Spatial analysis of Private school sites in Al-Jihad neighborhood in Baghdad-Iraq by using geographic information systems

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Abstract: High rates of population growth of Al-Jihad neighborhood in Baghdad-Iraq, and the urban expansion accompanying this increase, as well as internal migration due to the recent circumstances in Iraq led to a great pressure on educational services and their ability to meet the needs of the growing population, all that led to the establishment of private schools and as a result, the number of private schools has increased significantly in the past years. The selection of the locations of these private schools was random and with no consideration of planning criteria. This paper examines the issue of selecting the sites of private schools without relying on the special planning criteria and determinants. The research methodology is based on the analysis of spatial sites of private secondary schools in Al Jihad neighborhood in Baghdad-Iraq to determine spatial distribution patterns of private secondary schools in the study area as well as the distance between secondary school sites in neighborhoods. Evaluate the application of planning and design standards to locate school sites. Clarify the adequacy of the location of private secondary schools with the population's needs for educational services, analyze spatial distribution of schools and finally identify appropriate locations for these schools, by use of geographic information systems (GIS) in analyzing spatial distribution of the schools and determining the suitable locations for these schools, the research found that the private secondary schools within the study area are distributed randomly and are not subject to any planning criteria in their spatial signature. The research suggest a number of proposals and planning solutions to solve the problem of not appropriate spatial signature of private secondary schools in Al-Jihad neighborhood.

1. Introduction
Private schools have been established in Iraq in recent years in remarkable numbers due to the increase in population and the insufficient number of public schools. These schools spread within the residential neighborhoods of Iraqi cities in random distribution and were mostly not in accordance with the planning and design criteria for the spatial signature of educational services within the residential neighborhoods in the cities.

Research problem: The problem of research is the random spatial signature of private secondary schools in the Jihad neighborhood, without taking into account the planning criteria for choosing school sites within residential areas and the need for these services.

Research goal: Study and analyse the sites of private secondary schools in Al-Jihad neighborhood to determine compliance with the planning criteria in the selection of the sites of these schools, and develop a proposal for selecting appropriate locations for schools in the study area according to the planning criteria.

Research Methodology: The descriptive analytical approach was adopted in the study and the use of geographic information systems (GIS) in analyzing.
2. Spatial planning for private schools in Iraq:
The ideal location for educational services within the residential areas must meet the planning and
design criteria. The following points should be taken into consideration when choosing a educational
services locations in Iraqi cites:

2.1 Planning and Design Requirements for School Buildings in Iraq:
Choosing a school location in Iraqi site should include the following requirements:[1]
1- Location of the school’ building: - The location of the school building should be:
   A - A place accessible by walking and buses, taking into account that the entrances in places provide easily and safely access.
   B- In a region far from the noise and sources of environmental pollution such as industrial projects, massacres, oil products and railway lines and factories.
   C) Taking into account the specifications of the site (soil specifications and geographical nature).
2- Orientation of the building: The school must be directed according to exposure to the sun and
the direction of the wind so that the sun enters from all corners of the building while benefiting
from the wind in the ventilation of the building.
3- Area: The land area on which the school will be built should be large enough for future
expansion of buildings, including buildings, playgrounds and gardens.
4- School wall: The school should have a regular wall height (1.8 - 2) m from the level of the
pavement while reducing the entrances.
5- the school yard: the availability of a school yard for the deployment of students to carry out
activities and physical activity and this arena must be within the criteria.
6- School garden: increase plants in the spaces between buildings.

2.2 Planning standards for spatial signature of schools:
Educational services in Iraq depend on several indicators, including:
1- The size of classrooms for each stage according to the international standards and the standards
of the Ministry of Education.
2- Number of classrooms in the stage.
3 - The area occupied by the school.
4 - Number of students per teacher.
These indicators lead to the identification of several types of criteria: [2]
 a. Spatial criteria: These criteria are determined by assigning the distance, cost or time taken
from the place of departure to the school under the conditions of safety and accessibility as shown in 'Table 1',

| The educational institution | Distributed time to reach (Feet) | Distance (m) | Notes |
|----------------------------|----------------------------------|--------------|-------|
| Primary                    | Within the residential neighborhood | 5-10         | 400-800 | The physical capacity of the student serving more than a neighborhood |
| secondary                  | location is intermediate between the number of neighborhoods | 15-30       | 800-1600 |

b. Quantitative criteria: These standards are characterized by the ability to measure the efficiency
of educational performance by introducing specific indicators such as the number of students or
the number of population or the number of classrooms or counting teachers. These standards give a brief picture of the form of the educational system and divided into:
1- Survey criteria: In accordance with these criteria, we determine the student's share
of the school space. [4].
2- Capacity: It is based on the efficiency index in the provision of educational services. This indicator states that the number of students, the people and the school should be according to the residential neighborhoods and on the basis of the unit of residence [5].

3- Accessibility: The most important characteristic of the spatial signature of schools is easy access to school. Accessibility measured through the time it takes to reach the school and also through the distance [6].

c. Safety Standard: This is an important criterion that must be taken into account in every planning process for schools. The site should ensure safety for students. It should protect the student from highways to prevent accidents. The gas stations are far from school and the way to go to school and return to their homes is safe [7].

d. Environmental standard: This criterion is important because it preserves the student's safety from pollutants and diseases. Schools must be far from polluting industries, noise, cemeteries and public parks and recreation places [8].

Table 2’ shows the number of students per school, grade, and educational land area estimated by the distance to reach them.

### Table 2. Planning standards for educational buildings within the residential area

| No. | Type of Institution       | Number of Students | Number of Students in class | number of classrooms | popula| Distance to school (m) | The plot area of the educational institution M / 1000 inhabitants |
|-----|---------------------------|--------------------|-----------------------------|---------------------|-------|------------------------|---------------------------------------------------------------|
| 1   | primary School            | 480                | 36                          | 12                  | 2400  | 500                    | 3000-3500                                                     |
| 2   | intermediate School       | 360                | 30                          | 12                  | 4800  | 800                    | 1600-2000                                                     |
| 3   | secondary school          | 360                | 30                          | 12                  | 4800  | 800                    | 1400-1700                                                     |

2.3 The concept of Private schools:
Private schools and public schools have complementary roles in the education of young generations. [10]. They are known as state-run schools, and therefore these schools control the number of students they enroll in. Private schools are private educational institutions that provide education for different levels of education. Private schools in Iraq are managed by the private sector (whether individuals, groups or companies), financing and processing outside government spending, subject to the conditions and approval of the Ministry of Education. Public schools and private schools must be subject to the planning and design criteria mentioned above. But there are some design criteria that have been developed by the Ministry of Education for private schools as shown below.

2.4 Iraqi Private Schools Standards:
The private schools are not a new experience but an old experience with the establishment of the Iraqi state. These schools were run by independent bodies under the supervision of the Ministry of Education, Table 3’ below include Building standards for Iraqi Private schools.
Table 3. Building standards for Iraqi Private schools, Source / [11]

| State | Standards |
|-------|-----------|
| Iraq  | The primary school building should contain (6) classrooms and the allocated area (1.25) m² per student. The middle should contain (3) rows and (3) preparatory and (6) secondary. The area of the classrooms shall be (1.5) per student and the height of the ceiling shall not exceed (2.8) m². Room with ventilation and non-overlapping outlets. The number of students does not exceed 30 students per class. The hall of the science lab is allocated (35) m² Specialty hall for laboratory (chemistry and biology) And a hall for laboratories (physics and computer) not less than (40) m ². Library not less than (35) m². A room for the principal is not less than (16) m² and a room for teachers (20) m². Square paved (1) m² per student. Outdoor bathrooms with one rate per 30 students. Provides drinking water at the rate of 1 per 30 students with water coolers equipped with filters. The school building should be surrounded by an outer wall with two entrances devoid of coarse surfaces. The school must be far from industrial areas and factories. Providing a pharmacy + fire extinguishers. The building should not be occupied by shops or residences. |

The above table shows us the criteria for the Private schools. These criteria relate only to the design aspect and did not address the spatial signature criteria and requirements of the schools. The instructions for the establishment of private schools in Iraq did not include any reference to the subject of the planning criteria for the spatial signature of these schools, which led to random and chaotic sites selection of these schools, and the fact that these schools are not able to meet the basic requirements of educational buildings.

3. Spatial assessment of private secondary schools’ sites distribution in the neighborhood of Jihad in Baghdad

3.1 Reasons for selecting the study area:
Al-Jihad neighborhood was chosen due to the presence of private educational services (private secondary schools) despite the existence of government educational services. These schools are distributed over certain districts due to the increase in the number of residents due to the recent conditions and internal migration. This area was taken to study private schools.

![Figure 1. The study area (Al-Jihad neighborhood) Source/ [12]](image_url)

3.2 Private secondary schools in the study area:
Through the field survey it became clear that private secondary schools in Al-Jihad neighborhood are distributed in specific areas and are not subject to any criteria. Table 4 shows the private secondary schools in the area and population.
Table 4. The private secondary schools in the study area and the number of population and the number of students Source: the researcher based on statistical data, al karkh Directorate of Education / 2, 2015

| Schools                          | Neighborhood Population | Number of students |
|----------------------------------|-------------------------|--------------------|
| Anwar Baghdad for boys           | 3341                    | 294                |
| alqabs for girls                 | 10807                   | 100                |
| dar alsalam for girls            | 3341                    | 68                 |
| alfurat for girls                | 10807                   | 75                 |
| aljil alththani for boys         | 3341                    | 70                 |
| Alfurat for boys                 | 9864                    | 62                 |
| alfarashat albayda' for girls    | 10332                   | 222                |

3.3 spatial analysis of private secondary schools sites using geographic information systems:

After the data collection and survey of the study area to determine private secondary schools sites using GPS as shown in table,[5], and positioning their location in a satellite image by using GIS and providing the program with information about the area and the population of the study area in which the school is located and the number of school students. The following spatial analysis was performed:

Table 5. Private secondary schools sites using GPS Source: The researcher

| No | E       | N       | Name                             |
|----|---------|---------|----------------------------------|
| 1  | 434942.592 | 3680782.77 | Anwar Baghdad for boys           |
| 2  | 434754.835 | 3680495.637 | alqabs for girls                 |
| 3  | 434782.715 | 3680525.499 | dar alsalam for girls            |
| 4  | 434441.295 | 3683874.946 | alfurat for girls                |
| 5  | 434442.214 | 3683915.358 | aljil alththani for boys         |
| 6  | 434441.395 | 3682942.655 | Alfurat for boys                 |
| 7  | 434445.278 | 3683006.382 | alfarashat albayda' for girls    |

3.3.1 Analysis of the mean center: The spatial analysis of the average center means finding of the central coordinate, ie, the center of the distance of all the points, ie, the average of all the coordinates of the average of all the coordinates X, Y, for the seven private secondary schools that are included in the analysis process, so that the results of this analysis are presented as a central point between the points of the private schools as a whole. This central point is enclosed in its information table as a coordinate (X, Y). The researcher conducted this analysis using the ARC toolbox. The spatial analysis of the special school points defined by the coordinates was carried out. The coordinates of the schools were obtained through the survey by the GPS device and then the coordinates were introduced as tables in the GIS program. The tables, as well as the coordinates of each school, included the number of school students and neighborhood population size in which the school is located. After analyzing within the spatial analysis environment of the GIS program within the Spatial Analyst based on the weight overlay, which is the population of the areas in which the private secondary schools where the analysis was conducted twice, once without weight, considering all the points of the same importance and again by weight and the weight is Number of residents in the neighborhood where the school is located. A result was found in both cases of a mean spatial center for all points of private secondary schools as shown in 'figure 2'.
From the above figure it is shown that the blue point is the average central position of the points without taking the weight into account (population numbers). When opening the point table, this new point is known as XCOORD Y COORD. In 'figure3' below, we note that the analysis site for the average center of the points represented by the red point has changed from the previous one. If we use the analysis of the population of the districts where these schools are located.

3.3.2 Spatial analysis of the central phenomenon (central feature): The spatial analysis of the central phenomenon, or central feature, is a central feature of the points for which the spatial analysis was carried out. This feature includes the central character of the points. For example, in this particular study, the analysis included the private secondary schools. The results appeared in the form of a private secondary school that would have a central phenomenon for the points or other private secondary schools.

conducting this type of
spatial analysis by considering weight (ie weight is population) and again without weight. The data table in both cases shows a school carrying the central phenomenon as shown in 'Figure 4'. 'Figure 4' shows that After conducting the spatial analysis of the central phenomenon and opening the data table for analysis, it was found that the Euphrates private secondary school for boys is the one that achieves the central phenomenon for the secondary private schools when taking into consideration the weight of the population.

![Figure 4](image1.jpg)

*Figure 4. Central feature analysis, taking into consideration the population in the locality where the schools are located, Source: The researcher based on the GIS program*

![Figure 5](image2.jpg)

*Figure 5. Central feature analysis without taking into account the numbers of the population in the neighborhood where the schools are located Source: The researcher based on the GIS program*

'Figure 5' shows that the second generation private secondary school for boys achieves the central phenomenon for private secondary school without taking into consideration the weight of any population. The rest of the schools do not achieve the central phenomenon whether they are weight or not weight.

3.3.3 Spatial analysis Standard distance Standard distance technology calculates the density of school locations on the geographic area of al Jihad neighborhood. The standard distance is an absolute value representing the dispersion of schools around its mean center. Since the value represents distance, it is possible to measure the concentration of school density around its middle position. By drawing a circle around the center and its radius is that calculated value. Standard distance analysis is a type of spatial
analysis expressed in a circle. The greater the standard distance, the greater the dispersion of spatial distribution of private secondary schools and vice versa as the concentration of points around the center increases as the standard distance increases. We use this pattern to analyze dispersion of spatial distribution. This analysis is carried out by Spatial Analyst on the basis of private secondary schools data within the GIS environment, this data includes the coordinates (X, Y) and the population of the neighborhoods where the students are located. When the table of results was opened, tables of the same coordinates of the spatial analysis of the center appeared, with weight and without weight, and we conducted this analysis twice by taking into consideration the number of population and again without taking into account the population as shown in 'Figures 6' and '7' below.

![Figure 6. Spatial analysis of the standard distance without taking into account the numbers of the population in the residential neighborhood in which the schools are located](image1)

Source: The researcher based on the GIS program

![Figure 7. Spatial analysis of the standard distance taking into account the population of the locality in which the schools are located](image2)

Source: The researcher based on the GIS program

In 'Figure 7'. The radius of the circle, which represents the standard distance for school sites, was about 0.95985 km. It contained four out of seven school representing 23% of the total number of schools selected in this study. This indicates that the schools are concentrated in the middle of the residential area. The area of the district is 2.892 km. It is a small area, which represents 23% of the total area of neighborhoods in Al-Jihad neighborhood, which is equal to 12.55 km. This analysis shows that the schools are grouped within a relatively small area in al Jihad neighborhood. This area
represents the areas of high population density, vital areas and the commercial center of the neighborhood.

3.3.4 Spatial Analysis of Neighborhood Relationship pattern:
The GIS technique analyzes the neighborhood link pattern (Average Distance Neighbor Nearest), which is the distance between the geographical location of the school and the geographical location of the nearest school. The average distance between all schools is calculated. The calculated average is then divided by the expected mean of all distances between schools. If the calculated average distance is less than the expected average of random distribution, then the distribution is clustered. In the case where the calculated mean distance ratio is more than the average expected for random distribution, this means that the distribution of schools takes the form of Dispersed distribution. The Dispersed distribution form called a random distribution, The standard for determining the distribution pattern is the ratio between calculated distance between sites And the expected distance between them Which is called z value. These values are calculated by dividing the average distance calculated by the average expected distances of the same area. The average expected distance is calculated based on a presumed distribution of the same number of points on the same area. If the result is less than 1, this indicates to a cumulative distribution of the points representing the phenomenon studied. If the ratio is more than 1, the distribution is closer to the segment. There is a correlation between the Z value and the standard deviation from the mean. Where a large deviation from the mean indicates a non-random distribution of the points represented by the phenomenon. There are a set of basic variables that this method depends on to determine the distribution pattern:
1. The average distance of the points from each other.
2. Number of points representing the phenomenon
3. Area of the study area (which is one of the most important factors affecting the determination of the distribution pattern).

The spatial analysis of the neighborhood link is used in this paper to determine the distribution of private secondary schools in study area and the extent of dispersion. This analysis was applied to all 7 selected private secondary schools. The result of the analysis appeared in percentages ranging from 0.55 to 2.15. The representative patterns of the neighborhood link can be summarized as follows as shown in 'Figure 9':
1. Clustered mode: The neighborhood link is less than 0.67, reflecting the level (acceptable) in the performance of private secondary schools where schools are clustered in one location.
2. The random pattern: the value of the neighborhood link ranges between 1.01 - less than 2 and reflects the (good) level of service of the private secondary schools in these neighborhoods
3. Regular pattern: the value of the neighborhood link ranges from 2 to 2.15 as the result appears in 'Figure 9'.

Figure 8. Geographical distribution patterns
3.3.5 Proposals for spatial distribution and signature of private secondary schools in al Jihad neighborhood - Baghdad: After analyzing the spatial signature of the private secondary schools within the study area and diagnosing the negatives and positives of this signature, the researcher will try here to present future proposals for the spatial signature of the private secondary schools in the study area according to the planning standards for the educational services establishment. The land allocated for educational services in the Baghdad City Master Plan should be used to establish private schools. There must be a partnership between the government side, which provides land and expertise, and the private sector, which provides financial support. These schools must be under the direct supervision of the Ministry of Education.

After conducting the field survey by the researcher, the blocks were identified as valid for the construction of the schools, which was determined by using the GIS program. The sites proposed for the establishment of schools in the study area are accessible and in a place far from noise and most of these areas need schools and suffer from a shortage of schools.
3.3.6 Suggestions and recommendations In order to ensure the best spatial signature for private schools, the research presents the following -

Suggestions and recommendations:

1. Private schools should be subject to planning standards for the spatial signature of educational services within residential areas and not to allow the construction of any school that does not meet these criteria.
2. Include private schools within the basic plans of cities and detailed plans of residential areas and considered within the educational services.
3. Private schools currently located in the city of Baghdad in general and the study area in particular must be subject to a thorough study to determine their suitability as schools, and determine the extent to which they meet the planning and design standards of these services.
4. Choosing the lands allocated to the Ministry of Education for educational purposes to avoid changing in land use and turning homes into private schools.
5. Compelling private school owners who do not meet the planning and design criteria to find alternative sites that meet these criteria.
6. The Ministry of Education shall be invested in the field of private education to ensure the application of the planning standards.

References

[1] Ministry of Education, Directorate of Private and Foreign Education 2016, Instructions for school buildings.
[2] Kazem H J 1980 The Foundations and Planning Criteria for New Cities in Iraq at the Unit of Residential Neighborhood, Master Thesis (unpublished), Introduction to Urban Planning Center, University of Baghdad.
[3] Kazem, H J 1980, The Foundations and Planning Criteria for New Cities in Iraq at the Unit of Residential Neighborhood, Master Thesis (unpublished), Urban Planning Center, University of Baghdad, p 74
[4] Al Hitti M A R 2003 Geography of Services, Foundations and Concepts, Arab Society Library for Publishing and Distribution, p 104
[5] Iraqi Ministry of Housing 1982 Housing Standards and Housing Standards, Standards of Housing Scheme.
[6] Ghoneim O M 2010 Planning Standards, Philosophy and Types, and Methodology of Preparation and Application in Urban Planning, Dar Al-Safa Publishing and Distribution, Amman
[7] Ghoneim O M 2010 Planning Standards, Philosophy and Types, and Methodology of Preparation and Application in Urban Planning, Dar Al-Safa Publishing and Distribution, Amman, 75
[8] Al-Obeidi E H A 2005 Establishment of a spatial database for planning and evaluation of health and education services in the city of Muqdadiya, presented to the Faculty of Education, Diyala University, p 176
[9] Housing Standards Book 1982 Iraq Public Housing Scheme.
[10] Nasser, 1987, Foundations of Education, Dar Ammar Press, Amman, 172.
[11] Ministry of Education, Directorate of General Education, 2014.
[12] Image from Wikimapia maps site.