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Research Article:

The Effect of School Layout on students' sense of belonging

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Abstract

This paper explores the spatial school layout to enhance students' sense of belonging across mental, physical, social, economic and behavioral preferences. It identifies four key factors connected to the sense of belonging, including student traits, social interaction, school environment, and school support system.
The main role of school building gives the users movement, and this movement provides socialization, connection and amenities between students. The study employed a quantitative research design method; it is comparative study to analyze spatial connectivity from ten randomly chosen samples with different layout types in Erbil city high schools. Space syntax utilized visibility analysis maps by DepthmapX, emphasizes visibility, connectivity, and interaction between space components include entry, corridor, classroom, library, and social Space. A questionnaire survey was conducted among 303 students and included same grade level to ensure the reliability and validity of results. Used SPSS program by Spearman correlation, in which findings confirm statistically significant positive relationships between connectivity of school layout and students' sense of belonging. The study presents different school layouts addresses in change of belonging. This study contributes new insights into how school layout can be intentionally designed and supported to increase belonging. Its implications extend beyond Erbil, offering useful guidance to educators, designers, and policymakers aiming to develop school layouts that nurture the sense of belonging of all students.

1. Introduction

Belonging is multifaceted nature that is essential for students' integration and success, it is a key for student's engagement, self-confidence, mental health, well-being and academic achievement, it increases integration and success in educational building, and which has been less focus on role of physical space shaping the student experience [1], teacher's well-being in educational settings includes belonging, relational trust, and self-efficiency, all of which correlate positively with overall user satisfaction [2].
There are issues such as social isolations, loneliness and lack of community connection [3], Furthermore, students avoid returning to school buildings due to factors like (academic struggles, inadequate facilities, uncertainty about goals, external obligations, financial, poor institutional fit and isolation from school life), optimal school environments counter this by integrating essential elements of belonging to their schools [4], school buildings can create ease connection between students and teachers [5]. User Centered Design in school buildings focuses on the user demands, behaviors and preferences, in which includes students, faculty, staff… [6]. Student oriented design works to verify the school spaces place enough with student desires and preferences, as that have flexible study spaces, multi-use spaces,

shared environments cater studying and social interaction, to increase sense of belonging.

Combine directions and frameworks, that defined sense of belonging as "subjective feeling of deep connection with social groups, physical places and individual and collective experiences" means that sense of belonging is state that basic human needs that led to mental, physical, social, economic and behavioral preferences [5].

2. Literature Review

Sense of belonging lays a psychological foundation through which people feel connected, valued, and secure with social and physical environments. This connection affects how individuals connect to others and see their place in educational settings. sense of belonging is feeling that supported or hindered by people, things and experiences in social environments that connect to personal, experiences, culture, identity and perceptions. Students belonging is shaped by intersection of social, environmental, cultural and geographical [5]. Maslow stated belonging is basic human needs, belonging is essential as food, shelter, and physical safety for increasing health and psychological needs [7]. Spatial components such as circulation, social and learning spaces of the school building, and non-spatial components such as school management, quality of teaching and the students' level of deprivation influencing students belonging [8]. The spatial configuration of Japanese elementary schools measured by space syntax theory, the schools are classified according to the spatial connection properties such as integration, connectivity and intelligibility [9].

These studies provide empirical or theoretical support about how belonging contributes not only to the psychological needs of security and acceptance but also to the functional aspects of educational success, making it a core priority in educational design and community building. The gap of the study is focusing on isolated factors rather than holistic models with school layout, as this study attempts.

2.1. School Layout

Layouts of School enable students to develop physical and social environments easier on condition that spatial indications are understandable and intelligible to users. Spatial indications include boarders and inclusions among spaces that make it easier to achieve goals and informal activities, it is visual and physical connections among spaces or arrangements such as shape and openings, and the scale or size of the classroom or a whole school building together with spatial layout create simple and ease for students to figure out circle [10]. Therefore, understanding architectural spatial layout of schools is important for students and makes it easier for users to recognize spaces. Zoning of school layout is based on which classroom arrangement, it is grouped in linear or cluster, that categorize the school layout in fundamental zones including circulation, shared facilities and classrooms [11]. Layout can be open plan type, hall type, L-shaped type…, students create a mental cognitive plan of the school building to recognize the facilitate of school which is not by shape of the school but by the connection of spaces that classrooms link to the corridors, and then corridors to their halls, and as well as halls links to the staff rooms [9, 12]. The geometry shape of classroom in spatial layout impacts on psychology of users in space, the shape of space makes it more pleasant to arrange in balanced and central way [13]. Spatial openness of an atrium analyzed by viewing volume and area to differentiate among spatial openness in building to improve student activities [14]. Many studies examined physical environment influences on learning including natural light, artificial light, indoor environmental quality, ventilation, acoustic and temperature [15], and the design of classroom's environment increases student achievement [16]. Physical environments of classroom including (seating arrangements, acoustic quality, visual stimulation and classroom organization). There are three factors of spatial classroom analyzed on students' satisfaction, the factors include space and furniture perception, physical such as (sound, light and thermal) and decorative environment, related to display objects of view of lecture rooms [15]. This study examines key design factors within school layouts that shape students' daily experiences in multi-level hierarchical shows in Figure 1. These factors encompass spatial characteristics such as connectivity, overall form and openings, size and scale, location of the structure, and circulation patterns [9, 10, 11, 12, 13, 14] as well as functional considerations including accessibility [9, 11, 12, 14, 16] and environmental quality [15, 16]. The latter involves the presence of natural and artificial lighting, indoor environmental conditions, ventilation performance, acoustic comfort, and temperature regulation. Together, these elements in Figure 1 influence how students navigate, interact, and feel connected with the school building.

2.2. Factors of Sense of Belonging

The connection between school or classroom and social membership depends on teachers, peers and parents that promote from a positive interpersonal connection on care and support that lead to student's sense of belonging to whole community [17]. In addition, Maslow's hierarchy conceptualizes five categories of human needs, these needs are psychological needs, safety needs, love and belonging needs, esteem needs, and self-actualization needs [7]. This study proposes four factors influencing the sense of belonging, in Figure 2, typically arranged in a

pyramid from basic to complex including school support system, school environment, social interaction, and student traits. Lower-level deficiency needs must be largely met before higher-level growth needs, like student traits.

2.2.1. Student Traits

Belonging is state get it in daily life events. Individual traits include psychological needs [18], it is important for mental health and well-being, the characteristics of individual traits are personality, social skills and cognition [5]. Belonging is mainly conceived as the personal experience of engagement in a part of group or community, the psychological aspects as perceptions and feelings of being measured correspond with others [19], the perception and trust in students importantly connected to the feeling of belonging [3]. Furthermore, individual's innate needs where asked respondents' demographics such as age and gender [19]. Research consistently shows that students who have strong sense of belonging are more wanted to engage academically, persist through challenges, and experience positive mental health outcomes.

2.2.2. Social Interaction

Relationships with peers and teachers shape the emotional connections they form with their school. Social factors play a vital role in fostering a sense of belonging, especially as many individuals face social isolation and loneliness. Interaction with teachers and peers are key basics of students' sense of belonging to their achievement [3], Sociologically, belonging indicates membership in groups or systems [20], belonging is an element of social capital [21]. Social isolation and a threatened belonging indeed trigger to serve mental health like depression, grief, anxiety, suicidal ideation and attempts to weaken immune system, and heightened psychiatric risks, with loneliness, acting as core psychological symptoms. So, a strong sense of belonging is important for positive social and emotional growth, particularly in adolescence and emerging adulthood when identity forms through peer and institutional ties [22].

Strong social interactions promote sense of belonging that protects mental health and supports emotional development, particularly during adolescence and early adulthood.

2.2.3. School Environment

Belonging should be also determined from physical perspectives [20]. Academic engagement is described as relationship with academic staff and fellow students in the teaching and learning environment [21]. Moreover, belonging viewed as an element of place identity and linked to perception of "insideness" such as insideness of physical and social, that give engagement with and feelings towards surroundings and places, school environment included having a good or vibrant "atmosphere", being welcoming, comfortable, safe and with friendly and helpful teachers. Feeling comfortable or "at home" on school [19], Place as home, this can refer to concept of support, stability and security [23]. Thus, belonging is not only a social or psychological experience but also deeply intertwined with the physical environment, which together facilitates a supportive and inclusive school community.

2.2.4. School Support System

Social support not only nurtures familiarity, empathy, and encouragement but also helps students feel valued and accepted, that are key elements in developing a strong sense of belonging. It is an important key to getting community activity, social engagement including socializing with others, present in different social activities as school clubs, social support is the perception and reality that one is cared for to have supportive social network [21]. The positive association between chosen social support and the sense of belonging can be created by the truth enables familiarity, sympathy, encouragement and understanding of others. Ensuring students cared about, valued, have opportunities for a good social experience and are accepted as part of a community that has important role in achieving sense of belonging [19]. Furthermore, social support is notion of emotional and mental support from family, friends and significant others such as teachers, that increases positive managing between distance learning students and buffer against mental distress [24]. sense of belonging may mediate the correlation among perceived social support and academic persistence [25]. This will involve assessing the interplay of social support, school environments, social interactions and individual traits as they relate to students' sense of belonging within their school layout.

2.3. School Layout and Belongings

The main role of building is not to achieve the facilities, but it has to give the users movement, and this movement provides socialization and connection between users [26], spatial space configuration is important and effects in designing of layout [27], the design of layout pointed on shape of corridors includes double load, closed single load and open single load [28], vertical circulation as staircase in open single load enable visual connection before physically connected the floors together, the width of corridor makes potential to students to interact and socialize during movement from location to another location [29]. School is the main structure that students spend their time during personality formation, social space or school yard has positive impact on students learning and during breaktimes, which improves social skills, physical and mental health. So, social space gives opportunities to students to interact with real cases. Equipment for physical

activities and vegetation increases productivity of students in outdoor classrooms has impact on academic performances and interaction [30], atrium or open plaza creates amenities, social value and visual connection between floors [14].

This study aims to undertake a comparative examination of spatial connectivity of school layouts that improve students' sense of belonging. It seeks to systematically analyze how various elements including Learning space, entry, library, circulation and social space, in architectural features, communal areas, and visual design affect students' belonging, acceptance, and connectedness within their schools.

3. Methodology

From the factors of school layout design, we only measure spatial connectivity due to limited time. This study employed a quantitative research design to determine the aim of the research which is How much does school layout affect students' sense of belonging, by questionnaire survey and space syntax as instrument for data collection measured and tested. A statistical analysis was conducted on the numerical data to determine the results. The case study selected through random sampling in Figure 3 focuses on high schools in Erbil, the capital of the Kurdistan Region in northern Iraq. The study is comparative approach to analyzing spatial connectivity. We have seventy-two high schools, and ten secondary schools which are excluded from this study. Erbil city has a central urban layout, there are randomly ten schools with different layouts selected to capture diversity in connectivity. This ~14% of population (10/72) exceeds typical 10% purposive thresholds, minimizing sampling error to ±5% by stratified central city focus.

3.1. Space Syntax

Space syntax mathematically analyzes the spatial configurations in architectural and urban spaces which are presented in analysis of traditional settlement layouts, modern housing estates, traditional and modern houses, that method for modelling and analyzing spatial configurations connected to human activities [29]. See figure 15, visibility analysis map by Depthmapx, shows visual connectivity between spaces includes Entry (E), Corridor (Co), Classroom (Cl), Library (L), and Social Space (SS), the colors from the maps range from 3 colors, blue is low visibility comes from corners, hidden spaces and enclosed spaces, green and yellow is medium visibility, and red is high visibility comes from open halls, courtyards and corridors.

School A has one level, in figure 15, there is green school yard in front of entry building, corridor is double loaded, and there is closed garden at the core of building.

School B, in figure 16, has two linear blocks, classrooms are arranged into one linear block, closed double loaded, and two levels, the other block is linear and management and teacher rooms. And connected by corridor and open green area between two blocks. It doesn't have library space.

School C, in figure 17, has one level, consisting of two blocks, one is U-shaped open single corridor to social space, and the other block is linear, closed double loaded corridor, the classrooms have windows open to the corridor.

School D has two floors and complicated layout, in figure 18, there are 2 rectangle blocks of classrooms with open yard in center of each block, the corridor is open single load. Only one of the rectangle blocks is open for students, due to number of students. There are three horizontal linear blocks including teacher room, management and laboratory halls. And vertical linear block in layout is classrooms, store and library.

School E has two levels, in figure 19, there is an open plaza and has two staircases located in the entry and center of plaza, corridor is open single load, classrooms arranged into U-shaped corridors, and has large library located on first floor.

School F in figure 20, has large green yard from entry of building, it has two floors and classrooms are arranged into L-shaped to corridor open single load into social space and library.

School G has U-shaped layout, in figure 21, the corridor is closed double load, it has two floors, and the library is located on the ground floor near entry of building.

School H, in figure 22, is same as School G layout, only another linear block added, it is cafeteria and hall, there is green yard in front of entry of school.

School I, figure 23, has two floors, it has an open large social space, with corridor open single load and doesn't have library space.

School J has three levels, in figure 24, corridor is open on a single load, and it has green yard in the center of buildings.

3.2. Questionnaire Survey

A total of 303 students participated in the schools. One classroom in each school participated. A structured questionnaire measured students' sense of belonging, taking 7–10 minutes to complete, before students respond the questionnaire were briefed by researcher and if students did not understand any question, the researcher provided clarification. The questionnaire survey assessed students' sense of belonging through a five-point Likert scale. A Likert scale is a widely used psychometric measurement tool in quantitative research that helps researchers assess people's attitudes, perceptions, or levels of agreement with specific statements. It presents respondents with a set of declarative items and structured response categories (such as "strongly disagree" to "strongly agree"), which reflect increasing degrees of

endorsement. By assigning numerical values to these responses, a Likert scale enables researchers to quantify subjective views and analyze them statistically with greater consistency and depth. [31].
In table 1, presents brief description of all ten schools. The survey questions were organized around several sub-factors of student traits. The first sub-factor covers demographics (gender, age), academic level, socioeconomic status, and psychological attributes (see Figure 4). For example: "Do you have any job after school?" was included to assess the student's socioeconomic status. [24]. schools are single-gender (either girls-only or boys-only). All participants were 11th-grade students, because they are usually more familiar with their school environment. We also asked whether students plan to pursue higher education to explore their academic aspirations and how potential work commitments may affect their sense of belonging. Head teachers provided additional context and by indicating the city-quarter where their school is located, helping to measure the socioeconomic background at a neighborhood level [3]. Psychological factors were probed with questions such as "How would you rate your happiness during school?", "How pleased do you feel in the school environment?", and "How would you rate your overall stress levels?" [3, 5, 18, 19]. Social interaction was assessed via items like "How comfortable do you feel approaching your teachers with questions?", "Do teachers respect you in class?", "How supportive are your teachers?", as well as peer-relationship questions: "How comfortable are you sharing your thoughts with friends?", and "How often do your peers respect your opinions?" aiming to examine the quality of teacher-student and peer relationships, which support school belonging [3, 20, 22, 4]. To assess the school environment, we asked about safety, encouragement from peers, anti-bullying measures, general school climate, and about instructional practices and extracurricular opportunities: "How satisfied are you with teaching at your school?", "How often are you encouraged to take part in extracurricular activities?", "Are extracurricular activities accessible to all students?", and "Do these activities help you build friendships?" all factors related to students' sense of belonging. [19, 20, 21, 23]. The school support system was analyzed by questions like "How effectively does the school use your feedback to improve the environment?", "How often does the school provide student-support seminars?", "To what extent does the school respect diverse cultures?", "How well does it support cleanliness?", and "How well does the school help you plan your future path?" The questionnaire concluded with a direct item: "How often do you feel a sense of belonging in your school?" [19, 21, 25]. The survey aimed to offer an integrated view of the factors influencing students' sense of belonging. The sub-factors listed in Figure 3 together help determine the average students' sense of belonging in high schools. And then using SPSS, we compared the factors of students' sense of belonging.

4. Results

The key design features of high school layouts show in Table 2, exerts between the space components including entry, classroom, corridor, library and social space contains cafeteria, plaza, and private courtyard, finding out the outcome of the case studies, visual connectivity map analysis of schools (A, B, C, D, E, F, G, H, I, J), between school space components including Entry (E-Co, E-L, E-SS), Classroom (Cl-Co, Cl-SS, Cl-E, Cl-L), Corridor (Co-SS, Co-E, Co-Cl, Co-L), Library (L-Co, L-SS, L-E, L-Cl) and finally Social Space (SS-Co, SS-L, SS-E, SS-Cl). Table 3, it is Mean Value of visual graph analysis between space components in each school. Normality tests determine datasets follow normal distribution, and this test in table 5 for the questionnaire survey of belonging and table 6 for connectivity of school layout, indicates non-normality due to P-value<0.05. So, all the tests measured by non-parametric tests.
Table 7 is the average mean values of space components in each school measured by Kruskal Wallis test, which is statistical non-parametric test used to compare independent samples of different or equal sample sizes, (P<0.05) the result describes statistically significant difference in visual connectivity between the schools, School (H, J, G, I) have the highest value, in which describes, very open layouts, strong visual connections, better wayfinding and social interaction, School (C, D, E, F) moderate openness and interaction, and School (A, B) have lowest mean value, means more enclosed, less visibility, and weaker interaction. Standard deviation of school (G=896 and I=787) have very large value, clarifies visibility varies a lot inside those schools, some very open or closed, figure 25, is graph of mean value of visual connection between the 10 High schools.
Table 4 presents the reliability test (Cronbach's Alpha=0.869) the questionnaire is reliable, table 8 is Kruskal Wallis Test analysis indicated statistically significant differences between factors of belonging due to student traits, social interaction, school environment, and school support system (P-value<0.05). In figure 26 is chart size and trendline of Likert scale in Table 8 for the variables of sense of belonging factors in each of school. School (F=3.4444) demonstrated highest mean score in student traits, school F has L-shaped corridor layout with classrooms around hallways in an open single load, the library is located in central plaza, which is visually open to surrounding that improve interaction, encourage movement and increate comfort, the entry

is complemented green school yard in front of the building which increases students productivity.

School D has lowest mean score in student traits (D=2.2644), school environment (D=2.7217), and school support system (D=2.7094). Mean value of school environment in school (E=3.7619 and F=3.6769) have the highest score. School (H=3.4194) has lowest mean score in social interaction, it has U-shaped corridor, closed double load around private green courtyard, and lack of direct visual connections between plazas, the scale and location of social space affect opportunities for interaction and extracurricular activity to improve school support systems.

School E has highest mean score in social interaction (E=4.0909), school environment (E=3.7619), and school support system (4.0714), in which classrooms are arranged in a U-shaped around corridors, with staircases located in the entrance of the building and central plaza increase visual connectivity, social amenities and encourage movement, classrooms of School E has low density (22 students) reduces stress, in which have good cognition make the users feel comfortable.

Questionnaire and space syntax have different scale rates, to find the result we rescale space syntax metrics into Likert scales, in which rates between (1-5) by this equation formula [32].

$$x' = (x - \min) \times \frac{(\text{Likert Max} - \text{Likert Min})}{(\text{Data Max} - \text{Data Min})} + \text{Likert Min}$$

x is raw score

min, max: minimum and maximum possible raw scores

Likert Min, Likert Max: minimum and maximum values of the Likert scale (1 and 5)

The comparison between these two measurement tools, space syntax and questionnaire show in table 9, mean value of questionnaire are higher than space syntax, that describes students perceive more positively than the visual connectivity of school layout, analysis was conducted School (A, F, G and J) have significant difference between methods space syntax analyzed school layout and questionnaire analyzed belonging during ($P<0.05$), means school layout does not match sense of belonging. In contrast, School (B, C, D, E, H, and I), in which ($P>0.05$) have no significant difference between both methods. So, it is coherent in six schools, but differed in four schools, proposing that spatial connectivity in school layout design alone may not fully describe students' sense of belonging, and additionally the other factors of school layout design as functional or environmental factors may contribute to students' belonging.

In addition, the result of Spearman correlation between connectivity of space layout and students' belonging. Spearman correlation is measuring the strength and direction of relationships among two variables. We use stimulation method, increasing the sample to 1000, in table 10, and this is statistically possible. The study concludes, this relationship is statistically significant ($P<0.05$). So, there is an effect of school layout of spatial connectivity to students' sense of belonging. It indicates if connectivity of school layout increases also sense of belonging increases too. Figure 27, the scatter plot presents the relationship between connectivity of school layout and belonging at school level, with linear trend line equation $y=0.89+0.53x$ and $R2=0.42$, points out a simple linear regression analysis performed 42% of the variance in sense of belonging from connectivity of school layout.

5. Discussion

Physical school layouts significantly shape students' sense of belonging, when it planned to student centered design, as it is designed to around ownership and community interaction.

The presence and accessibility of libraries, and shared social spaces enhance both academic and extracurricular engagement to accomplish school support system. When space component allocation is adequate, these areas become good for interaction and collaboration. In the case study of ten schools shows Schools with U-shaped corridors and single-loaded, in which classrooms open onto adjacent social spaces maximizing spatial connectivity of school layout.

So, by focusing on visibility, social interactions, and amenities, that increases connectivity through spatial configuration. Rather than just circulation and control. Central courtyards or squares with connected corridors, providing better visibility than linear corridors, which reduces isolation, while confirming school support by designing into user centered space. Layout effects how easily meet friends and see themselves reflected in the environment. Ensure corridors are simple and legible with good natural light, to make students feel comfortable and at ease moving around. Centrally located and visually open social spaces from corridor, contribute to a cohesive sense of belonging among students.

A regional comparison illustrates how similar challenges have been identified across these schools in Erbil city, this might address local cultural factors influence the results. Because of central courtyards, traditional in Kurdish vernacular houses used for family gatherings create high integration potential.

6. Conclusion

This paper proposed theoretical framework between school layouts and sense of belonging to better understand spatial connectivity, by clearly addressing space components including entrances, classrooms,

corridors, libraries, and social spaces. This study concludes focusing on location of social spaces and shape of corridors having a big impact in school layout for students' cognition, students' interaction, visual connections, social amenities and encouraging movements.

Belonging encompasses mental, physical, social, economic and behavioral preferences. So, the study describes the four dimensions of belonging including students' traits, social interaction, school environment and school support system.

The results emphasize school support system has maximum value for increasing belonging in Erbil school layouts. School support system indicates a completing network of academic, social, and emotional to help students overcome challenges, to enhance students' sense of belonging.

It is important to note that only spatial connectivity of school layouts does not mean a complete list has effect on students' sense of belonging but are considered as an important conceptual starting point to acknowledge the spatial layout of school influence. In sum, the findings highlight spatial design of school space components play a pivotal role in improving students' sense of belonging that creates interaction, accessibility, movement and amenities in schools. Students' traits, social interaction, school environment and support system are factors directly influences sense of belonging in spatial design.

Recommendations

According to the findings of this study, strengthening in student centered design and major practical recommendations can guide schools in creating school layout design factors that increase students' sense of belonging. School planners and designers should prioritize spaces in school layouts such as green areas, libraries, plazas for physical education, that facilitate connectivity between spaces characterized by intuitive functional circulation, clear visual connections, and inviting communal areas. And attention should be given to environmental design quality including classrooms and shared spaces should optimize natural light, maintain effective ventilation, and ensure appropriate acoustic and thermal comfort. Moreover, accessibility must remain central to design considerations, ensuring that all students, regardless of ability, can navigate, participate, and feel a sense of belonging within the school environment. Collectively, these strategies can help cultivate learning spaces that are inclusive, responsive, and integrated into the diverse ways students experience and engage with their surroundings.

Future Studies

Future research should emphasize single-point data collection to focus design factors shape students' experiences over time. Longitudinal investigations could offer valuable insight into spatial configurations and influence students' evolving sense of belonging and community as they advance through different educational stages. Furthermore, cross-cultural and cross-climatic comparative studies may help clarify whether spatial features hold universal variables such as culture, pedagogy, psychology or environment. The integration of advanced digital technology methodologies such as virtual reality simulations, agent-based modeling, and real-time behavioral tracking could further deepen understanding of how students perceive, navigate, and react with classrooms. Together, these directions that authentically align with students inhabit, experience, and connect within their schools.

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تأثير تصميم مخطّط المدرسة على شعور الطلاب بالانتماء

المستخلص

يستكشف هذا البحث تخطيط الفضاء المدرسي بهدف تعزيز إحساس الطلاب بالانتماء على المستويات النفسية، الجسدية، الاجتماعية، الاقتصادية والسلوكية. ويحدد البحث أربعة عوامل رئيسية مرتبطة بإحساس الانتماء، وهي: سمات الطالب، التفاعل الاجتماعي، بيئة المدرسة، ونظام الدعم المدرسي. يلعب مخطط المدرسة دوراً رئيسيًا في حركة المستخدمين داخل المبنى، حيث تتيح هذه الحركة فرصًا للتواصل الاجتماعي، الترابط، والوصول للخدمات بين الطلاب. اتُبع في الدراسة منهج بحث كمي وصفي مقارن لتحليل التوصيلية المكانية عبر عشرة نماذج مختارة عشوائيًا من مدارس ثانوية ذات أنماط تخطيط مختلفة في مدينة أربيل. استخدمت الدراسة أدوات تحليل الفراغ (Space Syntax) من خلال خرائط تحليل الرؤية في برنامجDepthmapX ، التي تركز على رؤية، توصيلية، والتفاعل بين عناصر الفضاء المدرسي مثل: المدخل، الممر، الفصل الدراسي، المكتبة، والمساحة الاجتماعية. أُجري استبيان استقصائي على ٣٠٣ طلاب من نفس المستوى الدراسي لضمان موثوقية وصلاحية النتائج. وتم تحليل البيانات باستخدام برنامج SPSSمن خلال ارتباط سبيرمان (Spearman correlation)، حيث أكدت النتائج وجود علاقات إيجابية ذات دلالة إحصائية بين توصيلية مخطط المدرسة وإحساس الطلاب بالانتماء. وتُظهر الدراسة كيف أن اختلاف تخطيطات المدارس يؤثر في درجة إحساس الطلاب بالانتماء. تقدم هذه الدراسة رؤى جديدة حول كيفية تصميم مخططات المدارس ودعمها بشكل مقصود لتعزيز الانتماء. وتمتد دلالات النتائج إلى ما بعد مدينة أربيل، مقدمة إرشادات عملية للمربين والمصممين وصانعي السياسات الذين يسعون إلى تطوير تخطيطات مدرسية تدعم إحساس جميع الطلاب بالانتماء.

الكلمات المفتاحية:

الإحساس بالانتماء، استبيان، طلاب، مدينة أربيل، تخطيط المدرسة

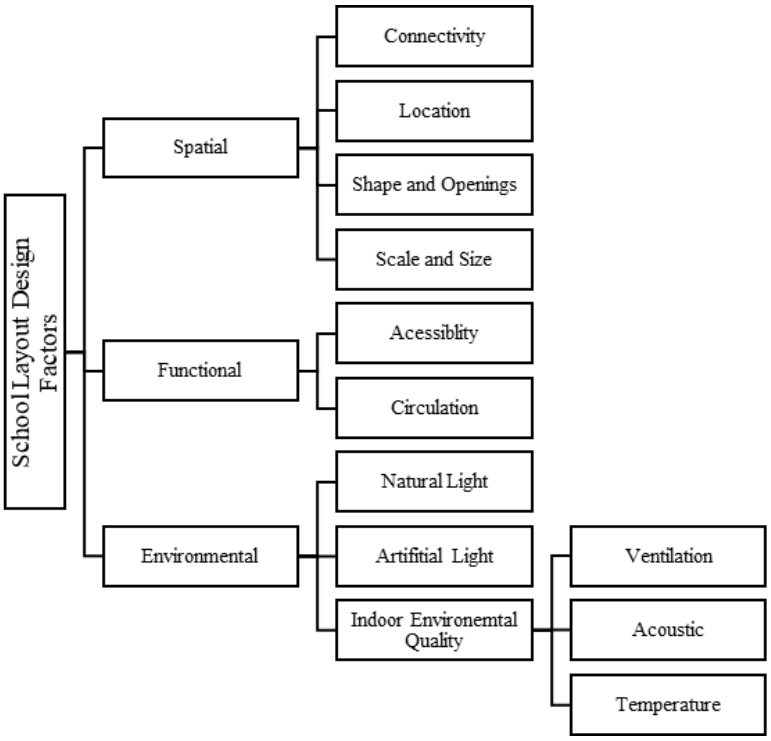


Figure 1. Diagram drawn by author, the design factors of school layout.

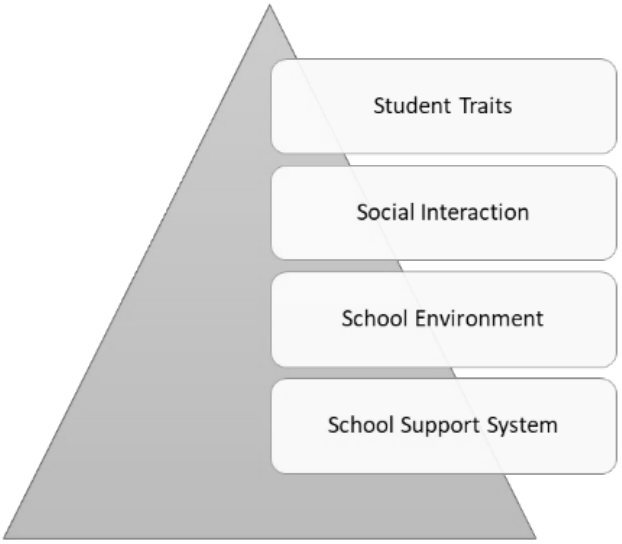
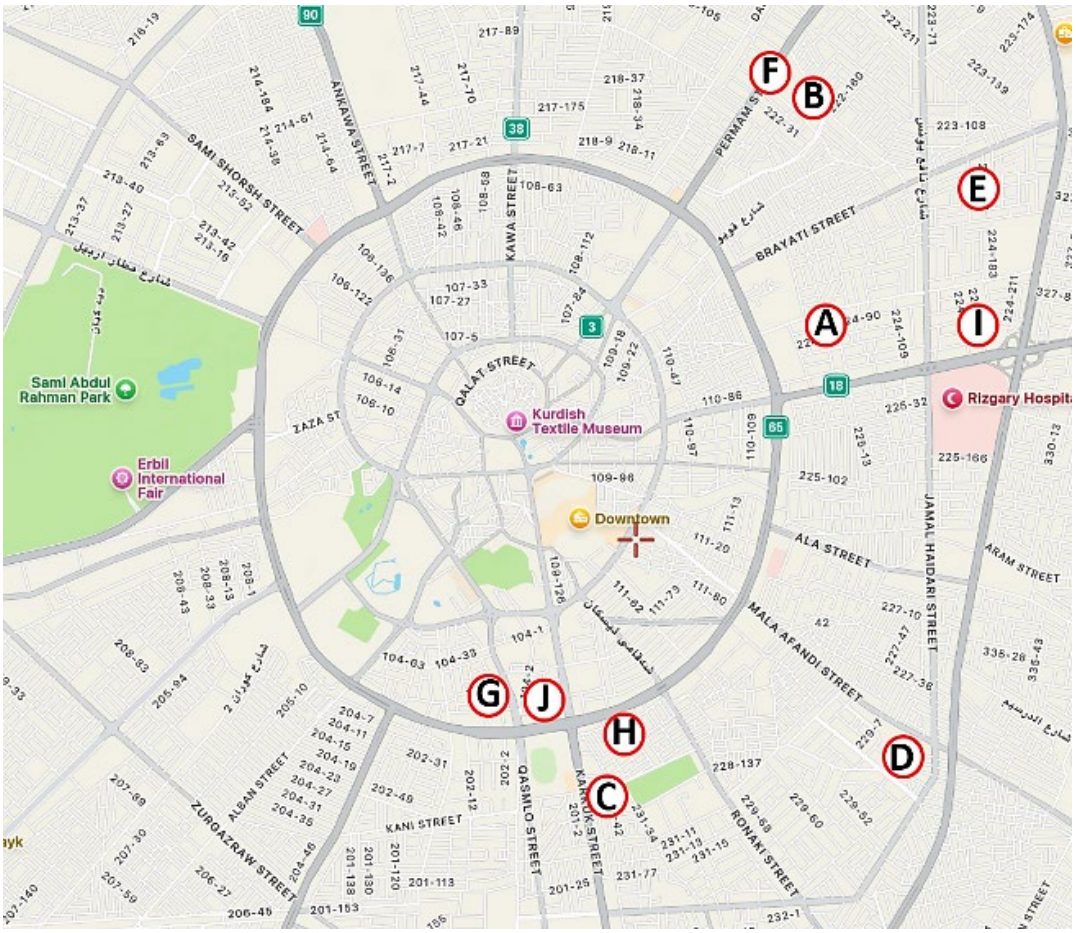


Figure 2. Diagram drawn by author, the factors of student's sense of belonging, typically arranged in a pyramid from basic to complex including school support system, school environment, social interaction, and student traits.



(A) Qala High School for girls in Brayati,
(B) Halmat High School for boys in Khanzad,
(C) Zahrah High School for girls in Azadi,
(D) Ikhwa High School for boys in Mufti,
(E) Chwarchra High School for girls in brayati,
(F) Shorsh High School for girls in Khanzad,
(G) Azadi High School for boys in Azadi,
(H) Shkodar High School in Ronaki,
(I) Kurdayati High School for boys in Brayati, and
(J) Hawler High School for girls in Azadi.

Figure 3. Location map of all schools in Erbil City.

Figure 4. Diagram drawn by author, the factors and subfactors of student's sense of belonging.

Figure 5. (A) Qala High School for Girls in Brayati

Figure 6. (B) Halmat High School for Boys in Khanzad

Figure 7. (C) Zahrah High School for Girls in Azadi

Figure 8. (D) Ikhwa High School for Boys in Mufti

Figure 9. (E) Chwarchra High School for Girls in brayati

Figure 10. (F) Shorsh High School for Girls in Khanzad

Figure 11. (G) Azadi High School for Boys in Azadi

Figure 12. (H) Shkodar High School in Ronaki

Figure 13. (I) Kurdayati High School for Boys in Brayati

Figure 14. (J) Hawler High School for Girls in Azadi

Table 1. Description includes location, plot area, number of floors, built, number of students, and schools are separated in gender of ten High schools in Erbil city.

Schools	Location	Plot Area	Number of floors	Built	Number of students	Boys/Girls
A 	Brayati	5970 m2	1	1983	350	Girls
B 	Khanzad	8645 m2	2	1984	232	Boys
C 	Azadi	7050 m2	1	1976	250	Girls
D 	Mufti	8200 m2	2	2002	210	Boys
E 	Brayati	5520 m2	2	1994	407	Girls
F 	Khanzad	3945 m2	2	1972	1111	Girls
G 	Azadi	6520 m2	2	1967	529	Boys
H 	Ronaki	5750 m2	2	2009	656	Boys and Girls
I 	Brayati	5600 m2	2	1998	421	Boys
J 	Azadi	6420 m2	3	1969	1170	Girls

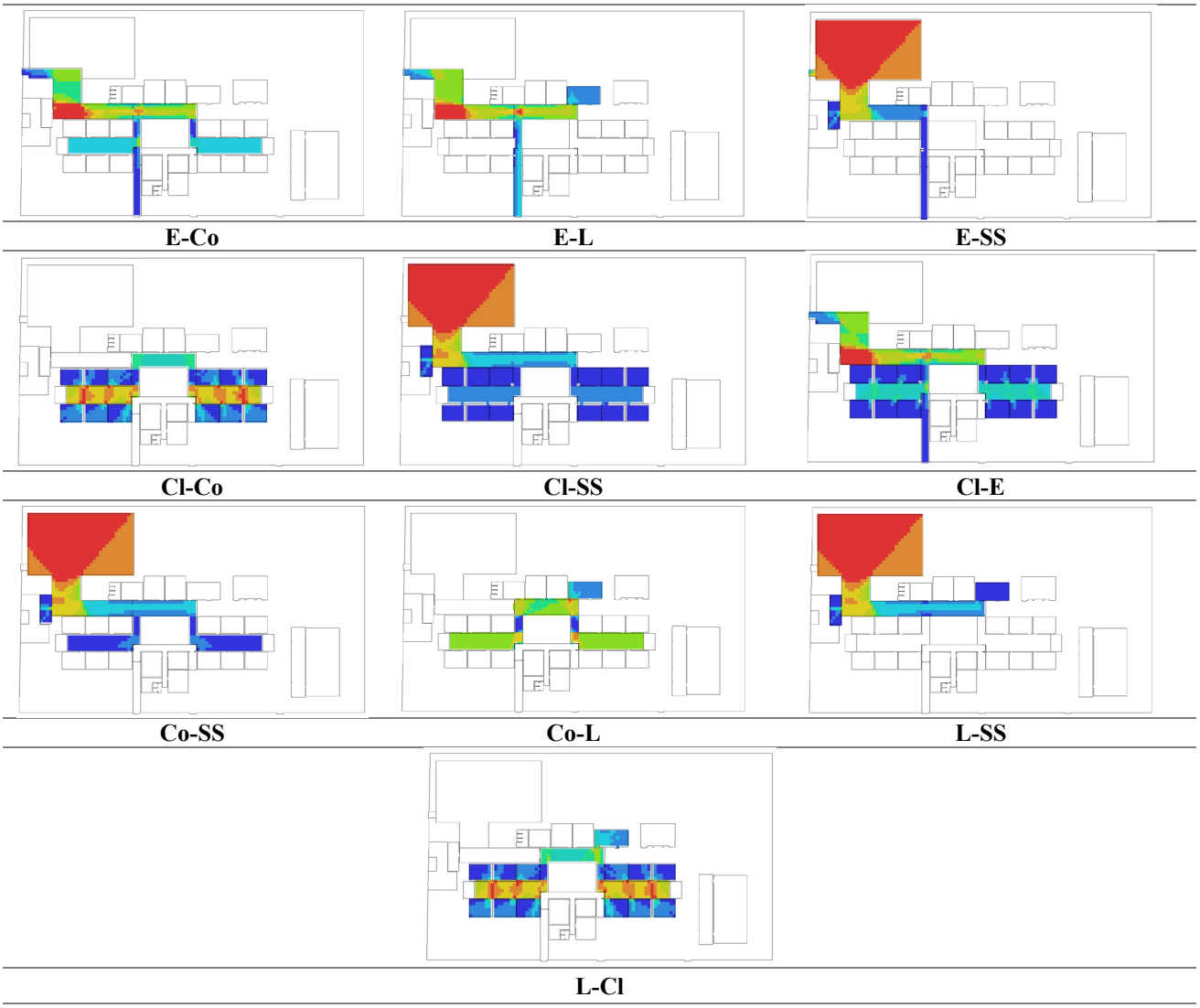


Figure 15. Visibility analysis map of school (A) Qala High School for Girls in Brayati

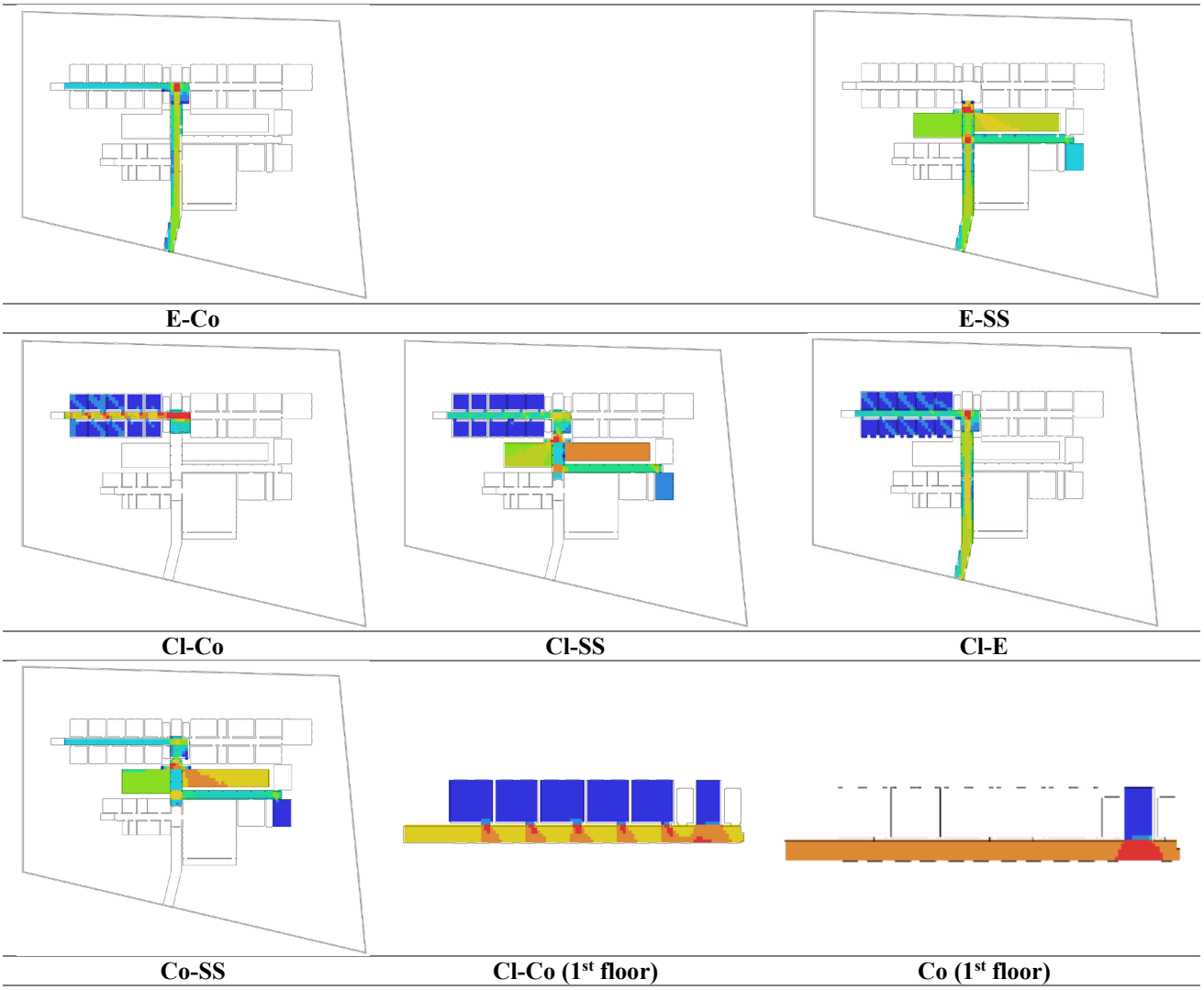


Figure 16. Visibility analysis map of school (B) Halmat High School for Boys in Khanzad

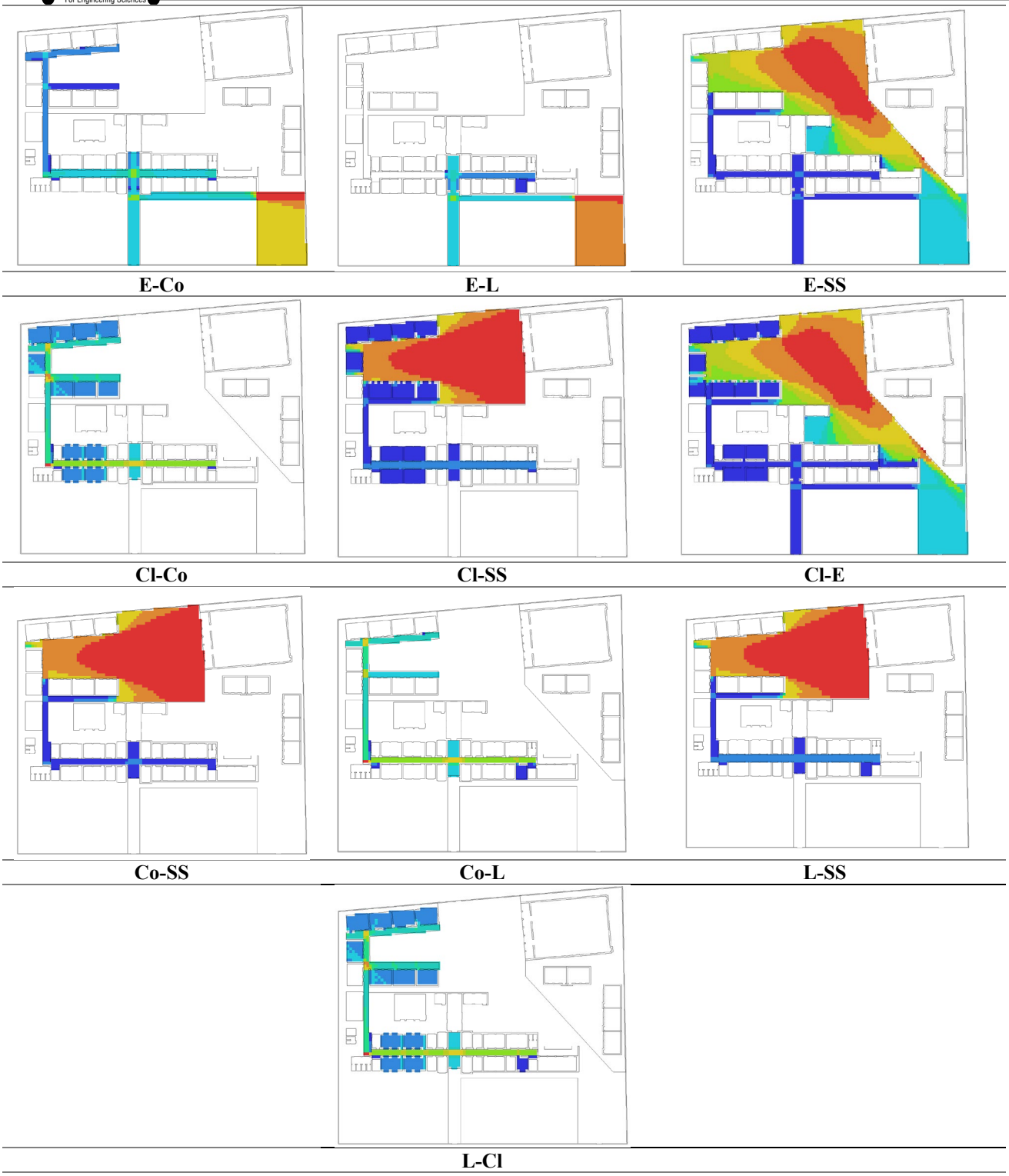


Figure 17. Visibility analysis map of school (C) Zahrah High School for Girls in Azadi

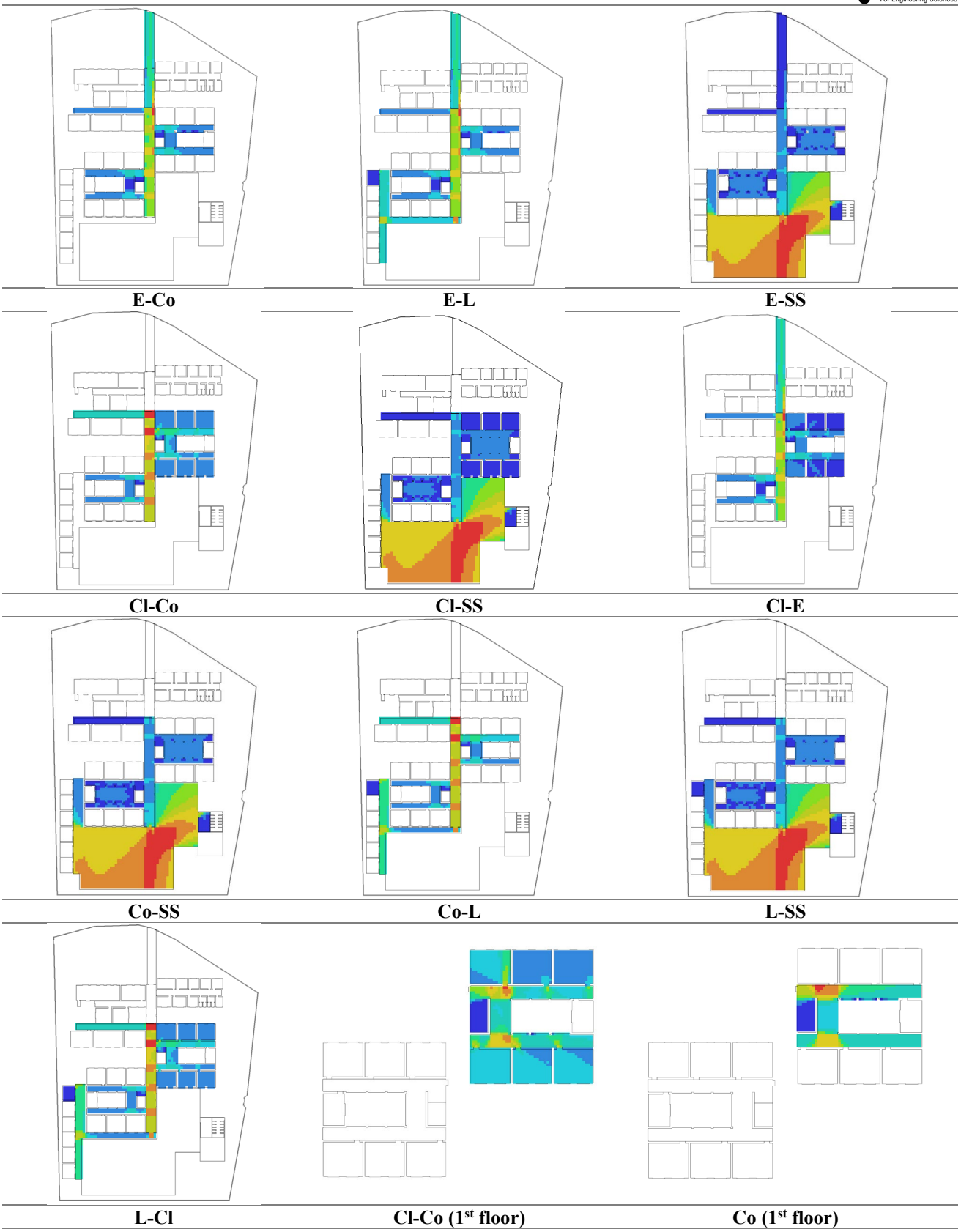


Figure 18. Visibility analysis map of school (D) Ikhwa High School for Boys in Mufti

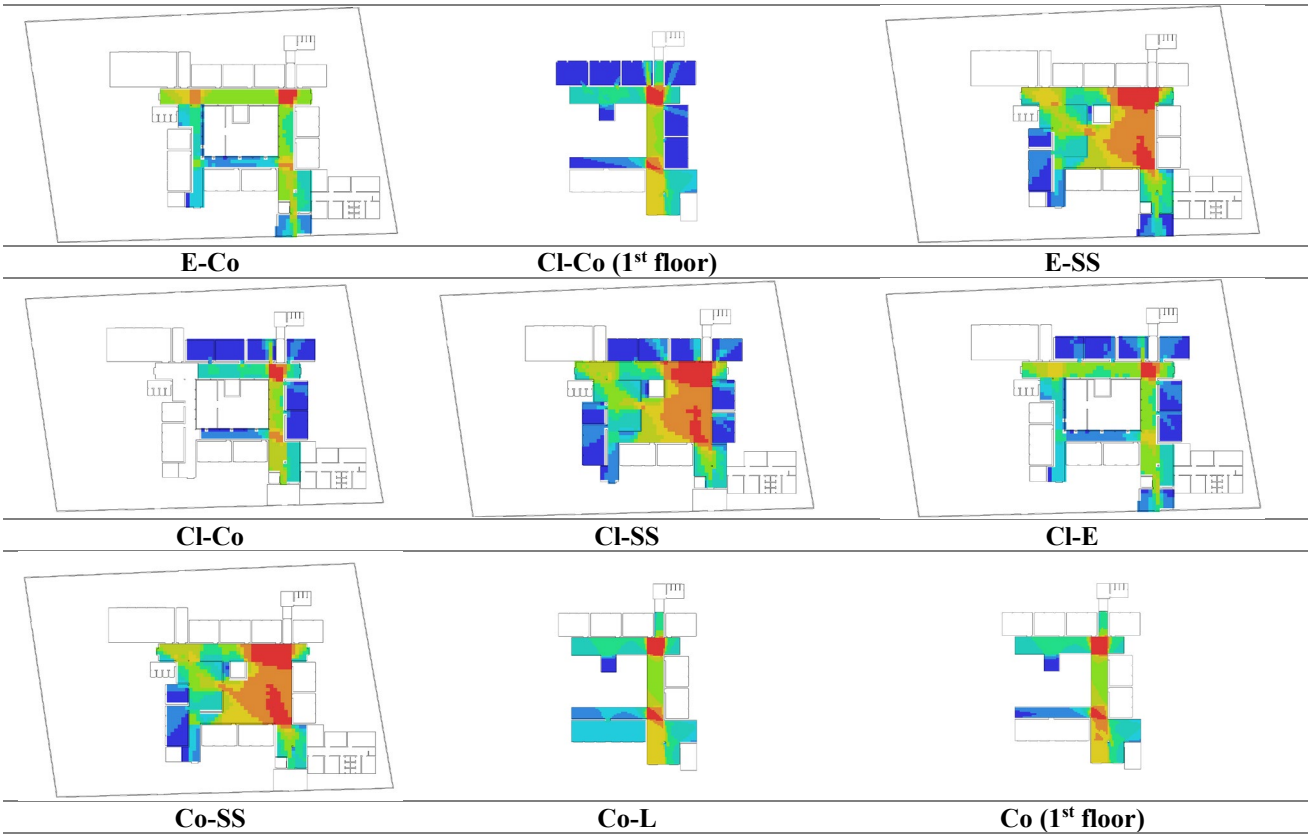


Figure 19. Visibility analysis map of school (E) Chwarchra High School for Girls in brayati

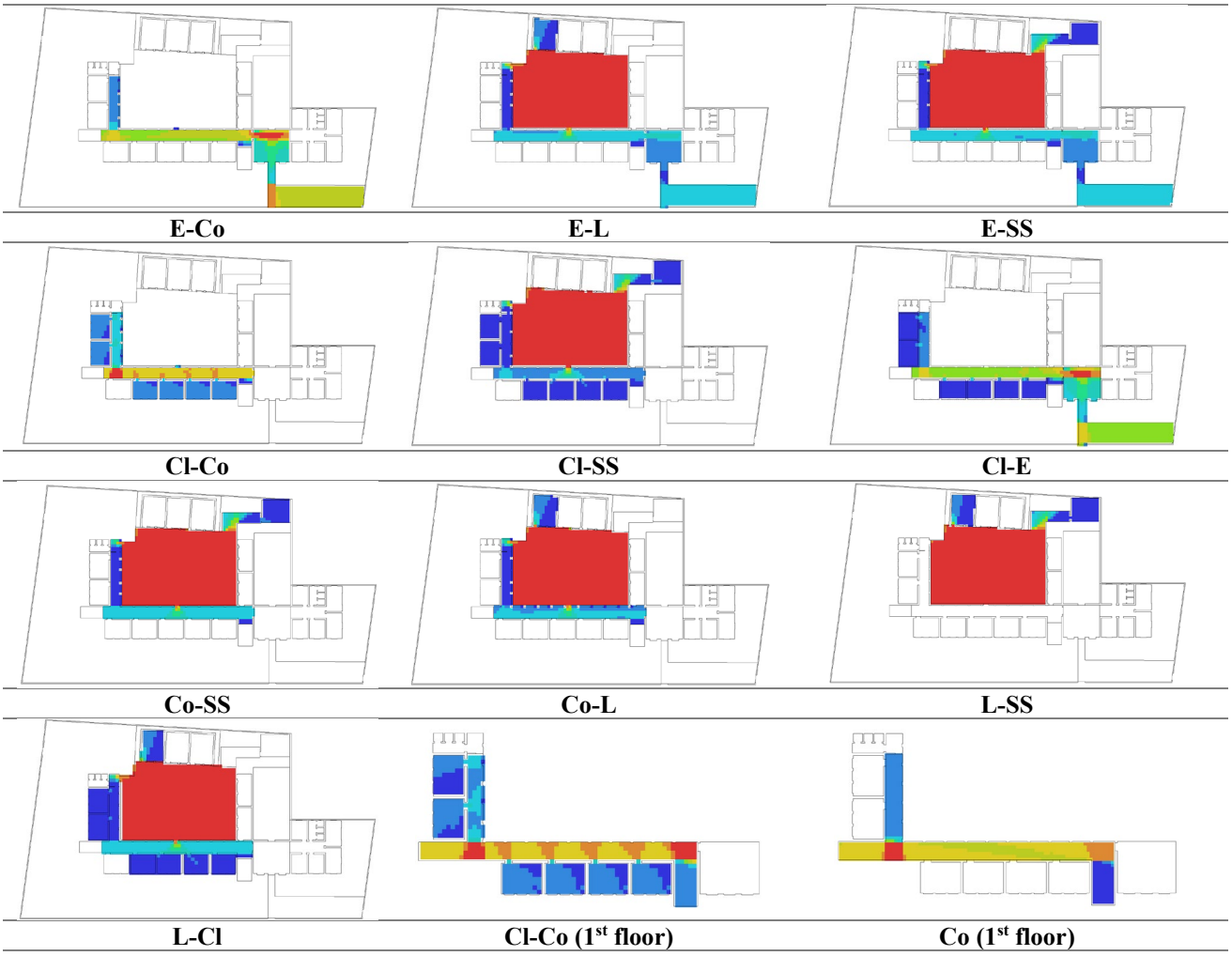


Figure 20. Visibility analysis map of school (F) Shorsh High School for Girls in Khanzad

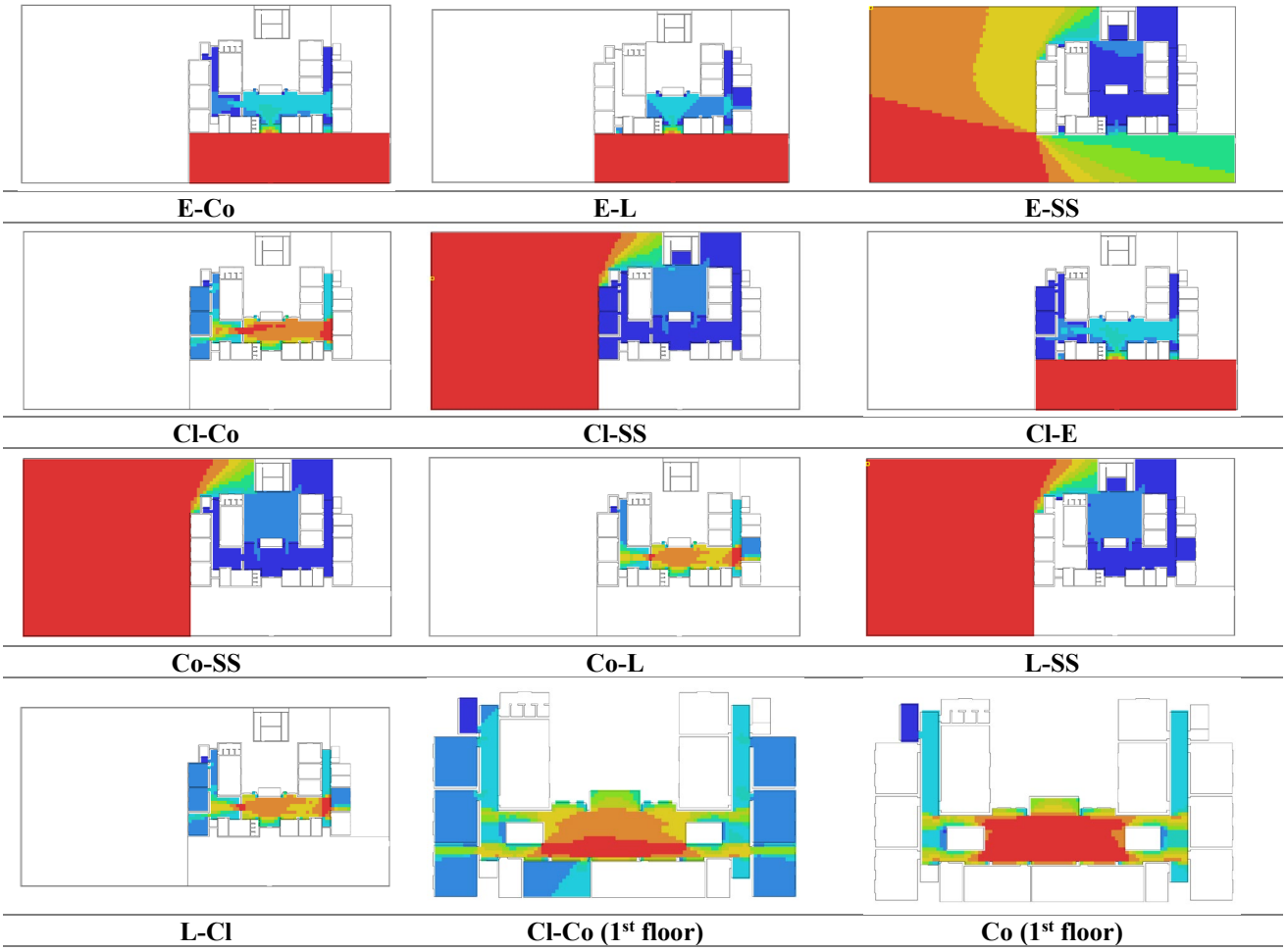


Figure 21. Visibility analysis map of school (G) Azadi High School for Boys in Azadi

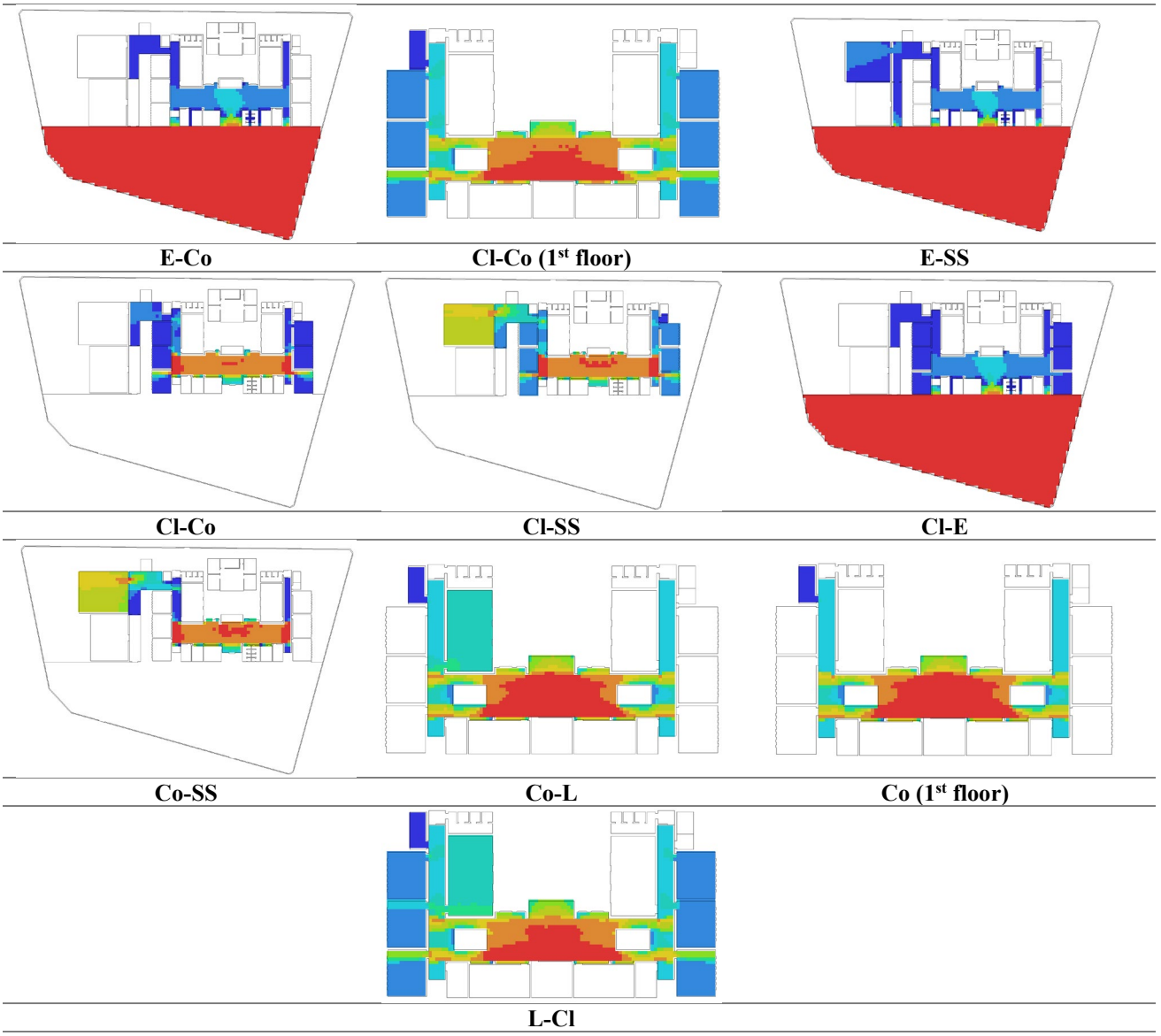


Figure 22. Visibility analysis map of school (H) Shkodar High School in Ronaki

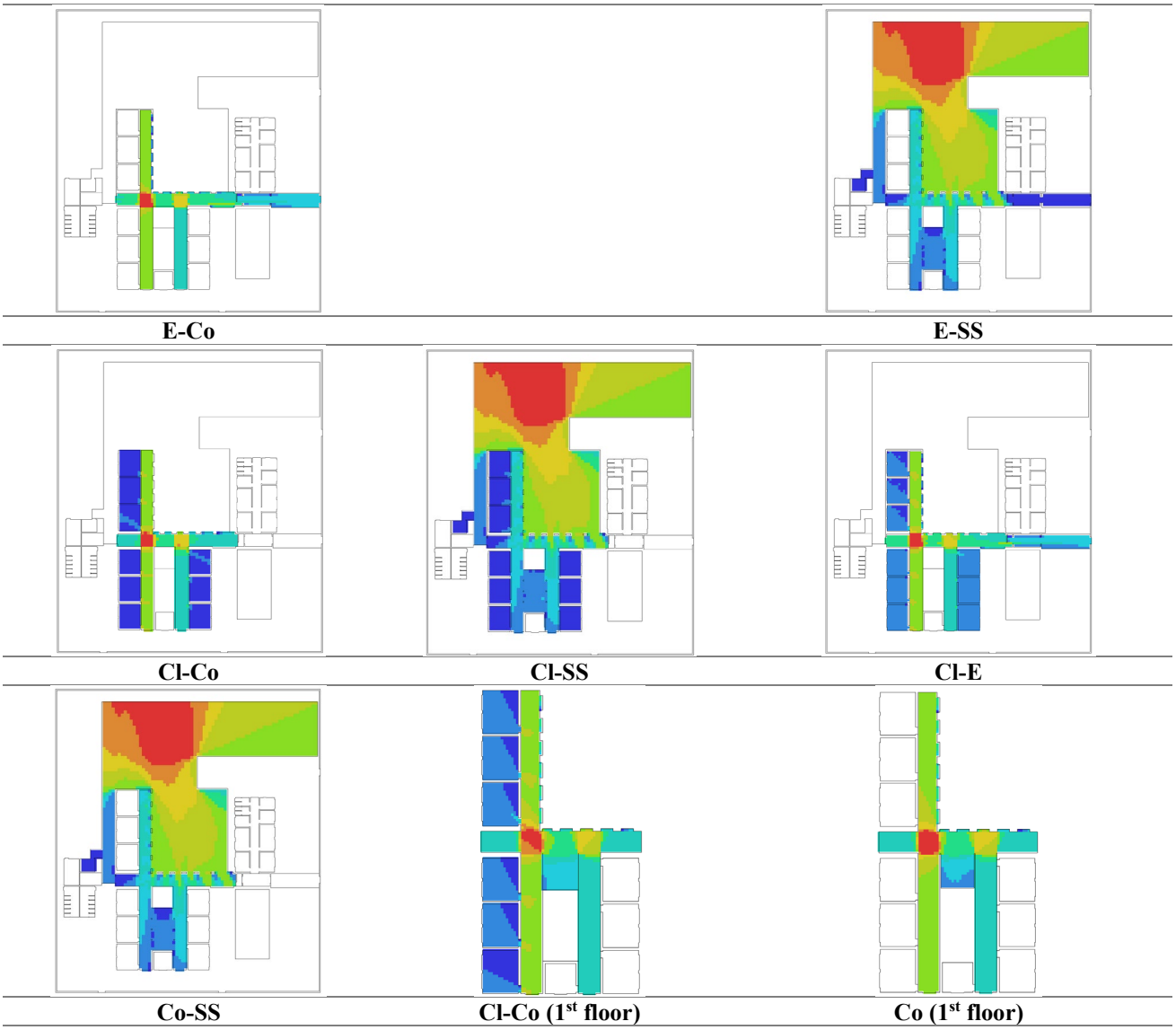


Figure 23. Visibility analysis map of school (I) Kurdayati High School for Boys in Brayati

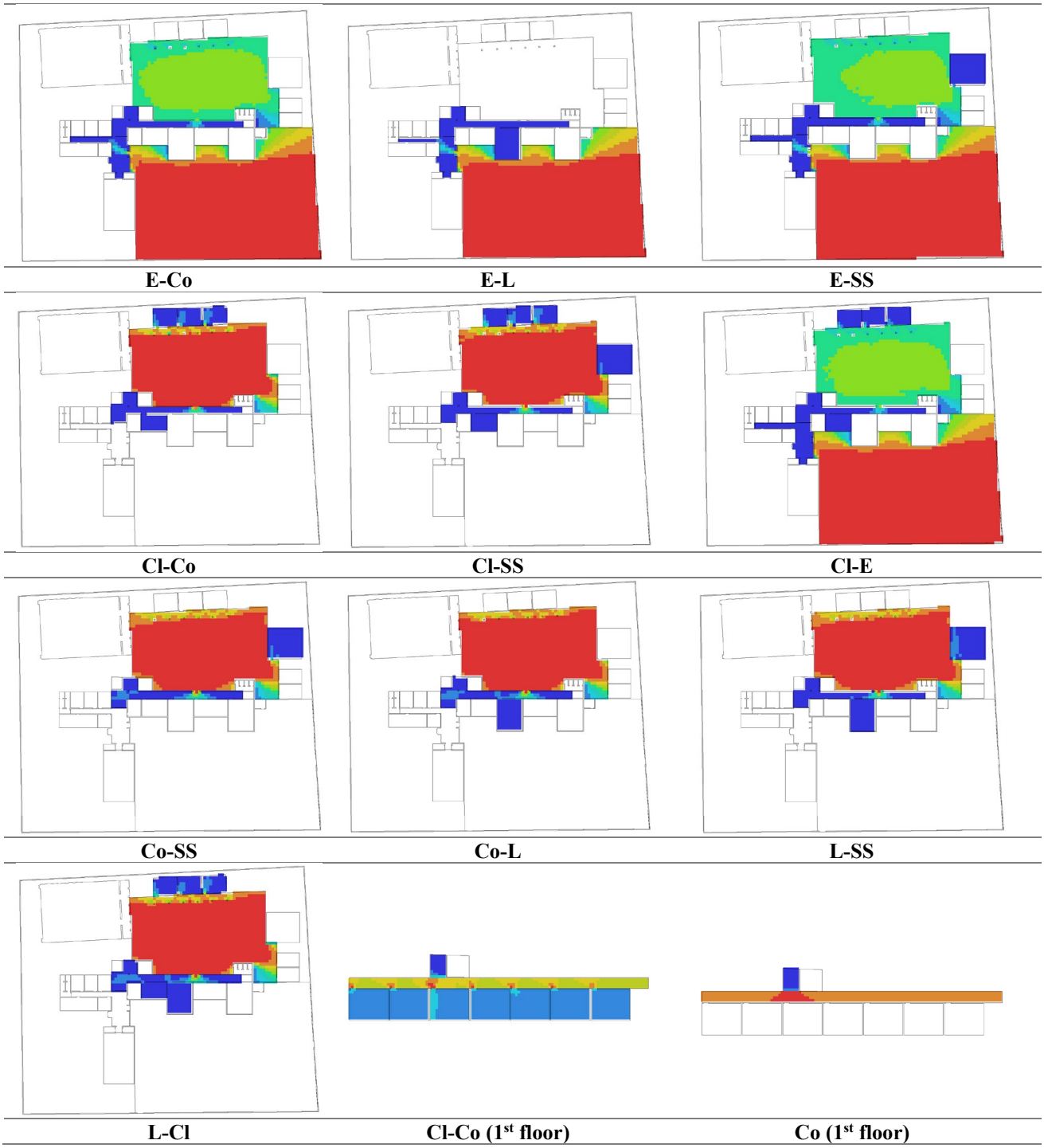


Figure 24. Visibility analysis map of school (J) Hawler High School for Girls in Azadi

Table 2. The key features of layout design are space components between the 10 High schools in Erbil city.

	Entry	Classroom Size m^2/ Students	Corridor	Library	Social Space
A	-Green school yard -Railings between entry and corridor	33 m^2 / 21	-Double loaded -Linear shaped divided into parts -Symmetrical	Available, inside of corridor	-Backside of School Building -Private courtyard -930 m^2
B	-Glass Partition between entry and corridor	33 m^2 / 25	-Double loaded -Linear shaped	Unavailable	-Frontside of School Building -380 m^2
C	-Green school yard -Railings between entry and corridor	34.2 m^2 / 25	-Half double loaded and half single loaded -Linear shaped and U-shaped	Available, inside of corridor	-Backside of School Building -930 m^2
D	-Green school yard -Glass Partition between entry and corridor	51.2 m^2 / 29	-Single loaded -Linear shaped -Symmetrical, two blocks	Available, inside of corridor	-Backside of School Building -Private courtyard -1320 m^2
E	-Open between entry and corridor	48.6 m^2 / 22	-Single loaded -U-shaped -Symmetrical	Accessible, inside of corridor	-Center of School Building -315 m^2
F	-Green school yard -Glass Partition between entry and corridor	33 m^2 / 51	-Single loaded -L-shaped	Accessible, inside of social space	-Center of School Building -625 m^2
G	-Glass Partition between entry and corridor	43.2 m^2 / 31	-Double loaded -U-shaped -Symmetrical	Available, inside of corridor	-Backside of School Building -245 m^2
H	-Green school yard -Open between entry and corridor	43.2 m^2 / 31	-Double loaded -U-shaped -Symmetrical	Available, inside of corridor	-Frontside of School Building -Private courtyard -1980 m^2
I	-Green school yard -Double Glass Partition between entry and corridor	38 m^2 / 29	-Single loaded -Linear shaped	Unavailable	-Center of School Building -Private courtyard -1765 m^2
J	-Glass Partition between entry and corridor	45.9 m^2 / 39	-Single loaded -Linear shaped	Accessible, inside of corridor	-Center of School Building -1000 m^2

Table 3. Mean Value of visual graph analysis between the 10 High schools between space components.

Layout Component		Mean Value of Connectivity (VGA)									
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Entry	**E-Co**	150.9	378.8	273.2	195.1	582.8	243.8	672.9	1169.1	574.5	876.3
	E-L	165		296.5	125.5	555.1	464	683.9	1151.7		1725.6
	E-SS	588.5	132.3	1131.3	802.5	309.6	466.7	2770.4	1102.4	2490.8	1689.6
	E-Cl	115.3	201.8	980.1	176.5	114.4	211.1	575.1	1021.9	314.7	741
Classroom	**Cl-Co**	87.9	187.5	67.2	181.1	447.8	191.9	279.3	277.9	629.4	483.8
	Cl-SS	393	208.1	827.2	486.4	190.5	375	1417.7	290	1251.7	737.6
	Cl-E	115.3	201.8	980.1	176.5	114.4	211.1	575.1	1021.9	314.7	741
	Cl-L	87.8		66.3	173.6	443.4	381.6	290.8	408.9		445.1
Corridor	**Co-SS**	520.6	376.8	1084.1	538.9	666.4	493.1	1529.4	377.1	1697.7	599.5
	Co-E	150.9	378.8	273.2	195.1	582.8	243.8	672.9	1169.1	574.5	876.3
	Co-Cl	87.9	187.5	67.2	181.1	447.8	191.9	279.3	277.9	629.4	483.8
	Co-L	103.5		86.2	190.3	561	304.4	355.6	355.7		604.1
Library	**L-Co**	103.5		86.2	190.3	561	304.4	355.6	355.7		604.1
	L-SS	585.8		1040.5	804.3	638.8	617.3	2530.7	1085		1707
	L-E	165		296.5	125.5	555.1	464	683.9	1151.7		1725.6
	L-Cl	87.8		66.3	173.6	443.4	381.6	290.8	408.9		445.1
Social Space	**SS-Co**	520.6	376.8	1084.1	195.1	666.4	493.1	1529.4	377.1	1697.7	599.5
	SS-L	585.8		1040.5	125.5	638.8	617.3	2530.7	1085		1707
	SS-E	588.5	132.3	1131.3	802.5	309.6	466.7	2770.4	1102.4	2490.8	1689.6
	SS-Cl	393	208.1	827.2	486.4	190.5	375	1417.7	290	1251.7	737.6

Table 4. Reliability Test for the questionnaire survey measured students' sense of belonging.

Reliability Statistics

Cronbach's Alpha	N of Items
.869	24

Table 5. Test of Normality for sense of belonging.

Tests of Normality							
Parameters	school	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Students' traits	A	0.157	21	0.191	0.955	21	0.415
	B	0.152	25	0.140	0.945	25	0.197
	C	0.256	25	0.000	0.883	25	0.008
	D	0.180	29	0.017	0.952	29	0.208
	E	0.170	22	0.096	0.902	22	0.032
	F	0.148	51	0.007	0.937	51	0.009
	G	0.176	31	0.015	0.929	31	0.041
	H	0.213	31	0.001	0.910	31	0.013
	I	0.190	29	0.009	0.942	29	0.112
	J	0.135	39	0.070	0.947	39	0.063
Social interaction	A	0.243	21	0.002	0.910	21	0.056
	B	0.181	25	0.034	0.923	25	0.060
	C	0.146	25	0.181	0.969	25	0.611
	D	0.162	29	0.050	0.955	29	0.249
	E	0.133	22	.200*	0.960	22	0.479
	F	0.116	51	0.084	0.969	51	0.199
	G	0.176	31	0.016	0.924	31	0.031
	H	0.166	31	0.029	0.949	31	0.147
	I	0.129	29	.200*	0.954	29	0.230
	J	0.159	39	0.014	0.927	39	0.015
School environment	A	0.115	21	.200*	0.965	21	0.617
	B	0.173	25	0.051	0.925	25	0.067
	C	0.168	25	0.067	0.965	25	0.521
	D	0.134	29	0.193	0.966	29	0.448
	E	0.089	22	.200*	0.981	22	0.935
	F	0.131	51	0.029	0.961	51	0.088
	G	0.115	31	.200*	0.949	31	0.150
	H	0.123	31	.200*	0.961	31	0.305
	I	0.104	29	.200*	0.974	29	0.663
	J	0.159	39	0.015	0.931	39	0.020
School support system	A	0.140	21	.200*	0.925	21	0.108
	B	0.126	25	.200*	0.973	25	0.720
	C	0.121	25	.200*	0.951	25	0.270
	D	0.109	29	.200*	0.958	29	0.292
	E	0.184	22	0.052	0.891	22	0.019
	F	0.164	51	0.002	0.915	51	0.001
	G	0.101	31	.200*	0.963	31	0.351
	H	0.103	31	.200*	0.975	31	0.673
	I	0.107	29	.200*	0.959	29	0.316
	J	0.216	39	0.000	0.866	39	0.000

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 6. Test of Normality for the connectivity of school layouts.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	school	Statistic	df	Sig.	Statistic	df	Sig.
Visual connectivity	A	.307	20	.000	.767	20	.000
	B	.321	12	.001	.784	12	.006
	C	.239	20	.004	.799	20	.001
	D	.345	20	.000	.758	20	.000
	E	.214	20	.017	.884	20	.021
	F	.146	20	.200*	.928	20	.142
	G	.283	20	.000	.812	20	.001
	H	.287	20	.000	.748	20	.000
	I	.250	12	.037	.869	12	.063
	J	.265	20	.001	.761	20	.000

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 7. Kruskal-Wallis Test results for visual connection between the High school layouts.

Test Statistics[a,b]

School	N	Mean	Std. Deviation	P-value
A	20	279.83	210.602	
B	12	247.55	99.517	
C	20	585.26	451.455	
D	20	367.42	261.985	
E	20	450.98	184.447	
F	20	374.89	134.406	.000**
G	20	1110.58	896.478	
H	20	723.97	395.491	
I	12	1159.80	787.105	
J	20	960.96	515.997	
Total	184	619.38	548.900	

a. Kruskal Wallis Test

b. Grouping Variable: school

** Significant <0.01

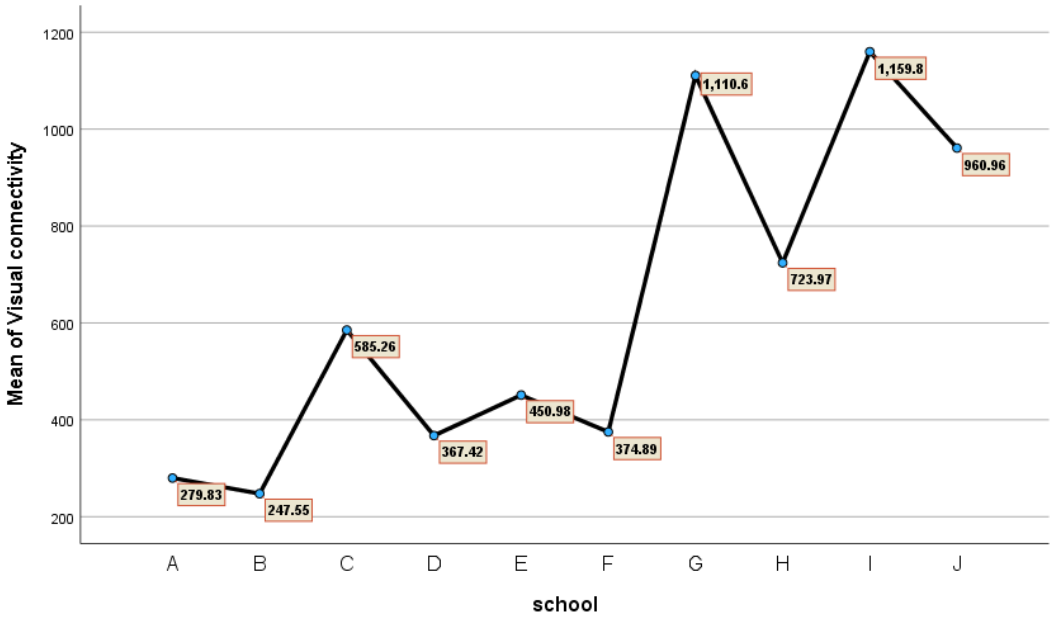


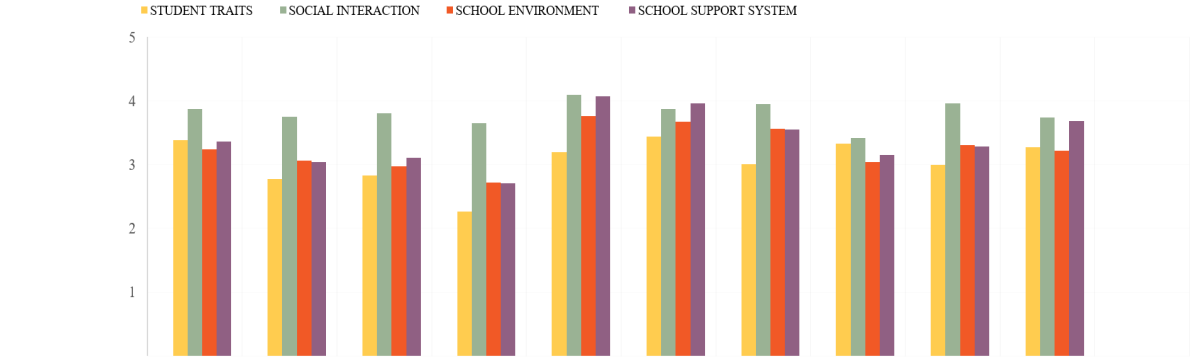
Figure 25. Mean value of visual connection between the 10 High schools.

Table 8. Kruskal-Wallis Test results for sense of belonging factors.

Test Statistics[a,b]					
		N	Mean	Std. Deviation	P-value
Students' traits	A	21	3.3810	0.62615	0.000**
	B	25	2.7733	0.62153	
	C	25	2.8267	0.39814	
	D	29	2.2644	0.80858	
	E	22	3.1970	0.67971	
	F	51	3.4444	0.57220	
	G	31	3.0108	0.78166	
	H	31	3.3280	0.63023	
	I	29	3.0000	0.51946	
	J	39	3.2735	0.52355	
	Total	303	3.0820	0.70344	
Social interaction	A	21	3.8762	0.39231	0.001**
	B	25	3.7520	0.76219	
	C	25	3.8080	0.56119	
	D	29	3.6552	0.53157	
	E	22	4.0909	0.49272	
	F	51	3.8784	0.54123	
	G	31	3.9468	0.58863	
	H	31	3.4194	0.61178	
	I	29	3.9586	0.55903	
	J	39	3.7436	0.53890	
	Total	303	3.8064	0.58290	

School environment	A	21	3.2449	0.73282	0.000**
	B	25	3.0629	0.73202	
	C	25	2.9771	0.76006	
	D	29	2.7217	0.71996	
	E	22	3.7619	0.63481	
	F	51	3.6769	0.58401	
	G	31	3.5676	0.76310	
	H	31	3.0438	0.67327	
	I	29	3.3054	0.61885	
	J	39	3.2161	0.68815	
	Total	303	3.2825	0.74459	
School support system	A	21	3.3605	0.71659	0.000**
	B	25	3.0457	0.72459	
	C	25	3.1086	0.72290	
	D	29	2.7094	0.81126	
	E	22	4.0714	0.65205	
	F	51	3.9580	0.63200	
	G	31	3.5484	0.89830	
	H	31	3.1567	0.83817	
	I	29	3.2906	0.68244	
	J	39	3.6813	0.75838	
	Total	303	3.4366	0.84059	

a. Kruskal Wallis Test
b. Grouping Variable: student
** Significant <0.01



	A	B	C	D	E	F	G	H	I	J	TRENDLINE
STUDENT TRAITS	3.3810	2.7733	2.8267	2.2644	3.1970	3.4440	3.0108	3.3280	3.0000	3.2735	
SOCIAL INTERACTION	3.8762	3.7520	3.8080	3.6552	4.0909	3.8784	3.9468	3.4194	3.9586	3.7436	
SCHOOL ENVIRONMENT	3.2449	3.0629	2.9771	2.7217	3.7619	3.6769	3.5676	3.0438	3.3054	3.2161	
SCHOOL SUPPORT SYSTEM	3.3605	3.0457	3.1086	2.7094	4.0714	3.9580	3.5484	3.1567	3.2906	3.6813	

Figure 26. The chart size and trendline of Likert scale in Table 4 for the variables of sense of belonging in each of schools.

Table 9. Kruskal-Wallis Test results for questionnaire measured sense of belonging and space syntax measured school layout between schools.

Test Statistics[a,b]				
School	Type	Mean	Std. Deviation	P-value
A	Space syntax	2.534	1.68340	0.020
	Questionnaire	3.4656	0.48740	0.026
B	Space syntax	2.8733	1.61372	0.431
	Questionnaire	3.1585	0.56685	0.563
C	Space syntax	2.55	1.36711	0.035
	Questionnaire	3.1801	0.42342	0.060
D	Space syntax	2.424	1.54489	0.191
	Questionnaire	2.8376	0.55557	0.263
E	Space syntax	3.442	1.33593	0.274
	Questionnaire	3.7803	0.49320	0.296
F	Space syntax	2.721	1.26448	0.003
	Questionnaire	3.6474	0.49436	0.005
G	Space syntax	2.336	1.44036	0.000
	Questionnaire	3.5184	0.64121	0.002
H	Space syntax	3.001	1.77536	0.495
	Questionnaire	3.2369	0.58172	0.571
I	Space syntax	2.5533	1.44598	0.007
	Questionnaire	3.3887	0.43156	0.073
J	Space syntax	2.643	1.59922	0.016
	Questionnaire	3.5505	0.40631	0.022
a. Kruskal Wallis Test b. Grouping Variable: school				

Table 10. Spearman's Correlation results between sense of belonging and visual connectivity of schools

Correlations

			Connectivity (Mean)	Belonging (Mean)
Spearman's rho	Connectivity (Mean)	Correlation Coefficient	1.000	.420**
		Sig. (2-tailed)	.	.000
		N	1000	1000
	Belonging (Mean)	Correlation Coefficient	.420**	1.000
		Sig. (2-tailed)	.000	.
		N	1000	1000

**. Correlation is significant at the 0.01 level (2-tailed).

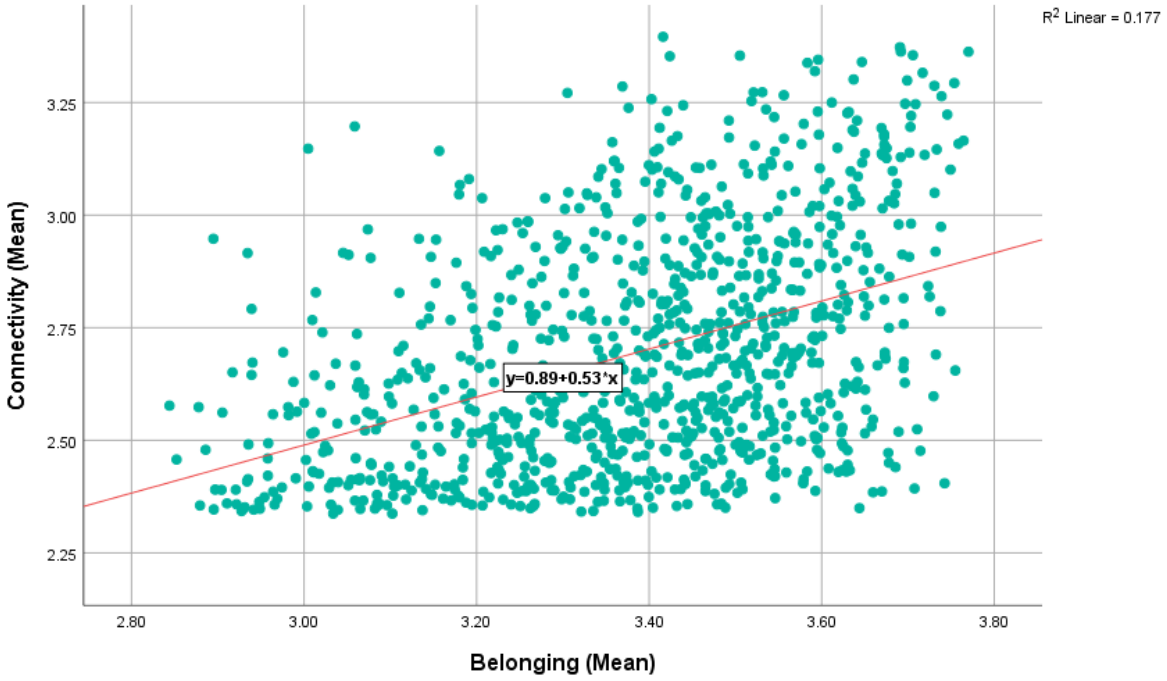


Figure 27. The scatter plot and trendline of correlations in Table 8 for sense of belonging and connectivity of school layout.

This Survey is Conducted as Partial Fulfillment of the Requirements for the Degree of Master of Science Engineering, Architectural Department in Salahaddin University-Erbil

Thank you very much for the students participating in this survey. Please select your feedback to help us strengthen significant improvements.

1. Do you have any job after school?

- *Yes*
- *No*

2. Do you plan to take higher education?

- *Yes*
- *Average*
- *No*

3. How would you rate your happiness during school?

- *Not Very happy*
- *Not happy*
- *Average*
- *happy*
- *Very happy*

4. How pleased do you feel in a school environment?

- *Not Very comfortable*

- *Not comfortable*
- *Average*
- *Comfortable*
- *Very comfortable*

5. **How would you rate your overall stress levels in school?**

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*

6. **How comfortable do you feel approaching your teachers with questions?**

- *Not Very comfortable*
- *Not comfortable*
- *Average*
- *Comfortable*
- *Very comfortable*

7. **Do you respect your teacher in the classroom?**

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*

8. **How supportive are your teachers in helping you during classroom?**

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*

9. **How comfortable are you sharing your thoughts and feelings with your friends?**

- *Not Very comfortable*
- *Not comfortable*
- *Average*
- *Comfortable*
- *Very comfortable*

10. **How often do your peers respect your opinions?**

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*

11. **How safe do you feel in your school environment?**

- *Not Very safe*
- *Not safe*
- *Average*
- *Safe*
- *Very safe*

12. **How often do you feel encouraged by your peers to do well in school?**

- *Never*

- *Rarely*
- *Sometimes*
- *Often*
- *Always*

13. How effectively does your school get rid of bullying and harmful behavior?

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*

14. How satisfied are you with teaching at your school?

- *Not Very satisfied*
- *Not satisfied*
- *Average*
- *Satisfied*
- *Very satisfied*

15. How often are you encouraged by your school to participate in extracurricular activities? S

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*

16. How accessible are extracurricular activities to all students at your school?

- *Not Very accessible*
- *Not accessible*
- *Average*
- *Accessible*
- *Very accessible*

17. How often do you feel that extracurricular activities help you build friendships?

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*

18. How effectively does the school use your feedback to make improvements in the school environment?

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*

19. How often does the school provide seminars for students to support student engagement?

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*

20. To what extent does your school respect diverse cultures?

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*

21. How well does your school support efforts to maintain cleanliness?

- *Not Very supportive*
- *Not Supportive*
- *Average*
- *Supportive*
- *Very supportive*

22. How well does the school support you in passing levels up in your school?

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*

23. How well does the school support you in planning your future path?

- *Never*
- *Rarely*
- *Sometimes*
- *Often*

24. How often do you feel a sense of belonging in your school?

- *Never*
- *Rarely*
- *Sometimes*
- *Often*
- *Always*