmed to be a reliable tool for presenting critical configurational properties of urban networks (Joutsiniemi, 2005). The Axial map analysis's hues, ranging from blue to red, reflect values ranging from the weakest to the strongest (Hima et al., 2018). The fewest Axial map minimizes the number of lines in the All line, making the map more legible while retaining its syntactic properties.

For the current study, the syntactic analysis of the Axial map is focused on the intelligibility that guided the connection and integration readings, as well as on the integration core. Integration core is:

Interesting to see where the most integrating lines are and what they relate to in the system; but more important is what type of pattern the strong integrating spaces make. A useful device is to make a map of the 10%, 25% or 50% most integrating spaces (Hillier & Hanson, 1984, p. 115).

The synthesis consists of establishing correspondence between the mental map and the syntactic analysis.

## Results



**Figure 2** – Location of the people interviewed for the representation of Setif city. Source: National Institute of Cartography and Remote Sensing/ Rahmani Kelkoul & Chougui (2019), treated by authors (2021).

### Results of sketch maps representation

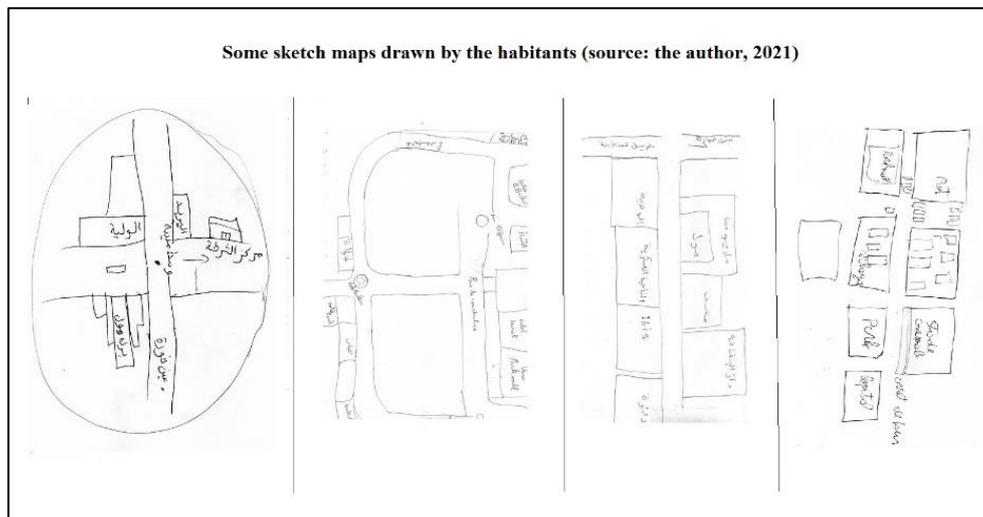


Figure 3 – Some sketch maps drawn by the habitants. Source: Authors (2021).

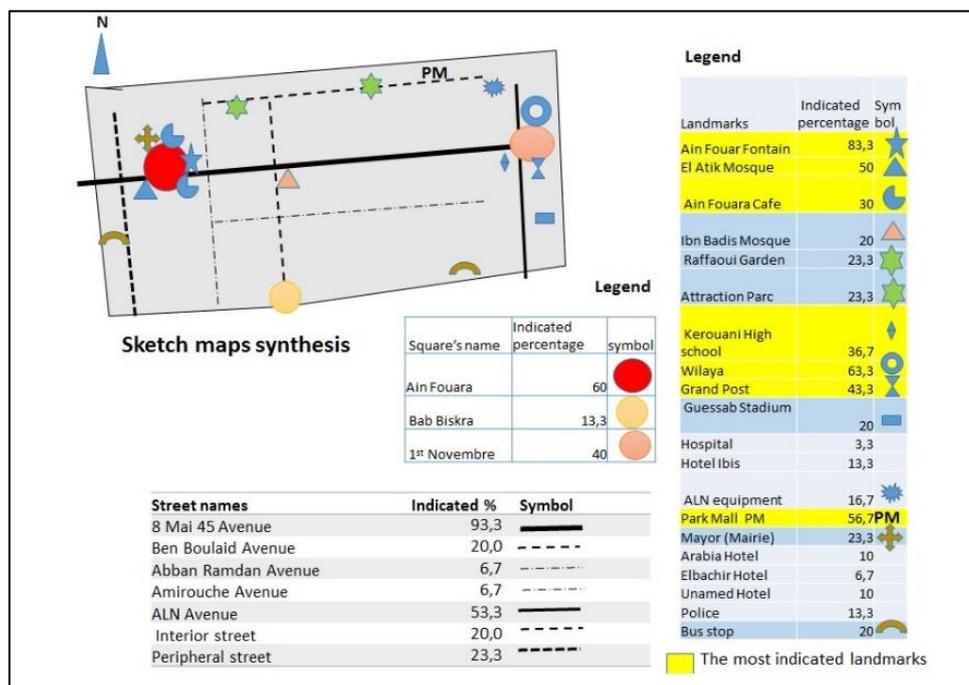


Figure 4 – Sketch maps synthesis. Source: Authors (2021).

The request to the inhabitants to design the city was carried out in all neutrality to avoid any subjectivity. The profile of the participants included various ages, both gender, and different occupations in order to ensure the representativeness of the sample. Participants were high school pupils, students, shopkeepers, parking attendants, housewives, taxi drivers, university teachers, and retirees. Some sketch maps drawn by the habitants are presented in figure 3. The decryption of the study results concerned the spatial aspect was done through IBM SPSS 23 software, as illustrated in a schema summarizing these representations with the frequency of streets, public squares, and landmarks (Figure 4).

Although the city has an area of 127.30 km<sup>2</sup>, the results suggest that the city's center has been identified as its representative; this matches the findings of prior research by Rahmani-Kelkoul & Chougui (2019) and Bousnina & Omari (2018).

On the total of 100% indicating the city center as representing the city, 93.7% did not sketch the whole Setif city but represented only the city center. The 6.3% who sketched the entire city envisioned it as a large space in which districts and peripheral limits were mentioned, with a crossroads of streets and some equipment in the center, indicating those of the city center (Figure 3). However, the city center was not represented uniformly in the sketch maps. Some participants (33.3%) configure it as a space surrounded by continuous and closed boundaries representing some associated spatial elements: 8 Mai 45 Avenue called "Rue de Constantine" (Constantine Street) and Ain Fouara square (88.3%). Other participants did not represent a closed space, but a few spatial elements: The ALN Avenue, the Wilaya, and the Park Mall (57.7%); or Ain Fouara fountain and El Atik Mosque (66.6%), sometimes associating the cafe of Ain Fouara square (48.3%). Others represent Ibn Badis Mosque associated with Ben Boulaid Avenue and Constantine Street (44.4%). Others associate Constantine Street, Kerouani high school, the Wilaya, and 1st November square (Liberty square) (64.4%). Technically, the representations vary; some depict facades aligned along a street (3%), while the majority depict a view of two-dimensional planning, with writing indicating the various places (Figure 4).

This representation of the inhabitants reveals permanent features that repeat in a loop, such as Constantine Street, Ain Fouara Square, and the landmarks that punctuate it, such as the Ain Fouara fountain, El Atik Mosque, 1st November Square, the Wilaya, and the Park Mall. Although the city center is depicted on maps as the location that best represents the city, the space most represented there is constrained.

## Results of the Syntactic analysis of two samples

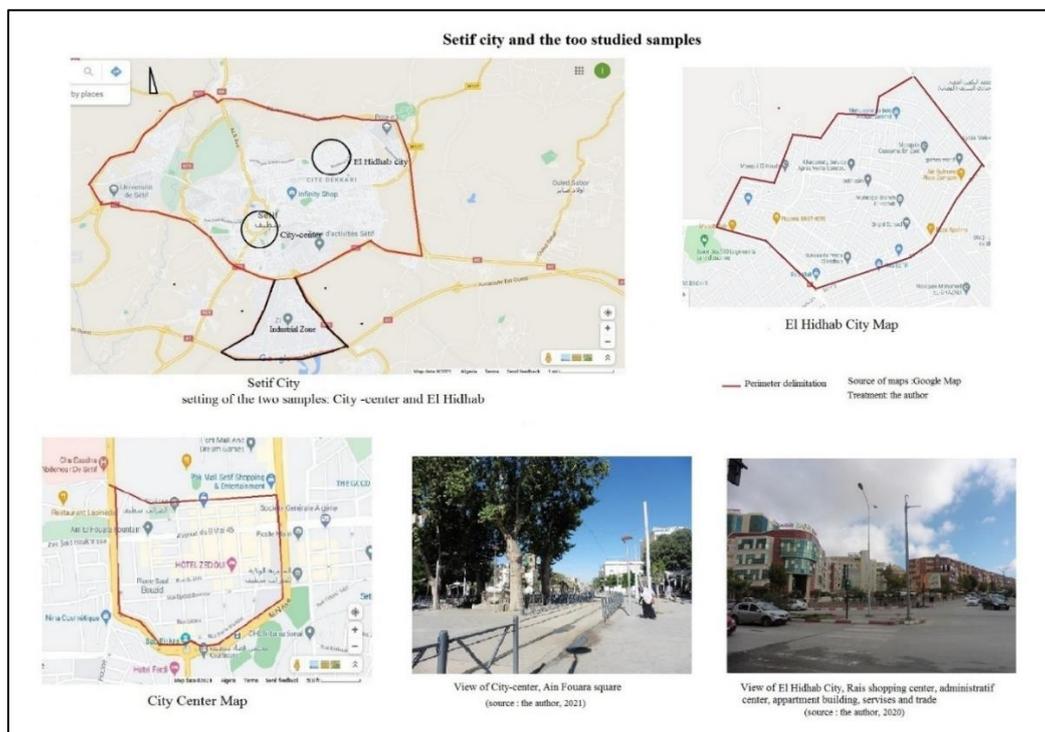


Figure 5 – Location of the two studied samples. Source: Authors (2021).

Syntactic analysis of the city center of Setif

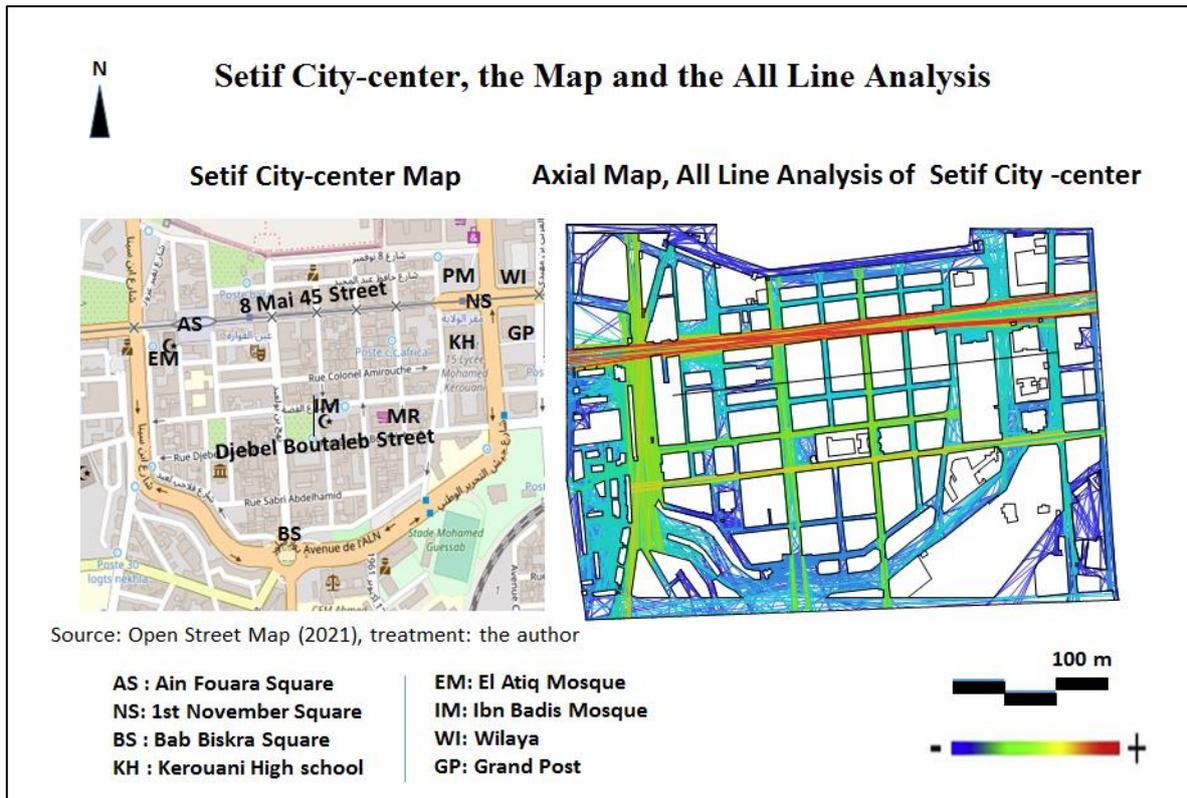


Figure 6 – Setif city center, the map and the Axial map analysis. Source: Authors (2021).

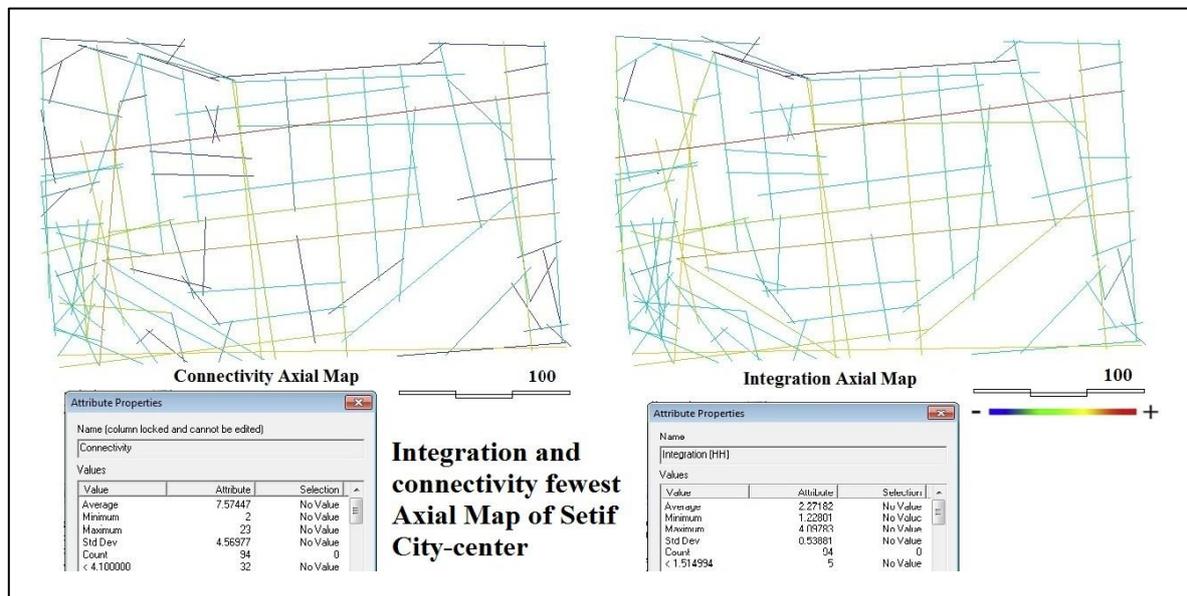


Figure 7 – Integration and connectivity, the fewest Axial map of the city center. Source: Authors (2021).

Table 1 – The connectivity and the integration values of the city center

Value	Intégration	Connectivity
Maximum	4,097	23
Minimum	1,228	2
Average	2,271	7,574

Source: Authors (2021).

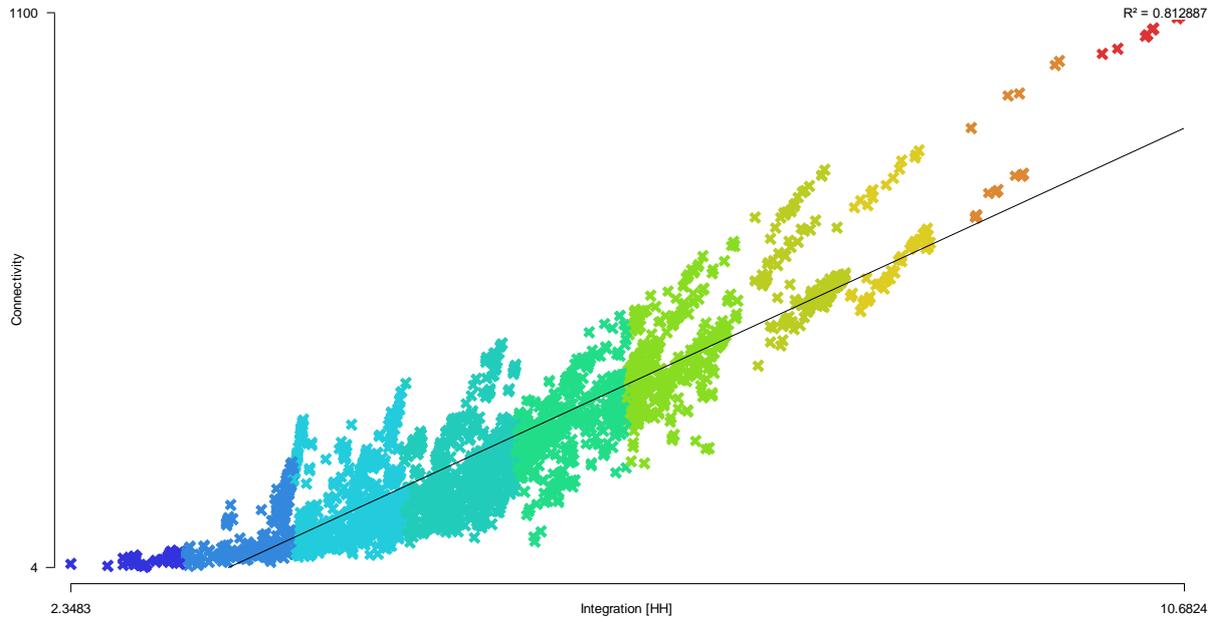


Figure 8 – Intelligibility graph<sup>1</sup> of Setif city center, R2= 0,8128. Source: Authors (2021).

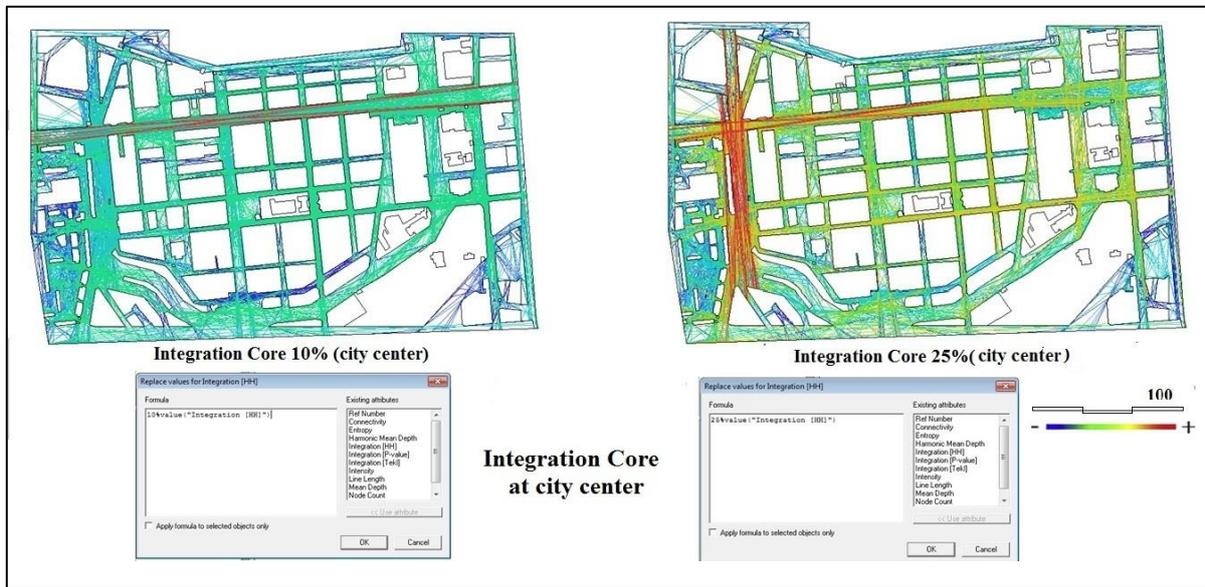


Figure 9 – Integration core at Setif city center. Source: Authors (2021).

By referring to the indications of space syntax analysis, the orthogonal and hierarchical structure of the city center, representing an intelligibility index R2= 0.8128, is intelligible. Figure 8 of intelligibility

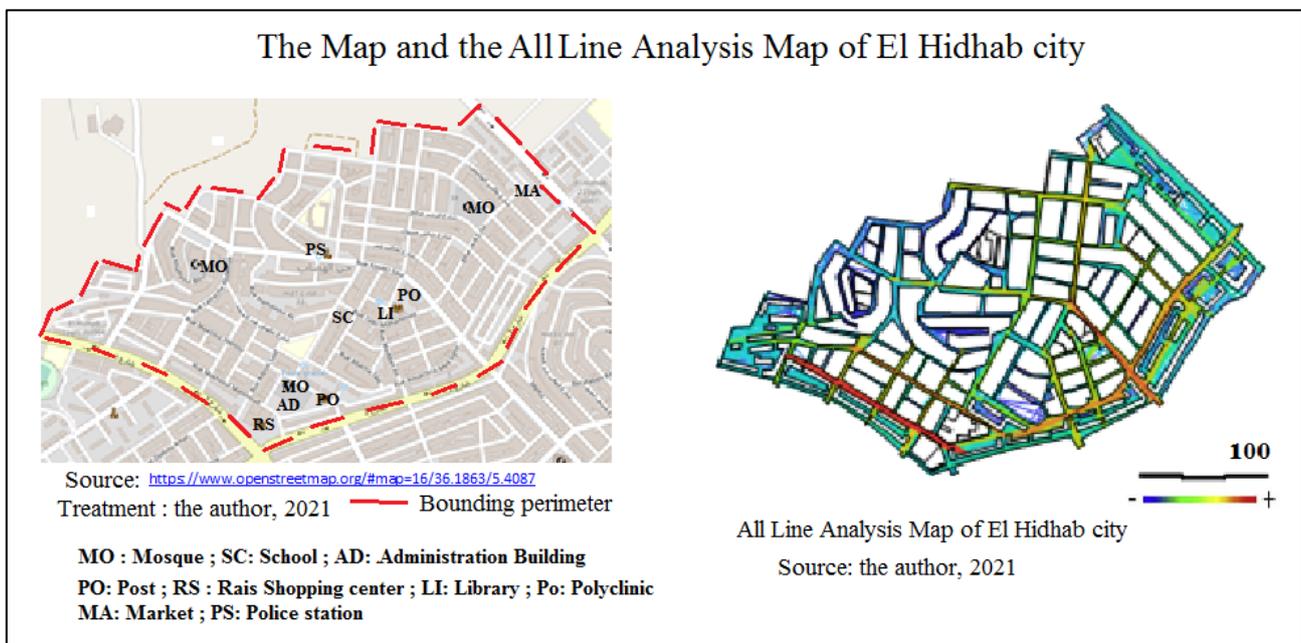
<sup>1</sup> The intelligibility graphs of the two samples are calculated from the all line maps.

indicates a rapprochement of the points of the cloud, indicating a correlation between the values of connectivity (C) and integration (HH). Figure 7 of integration and connectivity indicates the most connected spaces are the most integrated spaces. Thus, for Cheikh el Aifa Boulevard HH= 3.490; C= 20; 8 Mai 45 Avenue HH= 4.097, C=23; Ain Fouara HH= 4.097, C=23; 1st November square HH= 4.097, C=23; Djebel Boutaleb Street HH= 3.808, C= 20; ALN Avenue HH= 3,090, C=16; Abbane Ramdhan Avenue HH=2,618, C=8; Ben Boulaid Avenue HH=3,222, C=15. Thus, the data allowed a reading of a correlation between the two values (connectivity and integration).

It is noticed that Ain Fouara and the 1st November square are among the top three most integrated and connected spaces, but they share the same values since they are positioned on the same axis on 8 May 45. On this axis, this is owing to the fact that the Axial map (fewest map) does not distinguish between its multiple parts. However, this issue may be resolved by referring to the segment map -another syntactic characteristic- which does distinguish between the multiple parts of the same line (Shrestha, 2019).

Additionally, Figure 9 of the Integration Core depicts a linear integration core at 10% represented by 8 Mai 45 Avenue, which is the main avenue that organizes downtown's main space and connects the two main squares: Ain Fouara and 1st November. However, at 25%, the Integration Core takes the form of a horizontal U, connecting 8 Mai 45 Avenue to Cheikh El Aifa Boulevard and returning inward to Djbel Boutaleb Street. This Integration Core is both linear and horizontal. Additionally, a careful examination of the location of services and public squares reveals a prudent choice consistent with a development strategy. The most significant public squares (Ain Fouara, 1st November, Ain Droudj) are located on the most important axis of integration (8 May 45) and punctuate it. Thereby, they establish stopping points and breaks in the axis' linearity, while the axis of integration within Djebel Bourtaleb Street distributes the centrality (Figure 6, 9).

### Syntactic analysis of El Hidhab neighborhood



**Figure 10** – El Hidhab neighborhood, the map and the Axial map analysis. Source: Authors (2021).

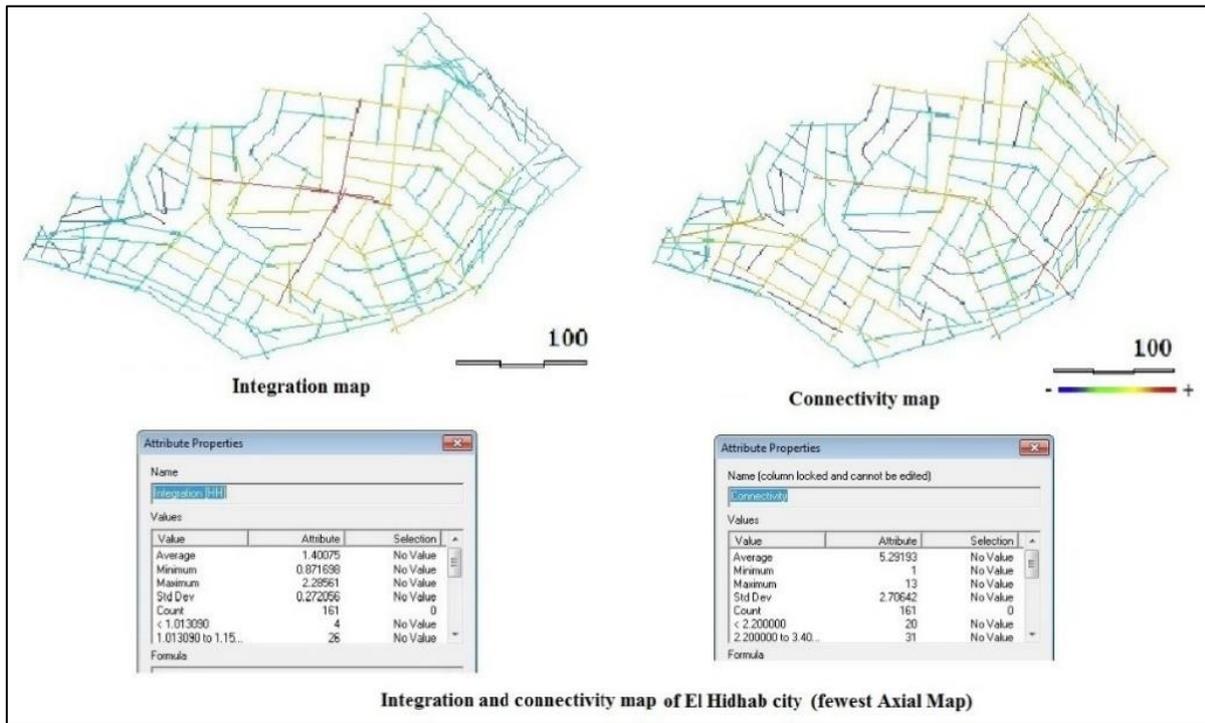


Figure 11 – Integration and connectivity, the fewest Axial map of El Hidhab. Source: Authors (2021).

Table 2 – The connectivity and integration values of El Hidhab

Value	Intégration	Connectivity
Maximum	2,285	13
Minimum	0,871	1
Average	1,4	5,291

Source: Authors (2021).

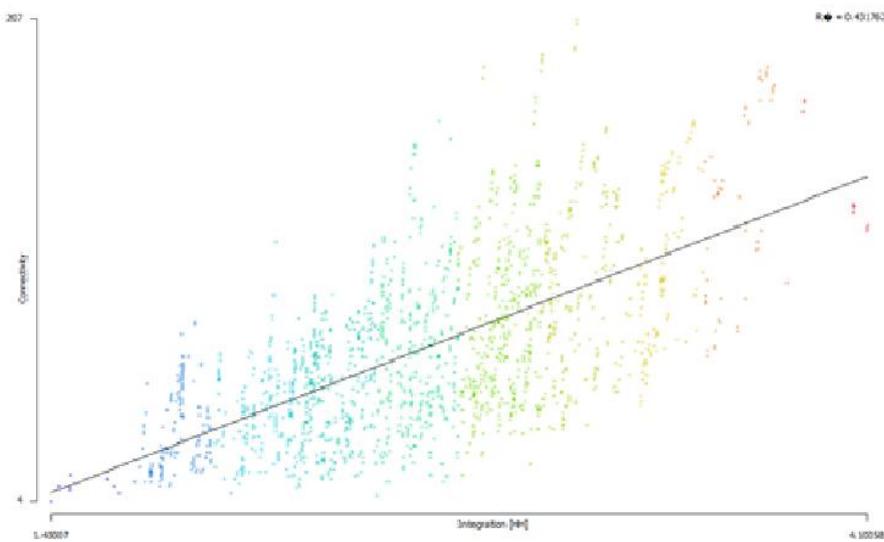


Figure 12 – Intelligibility graph of El Hidhab  $r, R^2=0,431$ . Source: Authors (2021).

Figure 12 indicates for El Hidhab an intelligibility index  $R^2=0,431$ . Referring to the indications of space syntax, this semi-labyrinthic structure is unintelligible. Figure 12 of intelligibility indicates a scattering and a distance of the points of the cloud, indicating a lack of correlation between the values of connectivity and integration (HH). Figure 11 of integration and connectivity indicates the most connected spaces are the least integrated spaces. Thus, the street Aaouachria Med Seghir (East) has a value of  $HH = 1.676 - C = 13$ . The same indications have been marked for the market street  $HH = 1.317 - C = 11$ . Similarly, Street Kouaci Said (South-east) has  $HH = 1.974$  and  $C = 12$ . This is a high value of connectivity for a low value of integration while it is the main axis of the city. It crosses the city from south-east to north-west on which are located public facilities, the health center, and the library. Moreover, it connects El Hidhab to the neighborhood of Hachemi. While the same street Kouaci Said scores a high value of integration  $HH = 2.213$  and a relatively high connectivity  $C = 9$  on the north-west side but distributes only housing, an exception for the post street, which leads to the post office was noted. Hence, there is a relative correspondence between the values of connectivity and integration  $HH = 2.163, C = 9$  on the north-east side and  $HH = 2.285, C=10$  on the south-west side. However, this street lacks the proper development, although it leads to the facilities, and it is the only one that presents a certain correspondence between the values of integration and connectivity.

## Discussion

As stated in the schema of Figure 4, spatial representation through sketch map identifies the city center as representing the city. Although 100% of inhabitants identified the city center pattern as representing the city, only the unifying elements and spaces were identified: 8 May 45 Avenue, Ain Fouara and 1st November public squares, the ALN, Abbane Ramdhan, Ben Boulaid Avenues, Djebel Boutaleb street, and some equipment located in these spaces.

The comparison of the city center syntactic analysis to that of El Hidhab, which was built in the 1990's to serve as a new urban pole to balance the city center, can help explain why the city center was chosen to represent the city, even if this choice can also be explained by other social factors such as memory and affection. In the case of the current investigation, the findings are corroborated by the theory of the spatial components and the characteristics that enable their representation.

The comparison of the syntactic analysis findings with the spatial representation of the city reveals a correspondence between the two methodologies, demonstrating that the first may support the second.

The city center has an intelligible checkerboard structure, as indicated by a high intelligibility index, whereas El Hidhab has an unintelligible labyrinthine structure, as indicated by an intelligibility index  $R^2=0,431$  indicating that there is no correlation between connectivity and integration values. Hence, the most integrated places are not the most connected.

On the other hand, the intelligibility index  $R^2= 0.8128$  for the city center is explained by a correlation between the HH integration and the connectivity C. The locations with a high correlation are those that have been represented in the sketch maps of the occupants. The most indicated is the 8 May 45 Avenue, which has a representation rate of 93.3% and is characterized by highly correlated syntactic values: an integration  $HH = 4.097$  and a connectivity  $C = 23$ . Additionally, Ain Fouara public square has a representation rate of 60%, and the 1st November square has a representation rate of 40% in the sketch maps. However, as mentioned previously, even though these locations have the highest and most correlated syntactic values, the Axial map does not distinguish between the two, since both are located on the same axis. At this phase, it will be necessary to explore in the future the segment map -another syntactic characteristic- which can establish the distinction between the different situations within the same axis. This remark also applies to the ALN Avenue  $HH= 3,090, C=16$ , which runs through the 1st

November public square and may account for the significant representation of 53,3%, but is not visible on the axial map.

Additionally, Djebel Boutaleb street (internal street)  $HH=3.808$ ,  $C=20$  is represented by 20%; Ben Boulaid Avenue  $HH=3,222$ ,  $C=15$  is represented by 20%; and Abbane Ramdhan Avenue  $HH=2,618$ ,  $C=8$  is represented by 6.7%. By comparing these data, it can be deduced that the spaces that are the most integrated and connected are the most represented, whereas the places that are the least integrated and connected are the least represented (Figure 4, 7).

Adding to the intelligibility factor of the structure, which would have favored this representation, the reading of the representation by sketch map is significant for the interpretation of the choice of the city center as representative of the city. Hence, what characterizes the city center is rather this axis of 8 Mai 45 punctuated by public squares (Ain Fouara and the place of 1st November) that are centers of social life, meeting, and mixing rather than being made up of social and commercial centrality. This set of 8 Mai 45 Avenue and the public squares that intersect it comprises at 10% of the most significant integration core in the syntactic analysis (Figure 9) and at 25% of the core that relates to the outside and organizes the inside.

In El Hidhab, which was designed to create a polarity on the northeast side, many amenities and stores are detected. However, there is a lack of structure in public squares and major streets. It is also noticed the complete lack of city-scale public spaces. This is added to the structure's unintelligibility owing to the absence of linkage between integration and connectivity. Even if the present equipment in El Hidhab comprises many centralizers, it is not positioned in the most integrated locations (Figures 10, 11, 12).

If the spatial representation evoked for the case of Setif that the inhabitants view the city center as representing the city through very precise and well-defined spaces, the spatial syntax revealed the syntactic characteristics that support this representation. These characteristics include an intelligible structure and a hierarchical structure with the main street punctuated by public squares and an integrated extension. Together, these areas and their syntactic characteristics define the structural aspects of the city's urban space. For the generalizability of the results, it is suggested to include more analytical studies and city examples.

## Conclusion

The space in which we live is neither unknown nor indifferent to us; it constitutes a source of our spatial knowledge. Questioning this knowledge makes it possible to understand how it would be necessary to act; because the experience of this world constitutes a knowledge that allows, in its turn, other experiences.

The qualitative approaches place a high value on the residents. Who better than the inhabitants to convey and exhibit their knowledge about their living space? Externalization of this knowledge occurs via verbal expression and a graphic representation known as sketch maps. This latter is the most developed tool since the work of Lynch. If this qualitative approach enables comprehension of the inhabitants' representations of their living space, the syntactic reading developed by space syntax theory is a quali-quantitative approach that enables reading the socio-spatial meaning of the represented space (existing). Most notably, via the intermediary of intelligibility and other associated characteristics, it provides explanations for these representations. These qualitative and quantitative methods enable the identification of the structural qualities of the space that underpin its representation.

How do people perceive the city? What are the representations' indices? How can they be explained by intelligibility as a syntactic reading? What are the objectives of this interpretation in terms of subsequent interventions? These are the issues that this article addressed in the example of Setif city,

which lacks this sort of mixed methods studies. The urban space of Setif is organized around a city center and three crowns of neighborhoods reflecting the city's various phases of urban growth. With the overcrowding of the northeast, El Hidhab was intended to create a new polarity on this side to balance the city center. Facilities, commerce, and housing all contributed to the creation of this polarity. Despite its wealth of materials, El Hidhab lacks a spatial framework that adequately represents the city.

In a prior study, it was established via a quali-quantitative interview that what characterizes the city is the city center. The current investigation validated this finding through the cognitive representation of sketch maps collected from residents.

The syntactic analysis of El Hidhab and the city center revealed a correspondence between the city center's syntactic characteristics and its spatial representation, which has several explanations. On the one hand, the city center's orthogonal and hierarchical structure is intelligible, whereas El Hidhab's semi-labyrinthic structure is unintelligible. On the other hand, the representation focused on the main street 8 Mai 45 and the two public squares Ain Fouara and 1st November, which punctuate it and constitute the public spaces for meeting and mixing of different people. This set constitutes a core of integration (Integration Core) with strong syntactic values, which distributes the interior and refers to the outside.

The article's primary objective is to approach the spatial representation of urban space, both qualitatively and quantitatively, since previous research on Setif lacks the use of these methodologies. A clearly structured and intelligible hierarchical form, with main axes and well-located public areas, constitute the spatial qualities that favor the representation of the city.

After confirming the initial hypothesis for the case of Setif, this study suggests the incorporation of additional case studies by comparing -if there are any neighborhoods with an understandable structure to centers with an unintelligible structure, as well as by including a syntactic analysis of the Segment Map.

These approaches may help sustainably organize the many existing and future spatial interventions aimed at creating what constitutes the city.

## Data availability statement

The dataset that supports the results of this paper is available at SciELO Data and can be accessed via <https://doi.org/10.48331/scielodata.8V8G8K>.

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