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THE DESIGN OF SCHOOL BUILDINGS

Potentiality of Informal Learning Spaces for Self-directed Learning.

AHMED TAREK ZAKY FOUAD; KERSTIN SAILER

Ahmed.fouad.15@ucl.ac.uk ; k.sailer@ucl.ac.uk

ABSTRACT

Schooling systems could be perceived through three main dimensions: students, the learning process and the built environment portrayed in the school building. Each dimension comprises different parameters. This research has chosen to focus on the spatial affordances of the school buildings specifically the affordances of ‘informal learning spaces’ for students’ activities including ‘self-directed learning’. Informal learning spaces are continuously overlooked within existing research. They are the spaces outside classrooms: assembly spaces, dining areas and circulation corridors, where students take initiatives to construct their own knowledge through different activities: reading a book, doing homework, revising for exams. These activities are defined as self-directed learning. The theoretical framing of this paper brings together the Gibsonian concept of spatial affordances i.e. possible actions that occur in the built environment with the systematic study of potentialities arising from configuration according to Space Syntax. Informal learning spaces will be evaluated through Bernstein’s concept of classification and framing. Classification is the degree of boundary, which applies to the curriculum, school system and more importantly the space itself. Framing is the locus of control, i.e. who controls the process of learning and its material, which also applies to spatial control.

The paper investigates the design of two school buildings in London to explore the key design features that could impact the students’ learning. Using interviews with architects and a detailed space syntax analysis, it highlights the potential of various school spaces to afford the students’ activity patterns.

The design process and the configurational analysis indicate that both schools show differential potentialities for self-directed learning. The degree of classification and framing influences the spread of activities, especially the ones initiated by the students: self-directed learning. School A seems to afford a horizontal grid distribution of activities along the main spine and the central arcade (lowest Visual Mean Depth spaces). School B has an overall vertical organisation scheme around five circulation networks and five house assembly spaces. The spatial configuration seems to afford the spread of students’ activities within the assembly spaces. The design of school A is argued to represent weak classification (boundaries) and strong framing (control). There are weak boundaries within the open plan arcade space and spine. Accordingly, self-directed learning would potentially spread organically along the building within low VMD spaces, when students need to be seen, mix and study together: assembly spaces, wide corridors and arcade; and within high VMD spaces when students need to concentrate: multi-use lab and study rooms. Still, the school communicates strong framing, due to the high degree of control within the classical design of the closed classrooms and studios. The design of school B is the opposite case of strong classification but weak framing. The school maintains strong boundaries between the five houses and their assembly spaces. Activities could flourish within each house boundaries and its dining area according to the management’s rules of dividing the building (strong classification). The open large learning platforms called ‘super-studios’ maintain low degrees of control over the learning activities, thus communicate weak framing. Insights presented in this paper lay the foundation for understanding the potentiality of the main design components inside the schools

(assembly spaces, dining rooms, circulation spaces) to induce and accommodate students' self-directed learning, thus to be considered by architects in future school building design.

KEYWORDS

School Design, Spatial Configuration, Self-directed Learning, Informal learning spaces, Affordances

1. INTRODUCTION

Education has been recognised in modern societies as one of the main contributors to economic productivity and growth (Ball, 2008). Following the need for better education systems, the UK Education Reform Act was established in 1988, which focused on improving teaching methods and unifying the course content and curriculum. Whilst school materials were updated and instructional methods were developed, “what has received too little attention is the physical environment in which education occurs” (Sanoff and Walden, 2012, P.276). Improvement in the physical environment of learning (school building) is crucial to the understanding of the learning process, the students’ needs and activities (Sanoff, 2015; Lackney, 2015). This approach is central in ‘building performance evaluation’ (BPE), as argued by Preiser and Vischer: “Criteria for designing and building new environments should be based on the evaluation of existing ones, and modified when appropriate in the context of the design process” (Preiser and Vischer, 2005, P.12). BPE is defined as the creative, convenient and scientifically researched approach to creating a physical environment that fulfils the functional requirements and provide users’ satisfaction (Mallory-Hill et al., 2012). BPE is based on feedback and evaluation of six main phases: planning, briefing, design, construction, occupancy and adaptive reuse, which all together formulate an integrative framework for BPE (Lam, 2005).

This paper focusses on the evaluation of two of the six phases of the integrative framework for BPE: briefing (2nd phase) and more importantly design (3rd phase). The research compares the design of two secondary school buildings in London utilising Space Syntax concepts alongside interviews with the architects, in order to evaluate the potentiality of school buildings to afford students’ learning activities, mainly self-directed learning. This paper is part of an ongoing study that contributes to the research body of analysing school buildings and how they could influence the learning process.

The overarching research question is: how does the spatial configuration lead to spatial affordances of self-directed learning inside the school building? To answer this question, three aspects are addressed: firstly, the design process; secondly, its output represented by the building spatial configuration; and thirdly, how the building actually functions (students’ academic and social life). The results presented in this paper answer the first two aspects (design process and spatial configuration) which explain the potentiality of space to afford the learning process. The final stage is still work in progress, which will eventually outline the actual performance of the building. The research studies the design process to understand: what stages the design went through to produce the current building; what key design decisions were made, and their impact on the spatial design; and how the architect perceived the spatial affordances of various activities inside the school building. The research continues by analysing the building spatial configuration to explain: how the spatial design accommodated the students’ informal learning spaces and how informal learning spaces induced self-directed learning and social interactions.

The paper is structured as follows: chapter two will give an overview of the research dimensions; chapter three connects existing literature to the topic of research; chapter four describes the methodology of analysing the two school building case studies; chapter five explains the findings and chapter six proceeds with the design implications; chapter seven will then sum up the findings and highlight areas for further research.

2. RESEARCH DIMENSIONS

There are three main dimensions in this research: the students; their learning and social activities; and the built environment of the school. Spatial affordances explain how students’ activities are manifested in the built environment.

2.1 The Built Environment – the School Building

The school building is the incubator of the students’ activities. It comprises a set of different spaces that enable the learning process to happen: classrooms, lecture spaces, libraries, social and gathering spaces, halls and other informal learning spaces (Oblinger, 2006). The school building is perceived through the design process performed by the architect. The design process is guided by the project brief, building regulations, management mission and vision. It is influenced by the architect’s design concepts, perception of learning and how schools function. The output of design is a set of drawings that

encompass the spatial configuration, functional allocation, equipage of space (furniture and its layout) and specific design attributes (sizes, dimensions, areas, volumes). All of these parameters translate into a physical premise (the school building). The research studies the building brief and the architect's design as part of a building performance evaluation (BPE) process, and investigate the spatial configuration, organisation of various spaces and function allocation.

2.2 Spatial Affordances: The Spatial Manifestation of the Students' Activities

The manifestation of the learning process in space, in the form of activities, is dependent on the spatial affordances offered by the environment. The original concept of affordances was introduced by James Gibson. He defined affordances as the possible actions that occurred by an organism on an object or an environment, so in return, this object (or environment) afforded this action. For example, a chair affords sitting (Gibson, 1979). Affordances have a relative nature depending on the organisms' way of life, social and cultural practices and the needs in any particular situation (Rietveld and Kiverstein, 2014).

This model of affordances has a translation in relation to the spatial design and the learning process. Firstly, the environment is represented by the physical premises of the school building. Secondly, the organisms are the users who occupy space and perform actions. These comprise: management, staff members, teachers, and most importantly the students as the main player in this study. Finally, the set of possible actions translate into activities taking place inside the school, performed by different user groups, for example, supervision by the management, administrative tasks by the staff members and teaching by the teachers. The most important activities (according to this research) are performed by the students, which includes their social and learning activities. The research is interested in the informal activities initiated by the students themselves, for example, reading a book, meeting a friend to socialise and study together, working on an assignment in free time. These activities are defined as self-directed learning.

Properties that underline the relative nature of affordances (users' way of life, social and cultural practices and the needs in particular situations) can be applied to school buildings. Firstly, the users' way of life is defined through the school guidelines, their methods of implementing the school vision and mission and the social rules that apply to different events and spaces in the school. Secondly, the cultural practices are the learning practices which are perceived through the pedagogic framework of learning. It is the holistic explanation of different parameters that contribute to the learning process. It includes the curriculum, the pedagogic device and the transmission of knowledge which is perceived through different learning philosophies. Thirdly, the needs of the users are the students' need depending on each situation: need to study for exam, finish an assignment for submission, lay down to relax, interact with friends to connect, etc.

Following the previous explanation, the concept of spatial affordances (figure 1) is reintroduced as the set of possibilities of learning and social activities, performed by the students and primarily shaped by the spatial design of the school, which unfolds into different parameters (discussed in section 2.1). It is influenced by the management guidelines and social rules as the way of life; the pedagogic framework of learning as the social and cultural practices; and students' needs in particular situations.

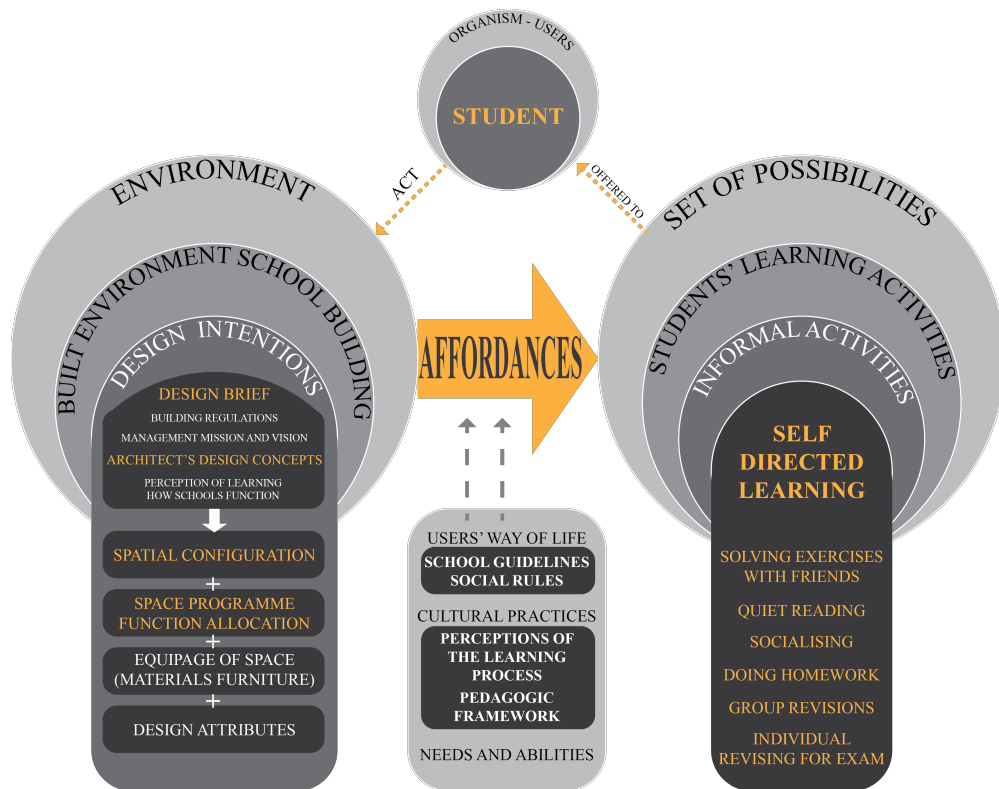


Figure 1: Holistic understanding of affordances

3. LITERATURE

This chapter defines the pedagogic framework of the learning process, which is utilised to evaluate the spatial design of the school buildings. The chapter also highlights the notion of informal learning spaces and how they are conceived in this research. Finally, it explores other research projects that focused on studying schools' spatial configuration.

3.1 The learning process

To study the relation between space and learning, the research perceives the learning process through Basil Bernstein's holistic definition of the pedagogic framework, which is concerned with the curriculum, explaining who has access to what type of knowledge (Bernstein, 1996). Knowledge is filtered through the 'pedagogic device' into the thinkable knowledge that students have access to. The thinkable accessible knowledge is the school curriculum. Then, the curriculum is re-contextualised through the 'pedagogic practice code' (section 3.3), which is the rules of the knowledge transmission, i.e. the pedagogical discourse (Bernstein, 1996). The rules describe how accessible knowledge is being expressed in reality and taught in the field of its reproduction: schools (Atkinson, 1985). Finally, the pedagogic framework is transferring the knowledge to a receiver (the student) by the teacher. There are different learning philosophies (section 3.4) that suggest how this process takes place.

3.2 Learning activities and self-directed learning:

According to the Oxford Dictionary, learning is defined as "the acquisition of knowledge or skills through study, experience, or being taught" (Oxford Dictionary, 2017). It is argued that learning (as a mental process) could take place all over the school building (Sailer, 2015). Learning is also a social process only bounded by the learners' interactions and experiences in the school building (Vygotsky, 1968). These assumptions dissolve the boundaries between social and learning activities and define all activities as part of the learning process. Activities are further unfolded into various actions. Some have a formal nature: lectures, exams, tutoring. These passive methods of learning do not fully prepare students with necessary skills for challenges in their future professions (Wanless, 2016). Other activities are more informal: social interactions, reading, studying, doing homework, etc. They are initiated by

the students and defined as self-directed learning. It is a contribution to the lifestyle of modern society (McLoughlin and Lee, 2010), where “students independently and proactively engage in self-motivating and behavioural processes that increase goal attainment” (Zimmerman, 2000, p.13).

Self-directed learning activities are highlighted in this research for several reasons. Formal events such as lectures have a lot of social rules assigned by the teacher and the school management. In a typical classroom, the teacher is the main contributor to how the learning process is manifested in the physical environment. On the contrary, self-directed learning is initiated by the student and has minimal interference from the teacher, thus it evolves as an activity (event) in space which has few social rules for the student to follow. The possibilities of learning formats are high. Bill Hillier (1996) refers to this case as an example of a short model where the events to rules ratio is high. A building is considered relatively more generative when events are dependent on the users’ activity patterns and co-presence, which themselves are function of the spatial configuration. Moreover, the scarcity of social rules amplifies the role of the physical environment (space) to trigger learning activities. The environment is a rich landscape ‘overflowing’ with possibilities (Rietveld and Kiverstein, 2014).

3.3 Classification and Framing

The main concept within Bernstein’s pedagogic practice code is classification and framing. Their representation in the context of learning is actually an application of a broader concept that applies to society. He acknowledged Marx and Durkheim for their theories. At a higher abstract level, Marx tackled “the social significance of society’s productive system and the power relationships” (Bernstein, 1971, p.134); which translated into Bernstein’s classification. Classification at the macro level represents the social division of labour where the resulting categories are instantiations of power. Durkheim was a pioneer in discussing “magnificent insight into the relationships between symbolic orders, social relationships and the structuring of experience” (p.133); which translated into Bernstein’s framing. Framing defines the social relations within this social division and signifies the idea of control (Bernstein, 1990).

Within the educational system, classification refers to the degree of boundary, which applies to the categories that exist in the structure of the pedagogic practice. It is applied on a smaller scale as in the strength of the boundaries between the programmes of study and the separations between the curriculum materials being taught into distinct subjects. The concept has a spatial translation, where classification is the degree of boundaries either within the building itself, or through the social rules that enforce boundaries on how space is being used. Classification could be strong or weak. The former (strong classification) is expressed for a system where the categories are highly insulated, and the boundaries are rigid and explicit. As for the latter (weak classification), it represents the opposite scenario where the boundaries are blurred (or maybe non-existent).

As for the notion of framing, it refers to the locus of control, i.e. the degree of control for the teacher and the learner over the process of learning and its material (Bernstein, 1971). If the teacher has full control with limited options to the learner, then framing is expressed as strong. The concept also has a spatial translation. The spatial design creates spaces that could allow for more freedom to the students in terms of what activities to do (preferences) and how to do them. The more freedom of choice the student has, the weaker the framing is (Bernstein, 1996). With the structural development of educational knowledge and the rise of constructivism, it is proposed by Bernstein that there would be an evolution in the educational knowledge codes from traditional systems of strong classification and framing to progressive forms of weaker classification and framing (Bernstein, 1996). Thus, the spatial design should reflect these changes and create spaces that communicate fewer boundaries and more freedom to the students.

3.4 Learning philosophies

Learning philosophies formulate the final part of the pedagogic framework in which knowledge is transferred from a curriculum to the student. Learning philosophies are abstract frameworks that describe how knowledge is received and processed during the learning experience (Instructional Design Central IDC, 2017). Going back to the Oxford dictionary definition of learning, it comprised two main aspects: the end result of gaining knowledge; and the technique of acquiring it. Learning philosophies

agree on the first aspect, the gain of knowledge, but they have different explanations for the way it is acquired. The above quoted definition includes three terms; study, experience and being taught. The first term (study) highlights the role of the learner as an initiator to take an action. The second term (experience) refers to the occurring situation during the process of learning and relates to the surrounding environment. The third phrase (being taught) reflects an action of passing the knowledge from one entity to the learner's mind. These are the generic foundations upon which most of the learning theories are perceived. Some scholars focussed on the behavioural growth and responses of the learner (Behaviourism), while others discussed the role of the mind to acquire knowledge (Cognitivism). Some reached the conception of knowledge construction according to the learner's individual perception (Constructivism). This research acknowledges constructivism as an explanation for how learning takes place. It highlights the role of the learner as the creator of their own experience and reality. Knowledge is being constructed in the learner's mind based on their own perceptions and experiences (Cooper, 1993), and the student's mind is perceived as the "builder of symbols" (p.16).

3.5 Informal learning spaces

The research is particularly keen to explore the potential of self-directed learning within informal learning spaces. They are defined as "spaces where students can collaborate with their peers, utilize technology and be involved in engaging activities that have overflowed from the classroom" (Wanless, 2016, p.11). In other words, they are spaces outside the classroom that host learning activities not during formal, teacher-directed instruction. The important role of informal learning spaces is also portrayed in Philip Coombs' theory of 'lifelong' learning. It promoted learning as the continuous accumulation of knowledge, skills, attitudes, insights that develop everywhere by the learner. Coombs described it as informal education, not in the sense of lacking structure, but being performed outside of the framework of formal educational systems (Coombs, 1985). Informal learning spaces could refer to areas such as meeting rooms, multi-use labs and libraries. However, they have a broader definition which comprises circulation corridors, staircases, assembly spaces and dining areas. These are all spaces where students could exist and perform a task (Oblinger, 2006; Boys, 2010). Designers tend to give more attention to formal learning spaces. They marginalise spaces that foster self-directed learning beyond the classroom, in spite of their importance (Niteckis and Simpson, 2016). That is why this study focuses on exploring the potentiality within these spaces to complement existing research.

3.6 Existing research on school buildings' spatial configuration

Before proceeding with this study, it is crucial to discuss other research projects which have explored the relation between learning and space, particularly those with a prime focus on spatial configuration. Through qualitative methods of analysis, Indira Dutt (2012) investigated visual connectivity and indoor/outdoor relations using site observations, questionnaires and exercises handed to students of grade six and seven in an American school. Findings suggest that "students felt a sense of freedom, moments of joy, social cohesiveness, and aesthetic pleasure in relation to indoor/outdoor interfaces and the natural places of their school site" (Dutt, 2012, P.216). Other types of research implemented configurational analysis of school buildings. For example, Pasalar (2004) utilised space syntactic analysis to compare four secondary schools in the United States. Results indicated higher rates of students' social interactions within spatial layouts that provided high accessibility, shorter and intelligible pathways. High levels of visibility and permeability within a school layout increased socialisation and friendship among students of different grades. Pasalar (2007) continued her research on school designs, which revealed that "creating smaller schools is assumed to reduce the isolation that often causes the alienation and violence among students" (P.51). Another syntactically driven research was performed by Kishimoto and Taguchi (2014) on Japanese elementary schools. They concluded that students' activity patterns correlated with the spatial configuration of school buildings. Spaces that were shallower to reach (more integrated) had higher movement, distribution and encounters of students for all school grades. However, teachers did not favour highly integrated overall building spaces because of their limited flexibility. Furthermore, within a comparative configurational study of nine secondary school buildings in the UK, Fouad and Sailer (2017) revealed that schools with overall less integrated spaces showed better outcomes in terms of school attainment. Extreme ends of the configurational spectrum (very integrated and very segregated spaces) were neither supportive nor inhibitive of the

occurring learning process. However, more variation within syntactic values could accommodate a variety of learning formats. Most recently, Sailer (2018) investigated the degree of choice for moving around, and the degree of overlap between movement and occupation in five school building case studies. She concluded that spatial features impacted social behaviours through the concept of ‘seeing others and learning from others. Design decisions could be drawn in line with pedagogic principles.

In summary, this literature review highlighted scholars’ theories and perceptions of the learning process especially through Bernstein’s pedagogic framework, while focusing on classification and framing as an important concept to decode the spatial dimension of the school building. Literature also defined informal learning spaces and introduced previous research that focused on the spatial configuration of school buildings.

4. Methodology

The study includes two schools that are registered as public secondary schools in the UK. Governmental data about the two schools (table 1) was obtained to give a general idea about each school. This indicated similarities between both schools in terms of location, total number of students, academic performance (attainment) and OFSTED scores (evaluation of school based on governmental inspection).

School	School A	School B
Open date	2013	2012
Gender	mixed	mixed
Lowest age of entry	11	11
Highest age of entry	18	18
Total number of enrolled students	831	835
% pupils English not 1st language	83.27%	49.82%
% pupils eligible for free school meals	38.2	31.1
Pupil : teacher ratio	12.6	12
OFSTED's overall effectiveness rating for the school. 1 = outstanding; 2 = good; 3 = requires improvement; 4 = inadequate	2	2
Average point score per a level entry	21.3	28.98
Average point score in best 3 a level entries expressed as a grade	c+	c

Table 1: General information of the two schools

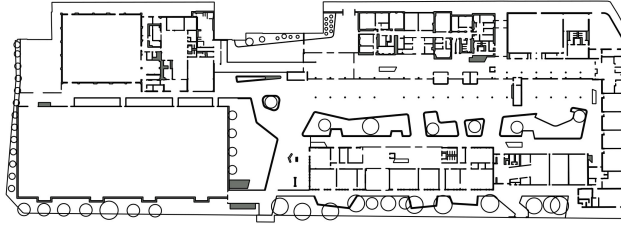
The research explored the design process of each school through qualitative and quantitative data. The first set of data includes a recorded and transcribed 1-hour interview with the lead project architect of each school. They explained the design through the drawings and their own ideas implemented in the design, and booklets about the design brief. Both schools were part of the “Building Schools for Future” (BSF) programme, a government project (run from 2007-2010) that intended to develop and invest into schools in the UK. The schools’ design processes were based on a competition, where each architect (teamed up with a contractor) submitted design documents multiple times to the local authorities before they decided on the winner. Contractors invested money and time in the design process to win the competition and to be granted a contract to work for the whole BSF programme. The time and effort spent on the design process, and the collaboration between different parties (school management, local authorities, contractor, architect) to produce the building, established the schools as interesting and rich research material. Moreover, the schools had similar briefs, which makes it interesting to find out how similar briefs could give rise to different design solutions.

4.1 Syntactic Analysis

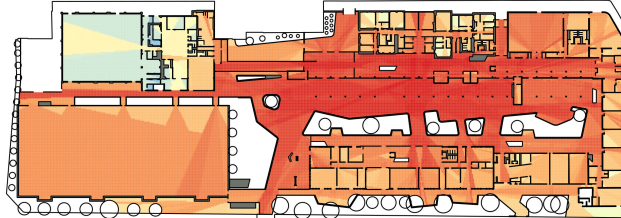
Quantitative data is portrayed in the analysis of spatial design and configuration of the school buildings. It is examined through the organisation of spaces in the plans, which highlights the main function of every space and its potential as an informal learning space. After comprehending how the spatial functions are distributed in the building, the floor plans then undergo syntactic analysis to evaluate the correspondence of the spatial configuration to the design intentions. The syntactic analysis performed on both buildings is based on the measure ‘Visual Mean Depth’ (abbreviated as VMD throughout this

research). It is convenient to utilise, because it measures the mean global number of visual turns to reach one specific point from every other point. Its values are comparable between different schools. The lower the VMD value, the more integrated the space is. The final VMD values are calculated as an average of two sets of data: the accessibility VMD and the visibility VMD. The accessibility VMD represents the network of spaces that could be reached from one point; for example, a glass partition is considered a barrier. The visibility VMD represents what could be visible from one point. A glass partition would not be a barrier nor furniture below 70 cm. Geographic information systems (GIS) software is used to spatially combine the two sets of data. The resulting outcome gives a more reliable representation of the depth of the space according to the user's choices, which are presumed to be influenced by where they could go and what they could see. If a space has an average value of six turns of accessibility, but glass walls reduce the visual turns to four, then the VMD according to this study is five. Figure 2 describes the sequence by which the final VMD was calculated in GIS software.

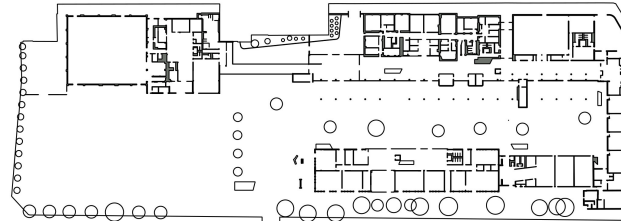
Step 1: Draw the base map of spaces that could be accessed



Step 2: Run analysis to get the visual mean depth of accessibility



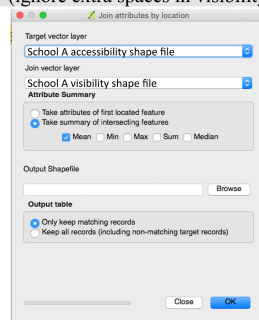
Step 3: Draw the base map of spaces that are visible (include courtyards visual connections, see-through curtain walls and glass walls, window openings, etc.)



Step 4: Run analysis to get the visual mean depth of visibility



Step 5: Use the command (Join attributes by location) in QGIS software to join accessibility and visibility only in the spaces that overlap (ignore extra spaces in visibility map)



Target Vector layer = Accessibility VMD

Join Vector layer = Visibility VMD

Take Summary of intersecting feature (mean)

Step 6: Get Final VMD MAP and repeat the steps for school B

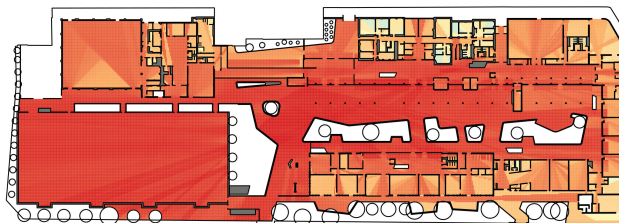


Figure 2: Steps of calculating the VMD

5. FINDINGS

5.1 School A



Figure 3: Space Programme - school A

The design process of school A was studied through interviewing the architect (project director). The project was a renovation of an existing old Victorian building to introduce new students' facilities (figure 3). The interview revealed the main design features of the building: the spine, the arcade and the internal piazzas (figure 4). Each building element (e.g. main spine) is a mini design process, sub-set of a design objective (e.g. solve circulation). Design solutions were submitted for feedback from the school and the authorities. The interview also outlined the spatial understanding of the students' learning and socialisation patterns according to the initial design. The architect indicated that lectures are intended to take place within each department's studios. The piazzas within each department are the spaces allocated for presentations and exhibitions. The architect also interpreted the internal piazzas and the ground floor arcade as the venue of students' learning and social activities outside the classroom.

Functional allocations in the floor plans are being explored to understand the distribution of spaces (figure 3). The main design features highlighted by the architect (arcade, spine and internal piazzas) are shallow and highly accessible in terms of their configuration (figure 4). VMD values gradually increase from the central court (arcade) and the spine towards the inner spaces of the building. The overall average VMD of the building is 3.84. Values fluctuate between 2.56 and 8.01 with few spaces of VMD more than 6.2. Figure 4 also illustrates the

high dispersion of VMD values across the spectrum due to the big variation of depth between main circulation corridors and the internal management spaces (especially in the old Victorian building).

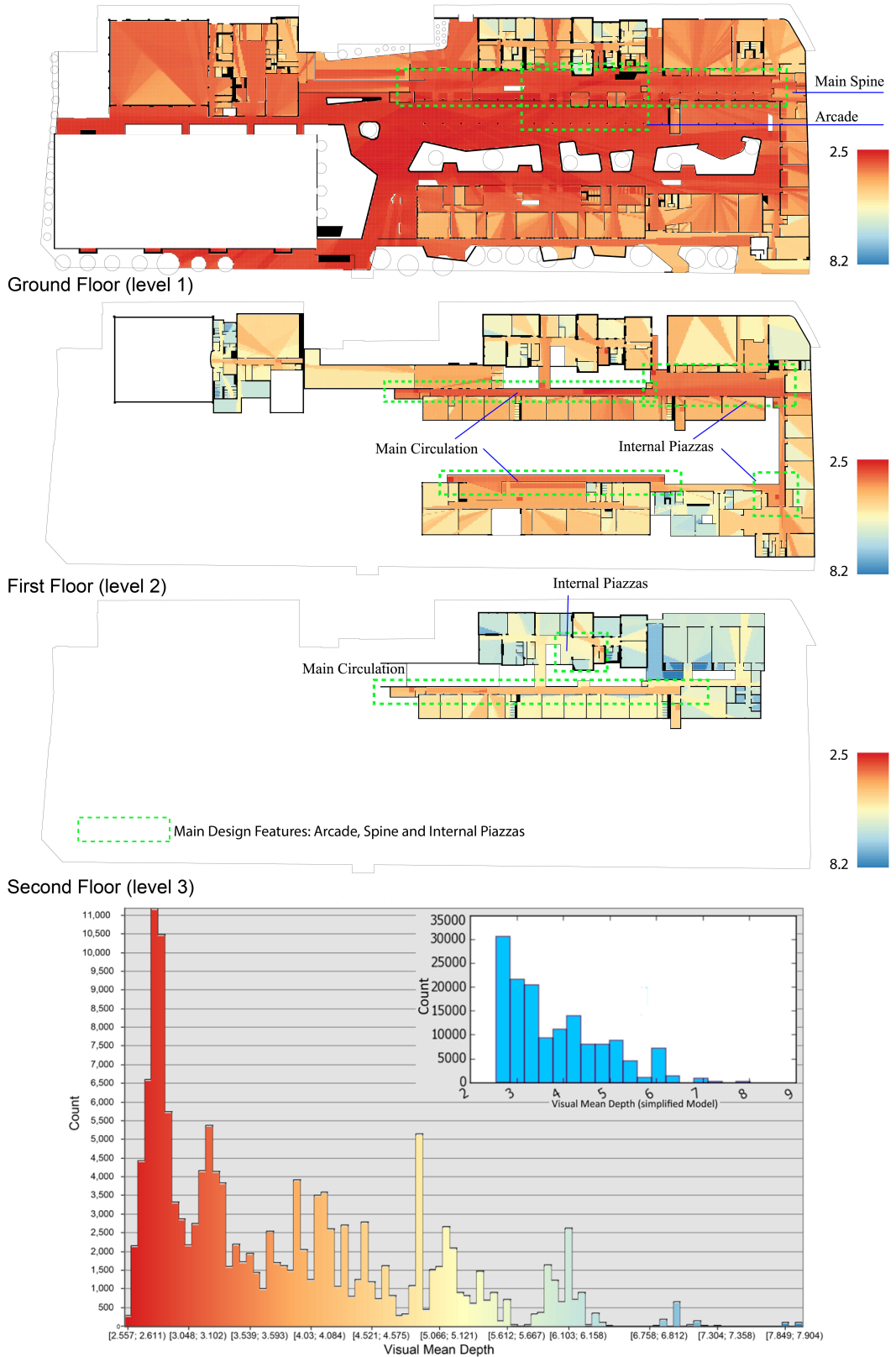


Figure 4: VMD and its distribution graph - School A

The Arcade and Spine

The basic concept of the school building is to integrate newly built parts into the conserved parts of the old Victorian building, through the main spine and the “generous and bright triple height arcade”¹. The arcade and spine average VMD is second lowest (3.70), reflecting the accomplishment of design to create easily accessible central circulation and gathering spaces for the old and new building. The new building has defined clean geometric spaces and an easy to read corridor system. However, the old Victorian spaces have imposed partitioning to divide existing spaces (maybe of different previous function) to fit new spatial requirements, thus resulting in higher VMD.

On the ground floor, the design succeeds to communicate one objective: providing a generous open gathering space where students are able to “look up and see the sky” while being at school. VMD data highlights the importance of the arcade as a central, open continuous space inside the building. The multiple connection points to the outside spaces creates a porous and almost merged indoor/outdoor space which could afford various students’ activities (meeting, socialising, eating, contemplating) especially on good weather days.

The Circulation Corridors

The architect expressed interest in avoiding deep super blocks (width-wise) which would become poorly lit and ventilated. Consequently, the design maximised single loaded corridors. The architect also referred to the importance of corridor width to avoid frictions among students. This is reflected in the final spatial configuration. Corridors have a minimum width of 3m on the ground and second floors, and 2.8m on the first floor. Some corridors reach up to 6.5m. Moreover, the main circulation corridors are the most accessible space within every floor. Accordingly, they maximise the potential for students’ co-presence. The combination of these factors reflects two possible positive contributions. Firstly, it potentially minimises student’s stacked movements and frictions (through wide corridors) and eliminates deep segregated corridors (through low VMD). Secondly, it maximises the spatial affordances for social interactions and students’ activities (eat, meet, socialise) especially during breaks when every part of the school is crowded. The design of the wide corridors just outside the classrooms and laboratories are capable of attracting various students’ activities. Firstly, they already act as attractors for students coming for lectures. Besides, in terms of organisation, they have big areas, and in terms of configuration, their integration results in high chances of movement and co-presence patterns. These conditions maximise the set of possibilities offered by the built environment for students’ activities. Thus, there are high spatial affordances for self-directed learning activities in the form of group studying, solving exercises, hanging out and socialising, revising for a class quiz, especially when students gather before and after lecture times.

Internal Piazzas (Assembly Spaces)

The design created flexible assembly spaces for each department. According to the architect “the traditional school with classrooms, which become the kingdom of the teacher is part of the past”. In terms of configuration, assembly spaces have the lowest average VMD (3.68), lower than the classrooms/studios (4.68). Their shallowness in the design, high connection to

¹ In the following, all direct quotes will be from the interview with the lead architect, if not marked otherwise

most of the classrooms amplify their spatial affordances for students' co-presence and interactions. However, in terms of design, two of the five main piazzas (humanities and math/ICT departments) are very limited in size, which questions their affordances for some learning activities, such as presentations, performances, exhibitions, discussion sessions and group meetings. It could be argued that the designer compromised the size to maintain their central location within each department. Sometimes, piazzas are part of the spine which maximises the spatial affordances to host students' social interactions, as a product of through movements encounters and mixing between the students. Deeper studios (high VMD) have higher spatial affordances for quieter formats of learning such as exams or problem-solving sessions.

The Typical Classrooms

The average VMD for learning studios is 4.68 which is higher than circulation spaces and piazzas. According to the architect, the design process aimed to provide high variation in formats of learning studios: their sizes and level of quietness (acoustic separation). The design only shows variation in size. The final drawings showed different names for different types of studios, however, their VMD values are almost the same within each department's spaces. Equal configurational values yield similarities in terms of movement patterns and co-presence in the spaces of each department, which might suggest similarities in the level of quietness/activity. The Math/ICT department is the only exception. Its spaces are distributed on two floors, yielding different VMD values.

5.2 School B

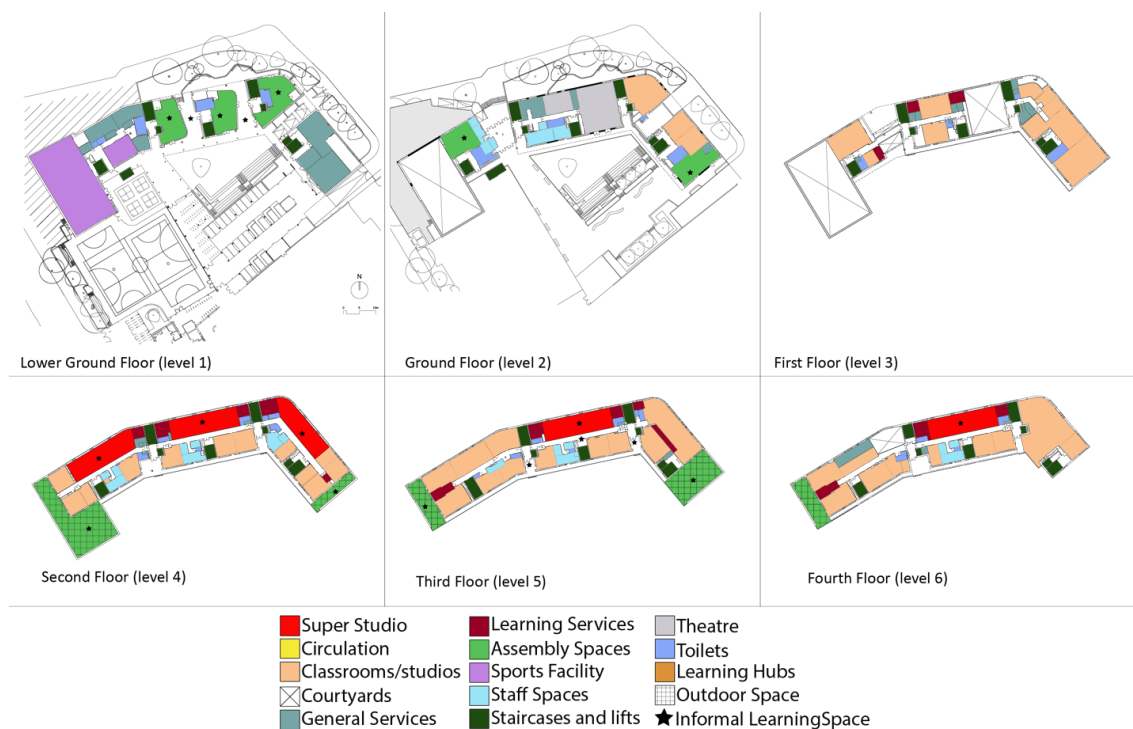


Figure 5: Space programme - School B

The design process of school B has different challenges than School A. It is impacted by site restrictions, in terms of physical obstructions. There is a rail network tunnel, a Thames water sewer and an electric cable passing through the site. The school site is also relatively small.

The architect had to organise the building on six levels. They produced multiple alternatives, which were negotiated with the school and the authorities, until reaching the final design.

The architect discussed the spatial interception of the students' learning and social patterns. The design process prioritised certain design features: five assembly houses, which are an organisational system to group students and are reflected in the five staircases; vertical circulation and the super studio which is a large, open, multi-functional learning platform. VMD values increase drastically across levels (figure 6). The overall average VMD is 5.18. Values fluctuate between 3.50 and 8.57 with most of spaces showing VMD below 7 turns.

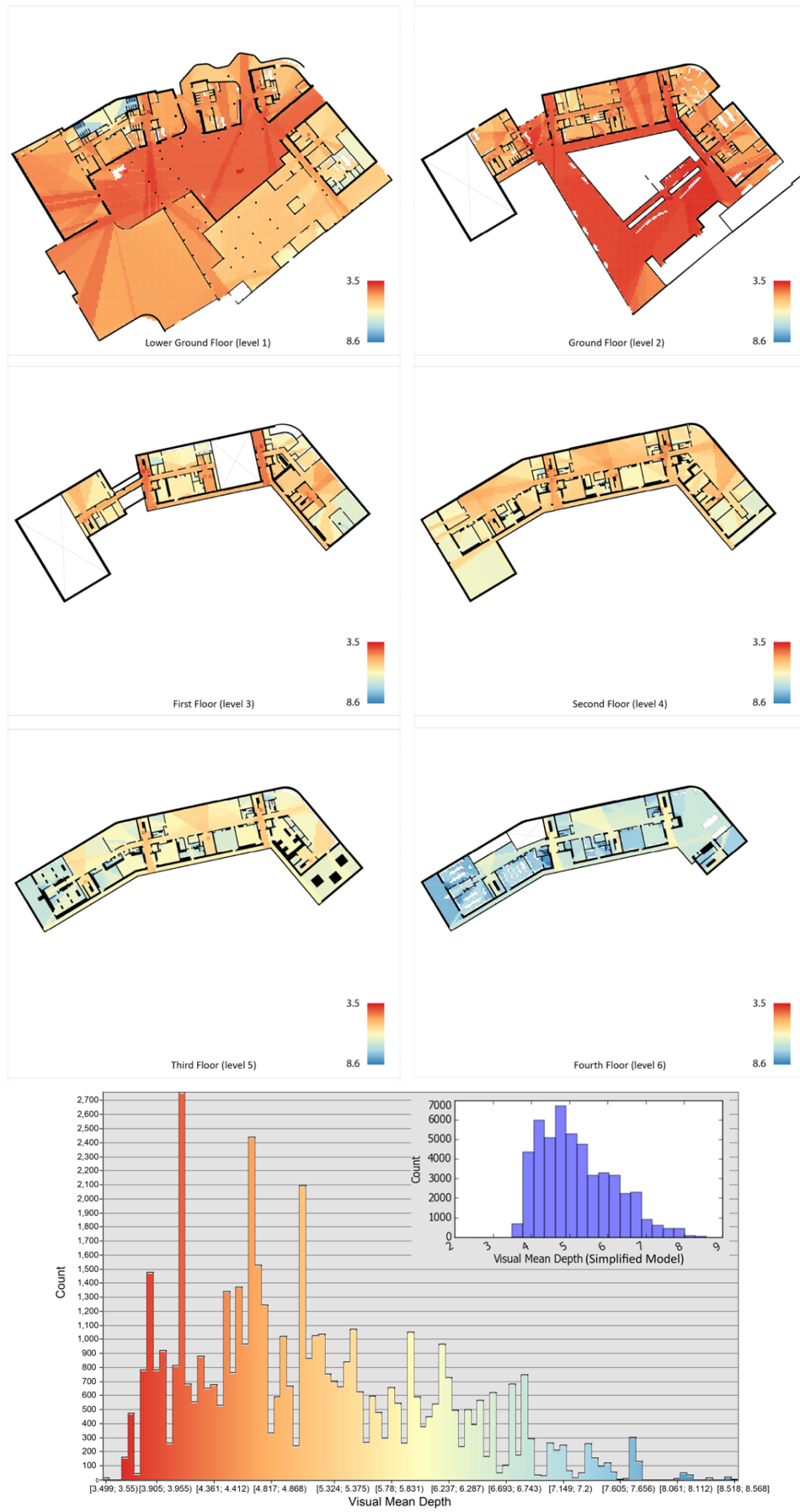


Figure 6: VMD and its distribution graph - School B

House Spaces

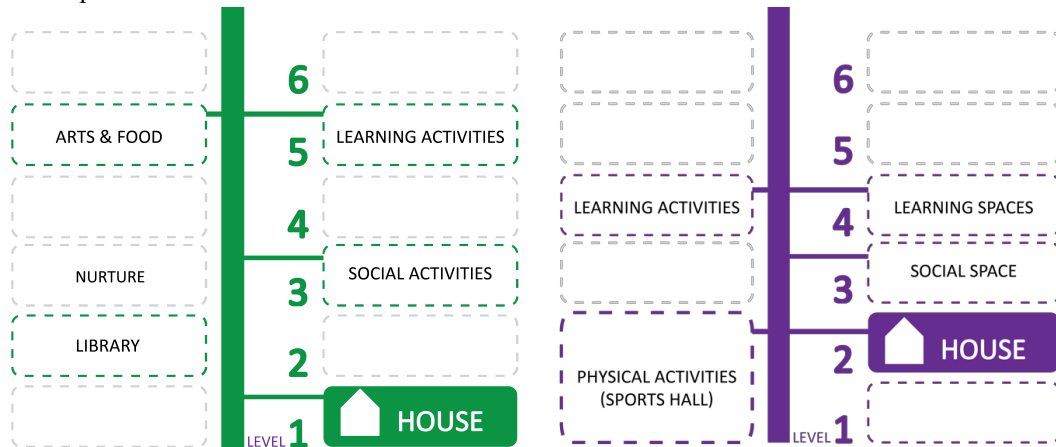


Figure 7: Example of two houses

The basic concept of the building is to create five stand-alone ‘households: Engineering, Art and food, Science, Music and Sports. Figure 7 shows two houses examples. There are spaces associated to each of the five ‘houses’, into which students are grouped. In terms of the spatial design, house spaces are “stacked vertically”. Each house has its own assembly space only serving the assigned house members. Other facilities are shared by all houses to serve a communal function, even if being primarily labelled as if they belonged to a certain house (for example the sports hall and labs). In terms of its accessibility, the average VMD of the house assembly is 4.66 (lowest of all spaces). The spatial configuration succeeds in conveying equality among the houses’ assembly spaces, they have similar VMD values. The only difference, in terms of organisation, is their distribution among two levels: three houses are on level 1, and two houses on level 2.

Circulation

The architect tried to solve the problem of multiple levelling by creating five staircases. “[students] could go up and down between the rooms of the house just using that one staircase”. In terms of configuration, the circulation network itself has lower VMD for corridors (5.01) and staircases (5.26) than super studios (5.54), which maximises the spatial affordances of corridors and stairs as informal learning spaces that accommodate some of the students’ self-directed learning activities: students hanging out in the corridor to socialise; group revision before an exam; and reading or private discussions on staircases (if allowed by the management). However, the staircases still do not provide even distribution of VMD values especially for the periphery of the upper two levels. The five staircases reduce the average length of journey between the house assembly and other house spaces, but become inefficient in connecting the houses to the super studios. Anecdotal evidence suggests that students did not stick to using the staircase labelled as belonging to their house and instead used the closest and most accessible option (depending on where they have a class), which questions the necessity of five staircases in the design.

Unlike School A, school B has double loaded corridors and deep blocks in terms of width, due to limited availability of space. This could suggest congestion in vital circulation spaces. However, the design provides a parallel outdoor circulation artery. The VMD of the outdoor corridor is 5.43, thus it is more segregated than the internal one (VMD 5.01). The distribution of the students’ movement between the two corridors depends on different factors. Firstly, the spatial configuration of each corridor (the interior corridor more integrated); secondly, how the management rules allow or restrict students’ access to both corridors; and thirdly the students’ preferences of choosing which way to walk depending on the weather outside, where are they going, who are they walking with.

Super studios

Super studios are large open multi-functional learning platforms for up to 90 students. They have lower VMD than the typical classrooms (5.54 < 6.02). The design intended to create vibrant super studios and quiet segregated studios. In terms of design, the super studio is highly emphasised as a central space in

the upper three floors. They blend with the internal main corridors, increasing their affordances for students' co-presence and interactions. Moreover, the school as a multi-storey system renders the playground deep and hardly reached by the students especially from the upper two levels. The super studios are closer large spaces that could potentially attract and accommodate a big number of students, which maximises their spatial affordances for students' self-directed learning (especially within furnished corners), if they are not being occupied by other formal activities.

Learning Terraces

The learning terraces are clear examples of informal learning spaces. They are created as complementary outdoor learning spaces to the playgrounds, so “[Students] do not go all the way down to paint and draw”. The average VMD value of these spaces (6.25) is higher than the average of classrooms (6.02) which reflects their segregation in the plan. Being allocated in the peripheries of the building isolates them from the rest of the spaces especially the super studios. Their configuration questions the architects' awareness of the importance of informal learning spaces. Still, there is a possibility of them functioning as attractors for students who are looking for a quiet environment to study outdoors, paint or draw in a different atmosphere, or socialise in a quieter zone than the busy playground. All these are examples of self-directed learning activities.

6. DESIGN IMPLICATIONS

In the context of the school building, the concept of affordances is the set of possibilities portrayed as the students' academic and social life inside the school building; their spatial needs and activities. Affordances are primarily shaped by the environment itself (Laland, Odling-Smee, and Feldman, 2000). The environment presents itself as a rich landscape of affordances for formal activities (lectures, exams, tutoring) and informal activities of which self-directed learning is a subset (socialising, reading, solving exercises, group studying, etc.)

Differential Affordances in the Two Schools

School A is spatially organised in a horizontal manner, utilising the main spine and the central arcade (lowest VMD spaces) as the connecting feature of the whole building (figure 8). This configuration results in the potential spread of students' activities (movements, socialisation and learning) on a horizontal grid. If spatial affordances are perceived as a set of possibilities offered by the design, students' self-directed learning patterns are expected to spread organically where the furniture satisfies the students' preferences. Firstly, within low VMD spaces, where students could see and be seen, there are high possibilities of co-presence, mixing and group studying in assembly spaces, wide corridors and the arcade. Students' activity patterns are also expected to take place within high VMD spaces, when students need to be isolated and concentrate, for instance, in the multi-use lab and study. The design of school A could be described as a 'rich landscape' of spatial affordances (Rietveld and Kiverstein, 2014).

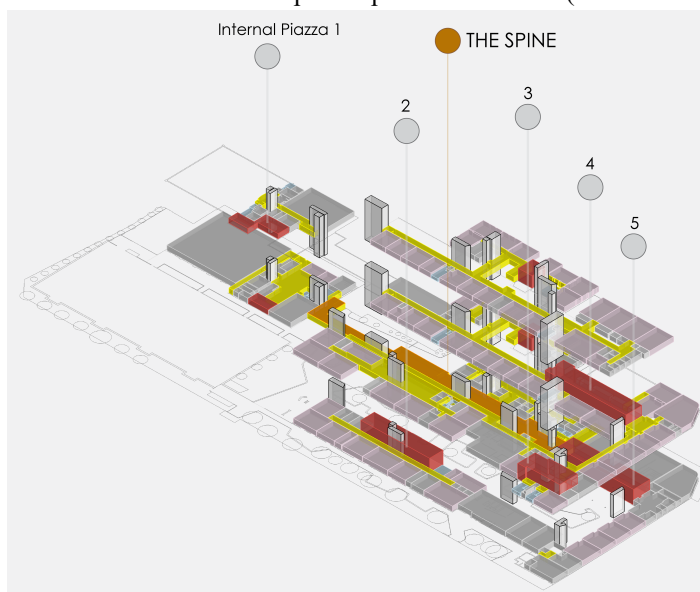


Figure 8: Horizontality of the design - School A

On the contrary, school B adopts a different design solution where the house spaces are vertically distributed across levels. The design creates vertical spines (backbones) using the vertical circulation grid of staircases and lifts (figure 9). In this configuration, the spatial design (environment) aims to influence the students (organism) choices, their movements and activities patterns. Considering the management decision of keeping boundaries between members of the houses during various learning activities, it is expected that self-directed learning activities are also following the same patterns. They evolve in the same area within each house: the assembly space. For example, a student would always move back to the house-base to sit with a friend and revise for an exam. This is an example where spatial affordances are less open as opportunities but are structured more like commands to be acted upon (Rietveld and Kiverstein, 2014).

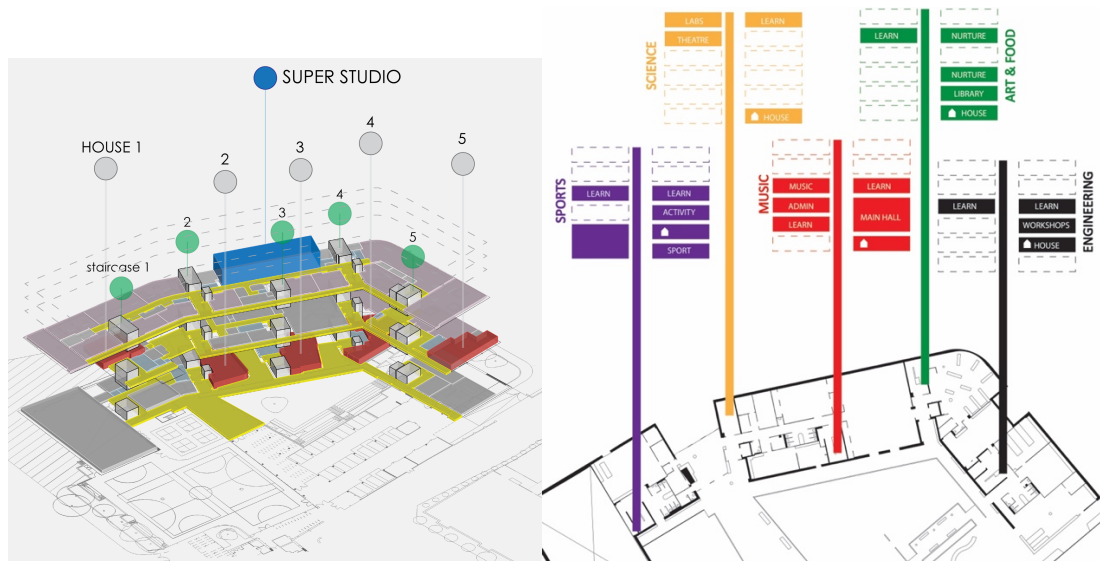


Figure 9: Vertical functional distribution, five houses, five vertical cores

Bernstein's Classification and Framing as a Product of Spatial Affordances

Through the organisational scheme of the main spaces and their syntactic analysis (VMD values), the research explains the two buildings' activities affordances in terms of Bernstein's classification and framing. Within learning institutions, classification typically refers to the 'degree of boundary' between the course materials. This concept is expanded to perceive all types of boundaries in the school environment including the spatial boundaries and rules that impact how students use the space. Framing refers to degree of control over the curriculum and the selection of tasks to fulfil (Bernstein, 1990). Still it could refer to the degree of control over the students' activities, which is influenced by the building spatial configuration and design.

In terms of classification (boundaries), the overall design of the internal spaces of school A delivers a message of unity and openness. The design opens up the plans through the main spine and the open internal Piazzas (lowest average VMD of all spaces of the two buildings). If the degree of boundaries is represented through space, it is argued that school A affords relatively weaker classification than school B, which has stronger boundaries and rules concerning the non-mixing of the five houses facilities. School A diminished the boundaries for the informal learning spaces: the open arcade, the circulation spine and the internal piazzas. However, School B spaces trains the students to do their activities within the boundaries of the house. The possibilities of self-directed learning activities are proportional to the weaker boundaries provided by the school spaces and rules of using spaces.

In terms of framing, school A defines the studio spaces by subject. If spatial affordances respond to the ways of life of an organism (defining spaces by subject) and the cultural practice (lecturing inside classrooms) (Laland, Odling-Smee and Feldman, 2000), the design of school A would inhibit the

students' self-directed learning inside the departments' studios. The design trains the students to perceive these spaces just as lecturing studios, exactly as human beings are trained to turn a door knob as the only way of using it. This is another example of affordances to be acted upon (Rietveld and Kiverstein, 2014). Contrarily, school B assumingly affords weaker control (weaker framing) as a result of the multi-functional, flexible, highly accessible super studios being the primary learning space. It could accommodate more than one learning activity, format or layout at the same time. The possibilities of self-directed learning are bound by the degree of framing, expressed through the degree of freedom provided to the student by the built environment. The spatial configuration cultivates spatial affordances that could trigger the students' constructivist's learning patterns within the open learning environment: trying different seating arrangements and formats of studying in the super studio; and maybe repeat these patterns somewhere else. Thus, affordances for self-directed learning could flourish within the super studios even if they are considered as formal learning space. Although Bernstein (1990) has argued that strong classification (boundaries) cannot maintain itself in the system without strong framing (control), the spatial translation of these concepts could reflect design possibilities that yield a mixture of strong classification and weak framing, or vice versa.

Architects' Configurational Sense in the Design Process

Both schools did not undergo any syntactic analysis during the design stages. However, the allocation of functions in school A corresponds perfectly to their VMD values. For instance, exam data room has the highest VMD (most segregated), assembly piazzas have the lowest VMD, which illustrates the architect's intuitive sense to embed different spaces within the plan. In contrast, the architect of school B mentions certain spaces as main design features, which are not emphasised in the final configuration. For example, the learning terraces are supposed to act as a social hub for students, but their configuration is deeply segregated in space.

Furthermore, the width of the corridors in the new building of school A is proportional to their VMD: the lower the VMD, the wider the corridor. This reflects design awareness of the vital circulation areas and actually predicts the provisional students' movement patterns. What could appear as a typical door is actually a vital circulation gateway. The continuity and the depth of circulation is functional to how the school management operates the building following or discordant to the design: whether they lock access or allow students to take shortcuts through these doors.

7. CONCLUSION

School A and B present a rich comparison of the design process and its outcome: the spatial design and configuration. Starting with quite similar briefs, their spatial translations are different. The buildings (if operated according to the design) have the spatial affordances to induce students' self-directed learning in various locations. For school A, self-directed learning would be expected to flourish along horizontal spread patterns in spaces which do not have a learning tag/label: the assembly spaces, arcade, wide corridors and the multi-use lab (informal learning spaces). School B is expected to have vertical spread patterns of activities within houses' assembly spaces as well as the super studios which are defined by the design as the main/formal learning spaces. These hypotheses illustrate the potentiality of the design to afford the learning activities.

Limitations of this research project are mainly derived from the small sample of case studies. Although the two schools provide an interesting comparison of the design process and its potentials, the study could have benefitted from more case studies that might highlight patterns in the design. Moreover, there are certain non-spatial parameters which the research did not fully explore, for instance, the budget limitations for design; the role of the school management in the design process and their degree of contribution; as well as political decisions that impact the process of creating new educational facilities in the UK. It is crucial to support this research with investigations of the actual performance of the buildings, which might differ according to the daily operation of the building, the management and their rules as well as many different factors. Therefore, further research will continue to study the students' academic and social life inside the buildings as well as their activity patterns, and relate this back to the potentiality afforded by configuration and other design choices.

Self-directed learning as an activity is not associated with time or space, which magnifies its importance in the daily routine of students inside the school building. In spite of its relevance, school buildings do not have spaces labelled as self-directed learning spaces. In fact, schools should not have such spaces, because it is a learning pattern initiated by the student, not enforced by the teacher/management, hence they are mainly impacted by the spatial configuration and its generative possibilities. That is why it is the role of the designer to create spaces that could trigger and accommodate self-directed learning activities. It is also the role of the school management to allow for self-directed learning to evolve as an everyday event.

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