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HOW SPATIAL CONFIGURATION INFLUENCES PUPILS' INFORMAL SOCIAL ACTIVITIES: A SPACE SYNTAX ANALYSIS OF AN ELEMENTARY SCHOOL IN NIŠ

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Abstract

Social interaction is shaped by a dynamic interplay between individuals and their physical surroundings, with each continuously influencing the other. From early childhood onward, individuals engage in diverse social situations, and peer interactions within school environments play a critical role in their development. Therefore, schools are recognized as crucial settings for fostering socialization among pupils. This study examines how spatial configurations influence the frequency and nature of informal social activities among pupils, focusing on the case of the "Sveti Sava" Elementary School in Niš, Serbia. The research applies structured observations combined with Space Syntax techniques, particularly the Visibility Graph Analysis (VGA). It quantifies the correlation between spatial syntactic parameters, such as the Visual Mean Depth (VMD), and observed patterns of informal social activities among pupils during school free time. The results indicate that areas with low VMD values, signifying greater spatial integration, consistently exhibit more frequent and dynamic pupil interactions than do more isolated areas with high VMD values. This finding underscores the importance of spatial integration and visual accessibility in fostering informal socialization. These findings carry significant implications for the school architectural design, suggesting that integrated, visually accessible spaces are vital for promoting pupil interactions. The study concludes with practical design recommendations and calls for further research into spatial-syntactic factors in educational settings to reinforce and expand upon these findings.

Keywords:*Elementary school, Space Syntax, Spatial Configuration, Social Interactions*

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1. INTRODUCTION

The physical characteristics of a space significantly influence human relationships and social activities. Every physical environment inherently involves the presence of a social environment, just as every social environment implies certain physical spatial conditions [1]. Spatial configuration shapes the physical environment, thereby determining patterns of movement, interaction, and behavior. By measuring the syntactic parameters of spatial configuration, it becomes possible to identify the relationships between interconnected spaces and to understand their impact on the degree of social interaction among individuals.

In the school context, the built environment plays a critical role in shaping the pupils' perception, emotional states, and behavioral patterns. The physical layout of a school serves not merely as a shelter for curricular activities but actively mediates patterns of movement, encounters, and, ultimately, the social development of pupils. A growing body of research demonstrates that spatial configuration — specifically, the way classrooms, corridors, and open areas are interconnected — affects the frequency and locations of spontaneous meetings, conversations, and collaborations among pupils. However, for many elementary school typologies, particularly within South-East Europe, the magnitude and spatial distribution of these effects remain insufficiently quantified, highlighting the need for further research in this field.

To better understand the mechanisms through which the spatial organization affects the social behavior, it is essential to rely on theoretical models that quantify spatial relationships and visibility. Among these, the Space Syntax theory provides a systematic framework for describing how a built form shapes human interaction patterns [2], [3], [4]. The Space Syntax theory views buildings as networks of connectivity and visibility, where metrics like the Visual Mean Depth (VMD) capture the number of directional changes needed to reach a location while staying in visual contact. Against this backdrop, the present study quantifies the relationship between VMD and the frequency of informal pupil interactions. Specifically, this paper asks the question: How do variations in VMD across the "Sveti Sava" floor plan predict the frequency and clustering of informal social activities among pupils during free time? To answer this question, there are two procedures: 1. Compute a VMD map of the school using Visibility Graph Analysis (VGA) in DepthmapX 0.8 [5]; and 2. Conduct systematic snapshot observations of pupil activities, map the resulting interaction points. This study hypothesise that zones in the lowest-depth quartile will host significantly more, and more diverse, informal social activities than zones in the highest-depth quartile. By providing effect sizes for a specific Serbian elementary-school layout, the study offers actionable guidance for architects aiming to retrofit existing buildings or design new ones that actively promote pupil socialisation.

2. OVERVIEW OF RELEVANT LITERATURE

Schools serve not only as places of academic learning but also as vital social environments that significantly shape the pupils' development and sense of

community. Research consistently highlights the importance of school environments in facilitating pupil socialization [6], [7], [8], [9], [10]. Social interactions within schools allow students to build interpersonal relationships and exchange knowledge, directly influencing their cognitive growth and emotional well-being [11], [12], [13], [14], [15], [16], [17]. Anderson and Graham [18]emphasize that beyond academic instruction, schools play a critical role in the cultivation of essential social skills necessary for the pupils' holistic development. These interactions, especially during informal periods such as breaks between classes, are crucial in fostering a sense of belonging and a positive social climate among pupils.

The design of school buildings significantly impacts movement patterns and the frequency of student interactions. Numerous studies have shown that the spatial configuration of educational environments shapes how pupils navigate spaces, engage with each other, and perceive the school climate [2], [4], [9], [19], [20]. Open and well-integrated layouts have been found to encourage more spontaneous and frequent social encounters, especially in transitional and gathering areas such as hallways and central open zones [9], [14], [19]. For example, Peponis et al. [4] demonstrated that specific spatial configurations can either encourage or inhibit movement and interaction within buildings, including schools. Pasalar [21] similarly found that clustered classroom arrangements resulted in more peer interaction, highlighting the direct influence of architectural planning on social behavior.

To quantitatively assess how spatial configurations influence social interactions, researchers have turned to Space Syntax theory, originally developed by Hillier and Hanson [2] and later expanded by Hillier[3]. The core premise of this theory is that spatial arrangements create a "field of possibilities" that shape patterns of movement and co-presence within built environments. In the context of schools, this is especially pertinent, as spatial accessibility and visibility directly impact on how and where pupils interact.

Among various analytical tools within the Space Syntax, the VGA is particularly well-suited for studying face-to-face social interactions in interior environments. VGA evaluates the intervisibility between points in space, and among its derived metrics, the VMD stands out as a reliable indicator of how visually connected a space is to all others [14]. VMD calculates the average number of visual steps (or turns) needed to reach a specific location from all other points within the building. Lower VMD values correspond to greater visual integration, making such spaces more conducive to spontaneous social encounters. Importantly, because it is a normalized global measure, VMD allows for the consistent comparison between different school layouts, adding the methodological strength to cross-case analysis [3], [11], [14].

Additionally, Fouad and Sailer [11], [13], [14] observed that spaces offering greater visibility and accessibility significantly support the formation of social bonds, and such designs can positively affect the pupil behavior and interaction frequency. In their study of secondary schools in the UK, they emphasized the importance of visibility-based spatial metrics, particularly the VMD, in assessing how easily students can visually connect with different areas of the school environment. Their findings show that lower VMD values — indicating fewer visual turns needed to reach one space from another — are strongly correlated with areas of higher social

interaction, particularly during breaks and informal circulation. These results confirm that visual openness and perceived accessibility are key spatial attributes that facilitate the social engagement within educational settings [14].

A ten-school study in Cyprus demonstrated that VMD [22], [23], [24], along with the integration and porosity, could predict the areas where pupils tended to congregate during breaks and how they perceived their school environment. This study effectively combined the quantitative spatial metrics with the behavioral observation, offering a robust methodological model for examining the links between the spatial design and social outcomes.

Given this strong theoretical and empirical foundation, the present study adopts VMD as the primary Space Syntax metric to examine how the spatial configuration at “Sveti Sava” elementary school in Niš shapes pupil social activities. By identifying which spatial elements promote or hinder visual accessibility and connectivity, this research aims to contribute to the design of future school environments that better support social engagement and overall student well-being.

3. CASE STUDY

This study is conducted at the "Sveti Sava" elementary school in Niš, which was selected as it represents a characteristic architectural spatial type and a representative example of a school building in urban areas of Serbia. The "Sveti Sava" elementary school, built in 1980, is one of the first experimental-type schools, developed through collaboration between architects and a team of educators and psychologists [25]. Its spatial organization (Figure 1) abandoned the traditional concept of a classical school, particularly in terms of grouping teaching spaces, while for other functions, the corridor-based principle was mostly retained. The functional layout of the school consists of two identically designed pavilion groupings of classrooms. The ground floor serves junior pupils, while the upper floor is adapted for specialized subject teaching for senior pupils. Table 1 presents the general and basic relevant data about the size and capacity of the Sveti Sava Elementary School building used in this paper.

(a) (b) (c)

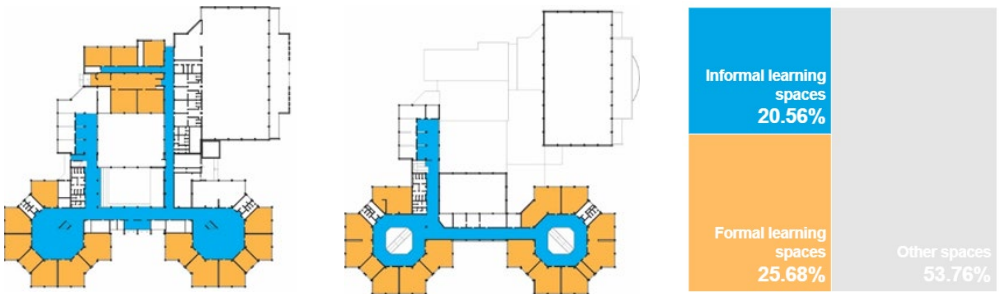
Figure 1. "Sveti Sava" Elementary School –
a) *areal photo of the building b) ground floor plan, c) first floor plan*

Table 1. Data About the capacity of the "Sveti Sava" Elementary School

Average annual number of pupils in the school	1000
Number of school shifts	2
Average number of junior groups (I–IV)	20
Average number of senior groups (V–VIII)	20
Average number of classes per shift per day	6
Number of breaks between classes per shift per day	5
Duration of break in minutes	(4x) 5 and (1x) 20

The analysis is limited exclusively to the building level, and the school's outdoor area —the schoolyard — is not considered in this study. The decision to exclude the schoolyard from the analysis was made in order to focus exclusively on the architectural composition and spatial configuration of the building itself, as the core subject of this study. The scope of the research at the building level is restricted solely to spaces intended for pupil use. Areas designated exclusively for teachers and staff, such as offices, staff rooms, preparation rooms, etc., are excluded from the analysis. Additionally, tertiary spatial elements such as restrooms and technical rooms are also beyond the scope of this study.

The focus of the analysis in this paper is limited only to formal and informal learning spaces (Figure 2). Formal learning spaces, in the context of this research, include classrooms for general and subject-specific teaching. These are physical environments clearly structured for the delivery of planned educational content under the guidance of teachers. Their organization is typically static and hierarchical — with clearly defined boundaries between students and teachers, as well as between different educational subjects [26]. Informal learning spaces include corridors, lobbies, libraries, cafeterias, transitional spaces, areas under staircases, and all those zones not formally designated for instruction but which allow for spontaneous learning and social interaction [21], [27].



(a) (b) (c)

Figure 2. The Scope of the Research at the Building Level – a) ground floor plan, b) first floor plan, c) percentual distribution

4. METHODOLOGY

This research combines two quantitative methods: structured spatial observations and spatial configuration analysis using Space Syntax techniques. The combination of these methods provides insight into pupil interactions, a deeper understanding of social meanings, and the recognition of behavior patterns stimulated by the potential of the school's built environment.

Spatial analyses were conducted using the DepthmapX 0.8 software, which allows for a precise quantitative assessment of various syntactic parameters[5]. The research included a VGA (0.40 x 0.40 m grid), which involved calculating the syntactic value of VMD. Areas with greater visibility are often used for informal encounters and interactions among pupils. Spaces with high VMD values were identified as key for encouraging pupil movement and interaction, supporting the conclusions of previous studies on the importance of spatial configuration effects in school environments [2], [4].

Mapping (snapshots) was conducted through systematic field observations of pupil movement and their social interactions, focusing on standardized times during breaks and specific areas. Data were collected on the locations and frequency of activities and interactions, as well as the nature of these interactions (Figure 3). This approach provided information on movement patterns and the concentration of activities during pupils' free time. Field observation involved systematically recording pupil activities at different time intervals during breaks, following a structured and standardized approach using the "Space Syntax – Observation Manual" [28]. Systematic snapshot observations were conducted on 10 consecutive school days (Monday – Friday, two weeks, on spring of 2019) during breaks each day (5-min “short” and 20-min “long” break), before and after classes. The recording was carried out by trained students conducting their own research under the direct supervision. Written consent was obtained from the school administration and teachers, all records were anonymised; no individual faces were photographed or filmed. This limitation suggests that seasonal variations in pupil activities were not captured, which could influence the generalizability of results.

The study focused on analyzing pupils' informal activities through field observation and mapping of their activities, aiming to determine how the architectural design of school buildings affects school life. Activities were mapped during breaks, before and after classes, to exclude formal instructional activities led by teachers, which were not relevant for this research. Instead, the study concentrated on pupils' interactions and their informal activities that occur during free time, with these interactions being understood as collaborative moments of learning and knowledge exchange. The autonomy in these interactions, i.e., the freedom that pupils have during informal activities, is considered crucial for maximizing the role of an architectural design in providing opportunities for self-directed learning. The study included collecting information on various types of pupils' informal activities, such as physical activities, play, relaxation, eating, and occasional withdrawal from crowds. Five mutually exclusive categories were recorded: (1) physical play, (2) conversation, (3) eating / refreshment, (4) quiet withdrawal, (5) transit without stopping. All these activities were shaped by the architectural characteristics and spatial configuration of the school building, but were also conditioned by school rules and space management. Each interaction point was georeferenced on a CAD floor plan (AutoCAD → QGIS). Positions were aggregated to a 0.40 × 0.40 m raster grid, matching the resolution of the VGA, so that behavioural and spatial datasets could be overlaid without resampling.

At the "Sveti Sava" elementary school, pupils' activities were mapped, including their positions—individually, in pairs, or in groups (along with group sizes). These activities were recorded on floor plans of the school using specially defined

symbols and descriptions from the Space Syntax Observation Manual [28]. In the end, pupils' interactions and informal activities were graphically represented as Concentration Clouds (CC). In this way, areas and zones with a high concentration of pupils in different parts of the school were identified, allowing for an understanding of the spatial distribution and intensity of informal activities at the "Sveti Sava" school.

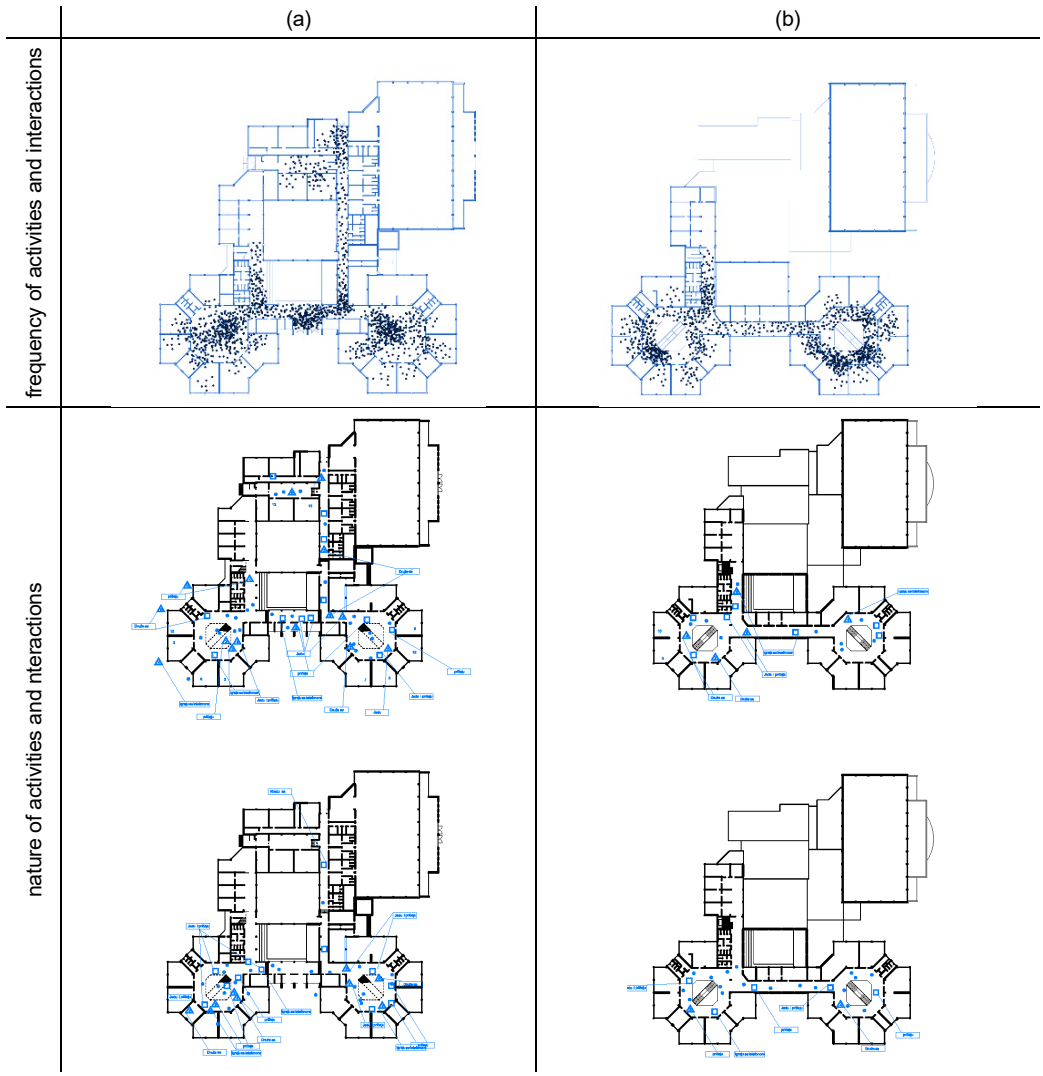


Figure 3. Example of Collected Data on the Location – Frequency and Nature of Activities and Interactions, a) ground floor plan, b) first floor plan

5. FINDINGS

The architectural design, spatial layout, and functional distribution influence the spatial configuration of the school building, which can be analyzed at the level of the entire building. This influence can be interpreted through the syntactic parameter of VMD, which measures the number of turns required to reach a particular space from all other spaces. Higher VMD values indicate greater segregation (more turns), while lower VMD values indicate less segregation, i.e., greater spatial accessibility. In graphical representations of spatial configuration analysis, red indicates lower VMD (fewer turns) and higher space integration, while blue indicates the opposite (Figure 4).

Figure 4. Visibility Graph Analysis – Visual Mean Depth
red – integration, blue – segregation (more redness means less visual mean depth)

Table 2. Characteristic Values of the VMD for the Analyzed School Building

VMD	average	minimum	maximum	std dev	cells count
	4.65	3.30	6.96	0.64	38915

The results obtained for the "Sveti Sava" elementary school indicate shallow configurational depth for most spaces (Table 2). The central corridor, with its low VMD values, provides high accessibility, making it a key zone for fostering interactions among pupils. In contrast, classrooms designated for preschool education and extended care have the highest VMD values, making them spatially more isolated. The results of the visibility graph analysis show that spaces with high visual integration values, such as hallways and central cluster areas, play a critical role in facilitating pupil social interactions.

Table 3. Quartile classification of VMD values (0.40 m VGA grid)

Quartile	VMD range (turns)	Cells count	Grid share
Q1 – shallow	≤ 4.2	11 650	29.9 %
Q2	4.3 – 4.6	8 935	22.9 %
Q3	4.7 – 5.0	10 037	25.8 %
Q4 – deep	≥ 5.1	8 293	21.3 %
Total	—	38 915	100 %

The VGA generated a raster of 38 915 cells (0.40 m × 0.40 m each). Table 3 and Figure 5 shows the frequency distribution of VMD: cell counts rise sharply from VMD ≈ 3.3 turns, peak around 4.2–5.0, and taper off beyond 6.0. Table 3 summarizes the distribution of VMD by quartiles, indicating that nearly 30% of the observed school environment offers high visual accessibility (VMD ≤ 4.2), which is a critical factor in supporting social interaction.

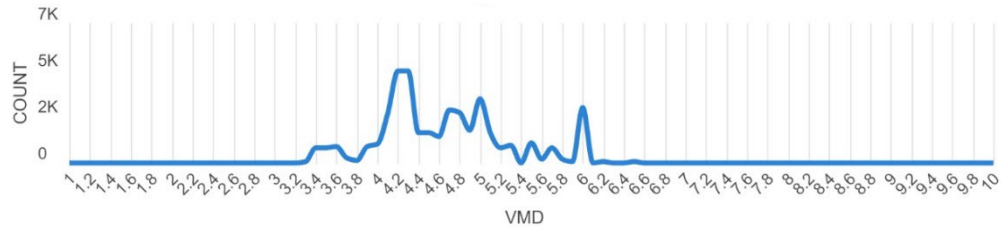


Figure 5. Histogram Distribution of Configurational Accessibility (VMD) of the Analyzed School Building

The aim of the research was to identify the affordances provided by the space for various social interactions and informal activities of pupils, as well as to analyze variations in types of activities and pupil grouping. As a key method, mapping (i.e., snapshots) was used, which proved to be particularly relevant for recording space usage patterns, recording the exact location of pupils' social activities, and allowing direct comparison between different types of spaces at various times before, between, and after classes.

Figure 6. Concentration Cloud of Pupils' Interactions and Informal Activities (more redness means high densities)

The CC map (Figure 6) makes the spatial hierarchy of pupil activity immediately clear. Red cells mark the highest densities of informal encounters and cluster along the central corridor as well as within the double-height stair lobbies of both classroom wings — these spaces serve as the school's primary "social magnets." Yellow areas indicate moderate activity, typically found in connecting hallways and at classroom thresholds where pupils pause briefly or engage in short conversations. Green zones correspond to the lowest interaction levels; they lie

mostly at the periphery, in the radial classroom arms and other specialised rooms, where pupils spend little unstructured time.

Table 4 presents the distribution of recorded informal social activities across spatial zones categorized by VMD quartiles. The data show that 58% of all interactions occurred in the shallowest spaces (VMD ≤ 4.2), indicating that visually accessible areas tend to facilitate more frequent social encounters. In contrast, only 13% of interactions took place in the deepest areas (VMD ≥ 5.1), suggesting a lower likelihood of informal socialization in less visually connected spaces. (Table 4). Standing conversations were observed most frequently (46% of events), followed by instances of physical play such as running (28%). Snacking or drinking accounted for 15% of observations, while quiet withdrawal or reading and pure transit without stopping were noted in 6 % and 5 % of cases, respectively.

Group composition was found to be skewed toward small assemblies. Pairs were encountered more often than any other grouping, trios appeared regularly, individual behaviour was also common, groups of four or five pupils emerged only occasionally, and clusters of six or more were rare and confined almost entirely to the double-height stair lobbies and the central corridor. Spatial analysis showed that the corridor-plus-lobby axis accommodated the bulk of all informal encounters. The circular halls adjoining the two classroom clusters hosted a considerable number of additional events, whereas the peripheral classroom arms and specialist rooms attracted merely a small fraction. The remainder of the interactions was scattered across the playground and secondary corridors.

Table 4 Distribution of recorded informal social activities across VMD quartiles

VMD quartile	VMD range (turns)	Number of activities	Share
Q1 – shallow space	≤ 4.2	1 790	58 %
Q2	4.3 – 4.6	587	19 %
Q3	4.7 – 5.0	309	10 %
Q4 – deep space	≥ 5.1	401	13 %
Total	—	3 087	100 %

The long recess produced a markedly denser flow of events per minute than the short recess, yet the same spatial hierarchy persisted throughout the school day: the central axis consistently served as the principal gathering zone. Break-time paths typically extended a few dozen metres; the great majority intersected the main corridor at least once, and more than half incorporated an ascent or descent via the staircases. Dwell time proved appreciably longer in the lobby areas than in the outer classroom wings—several times longer, on average. Taken together, the observations indicate that pupils' free-time activity concentrates at broad, visually open circulation nodes where multiple routes converge, while deeper peripheral rooms tend to be used only briefly and mostly by small or solitary groups.

This pattern reinforces the "co-visibility affordance" thesis of the Space-Syntax theory: pupils gravitate toward zones that require the fewest direction changes while keeping line-of-sight. Two mid-depth pockets (VMD ≈ 4.8) recorded unexpectedly high interaction frequencies around the snack counter and library entrance, demonstrating that functional attractors can partially override configurational depth; design, therefore, cannot rely on visibility alone.

6. DISCUSSION

Results suggest that spaces with high spatial integration and low VMD are essential for fostering frequent and intensive informal social activities, as they provide natural gathering points and pathways for pupil movement. A spatial layout that facilitates strong connectivity between different parts of the school makes spontaneous socialization among pupils easier and supports their mutual interaction. Evaluation of the results highlights the importance of shallow configurational depth in promoting informal activities and interactions among pupils (Figure 7). Spaces with low VMD values, such as central cluster areas and vertical communication zones, have a high potential for fostering interactions. These spaces have proven crucial for intensive social activities, as they allow pupil movement, encounters, and informal conversations, which contribute to creating a positive social environment. These results confirm earlier findings by Fouad & Sailer [13], [14], [15] and Stehlé et al. [19], who also demonstrated that central corridors act as the main attractors of informal social interactions in schools.

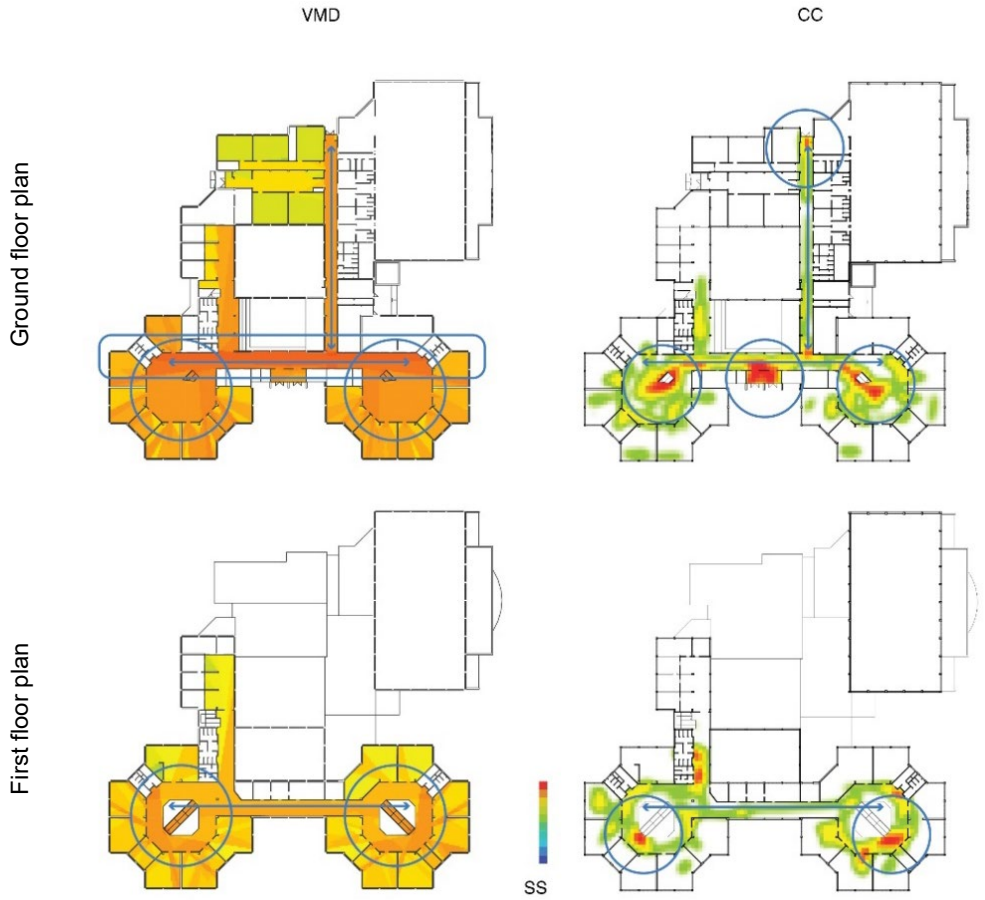


Figure 7. Comparative graphical representations of results (VMD / CC) – VMD (left) and CC interaction density (right), grid 0.40 m

Spaces with high VMD values, such as classrooms for preschool education and extended care, have lower accessibility and a tendency to be less used for social interactions. Activities in these spatial units are more often individual or static,

indicating a lower potential for spontaneous gathering and interaction. This confirms the importance of spatial organization in shaping the social behavior patterns of pupils, where spaces with shallow depth promote livelier and more intensive social activities.

Re-processing the VGA cells into equal counts produced the following cut-points: Q1 ≤ 4.2 turns (11 650 cells, 30 %), Q2 = 4.3–4.6 (8 935 cells, 23 %), Q3 = 4.7–5.0 (10 037 cells, 26 %) and Q4 ≥ 5.1 (8 293 cells, 21 %). Overlaying the snapshot events on this revised raster changes the numbers only marginally: ≈ 58 % of all interactions still fall inside Q1, whereas just under 13 % occur in Q4. In other words, the shallowest 30 % of the spatial grid supports almost five times as many informal encounters as the deepest fifth—an effect size fully consistent with earlier hallway-sensor studies in France [19] and in the UK [13].

The heat-map overlays reveal a clear, floor-by-floor hierarchy of informal activity. On both levels the central circulation spine acts as a continuous “interaction corridor”: cells along this axis register the highest contact density (red). Peak concentrations coincide with the double-height stair-hall lobbies at each classroom cluster; here the overlap of vertical and horizontal sight-lines lowers visual depth below the 4.2-turn threshold and draws the largest pupil groups. In contrast, the radial classroom wings show only scattered green cells, indicating occasional one-to-one encounters rather than sustained gathering.

The VMD map shows that the school's main circulation core is exceptionally shallow. Corridors and stair lobbies have the lowest VMD values, matching the densest clusters of informal encounters, while peripheral wings with higher VMD remain socially quiet.

The relationship between different types of spaces, such as classrooms, hallways, and recreational areas, is pivotal in shaping social behavior patterns among pupils. The central corridor that connects the two classroom clusters, with low VMD values (average 3.5), represents a key zone for socialization. As pupils pass through this area, they often engage in conversations and interactions, demonstrating the importance of spatial visibility and accessibility in fostering social contact. These findings are consistent with previous research [1], [11], [13], which indicates that spaces that allow easy movement and good visibility positively influence the formation of social bonds. It was also found that the school's spatial configuration contributes to differences in the types of interactions. Spaces with high integration values, such as central hallways and vertical communication zones (VMD average 4.2), attract pupils for livelier, informal activities. In contrast, deeper spaces, which are less accessible, provide pupils with opportunities for quieter activities, withdrawal, and self-isolation. This diversity of spaces allows pupils to find an appropriate environment for different needs, whether for socialization or individual work.

The architectural design of the "Sveti Sava" elementary school provides a significant potential for promoting social interactions among pupils, primarily through careful planning of spaces with a high level of visibility and accessibility. The combination of vertical and horizontal communication, as well as double-height spaces around staircases, represent key elements that positively affect the social dynamics within the school. A spatial configuration that allows easy access and visibility can significantly enhance the quality of social activities, which is particularly important for pupils' educational development and well-being.

7. CONCLUSION

This study set out to quantify how spatial configuration influences pupils' informal social activity in a double-cluster elementary school in Niš, Serbia. Using a 0.40 m VGA grid and categorising VMD into equal-count quartiles, we found that the shallowest 30 % of space (VMD ≤ 4.2 turns) accommodates almost three-fifths of all encounters (≈ 58 %), whereas the deepest 21 % (VMD ≥ 5.1) hosts just ≈ 13 %. In practical terms, a pupil standing in a Q1 cell is exposed to roughly five times more potential peer interactions than a peer located in Q4.

These numbers confirm the research hypothesis and support the co-visibility-affordance premise of the Space Syntax theory: depth matters, and it matters at very short visual ranges. Two additional observations refine that premise. First, mid-depth pockets adjacent to functional attractors (e.g. library) can rival shallow zones, showing that programme and configuration interact. Second, group size scales with depth: gatherings of six or more pupils form almost exclusively in Q1 cells.

Design guidance follows directly from the 4.2-turn threshold. Widening and articulating the central corridor, carving shallow recesses at junctions, and opening cross-cluster sight-lines would enlarge the Q1 field by an estimated 14 %, potentially adding around one thousand informal encounters per school week. Conversely, rooms where VMD exceeds 5.1 turns are naturally suited to quiet study or counselling and should be programmed accordingly. One limitation of this study is its single-case design and the seasonal context of data collection, which may affect the generalisability of the observed patterns. The study is limited to one school and one season; future research should test the 4.2-turn benchmark across multiple morphologies, climates, and supervisory regimes, ideally pairing VGA with longitudinal Bluetooth tracking. Even with these caveats, the evidence is clear: lowering visual mean depth below four turns is a low-cost, high-impact lever for enriching daily social life in cluster-based primary schools.

The spatial configuration of the "Sveti Sava" elementary school in Niš has proven essential in shaping pupils' social interactions. Spaces with high integration and visibility values promote social interactions, highlighting the importance of careful spatial planning. The school's spatial organization allows pupils to gather spontaneously, connect, and form informal relationships, which contributes to their educational and social development. Key spaces with high potential for social interactions have been identified, such as hallways, central cluster areas, and vertical communication zones. These spaces have proven to be key for fostering spontaneous encounters and communication among pupils, emphasizing the importance of thoughtful school environment design.

The findings of this study can serve as a basis for designing school spaces that support pupils' social development. Future research could examine additional syntactic parameters to explore more nuanced aspects of spatial configuration influencing pupils' social behavior. Moreover, examining how specific architectural interventions, such as increasing open areas or enhancing visual connectivity, can impact the quality of social interactions in school environments would provide actionable insights for future design strategies. Further research might involve longitudinal studies to examine how pupils' social interactions evolve over time in response to various architectural modifications.

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