Corridors, Classrooms, Classification – The impact of school layout on pedagogy and social behaviours

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Introduction: The development of school buildings and anywhere learning

School buildings have undergone significant changes in their structure, layout and interior organisation over the last centuries. Steadman (2014) traced the development of English elementary schools from the 1870s to the 1930s showcasing how school buildings turned from tall compact buildings into low open pavilion types as concerns for hygiene and daylight increased. In an even broader historic overview of school buildings from the 17th century onwards, Thomas Markus argued that a school is an "instrument for shaping society" (Markus 1993, 93) and that pedagogy and design are deeply intertwined. Evidencing the development of shifting building forms – from factory-like halls for vocational training and skills development for boys and girls in the 18th century; to the open halls, naves and teaching galleries of the Sunday schools of the early 19th century and the monitorial schools of the mid-19th century, shaped by long rows of desks and hierarchical furniture arrangements; followed by typical corridor and classroom schools at the end of the 19th century, to the open school movement of the 20th century – Markus showed how industrial, economic and societal developments coincided with changing ideas of pedagogy, teaching and learning, and as such bore the construction of matching spatial structures that supported the power models inscribed into society at that time.

As society changed with the industrial revolution, and school buildings adapted to serve new societal needs, our understanding of pedagogy began to change as well. Charles Dickens descriptions in his 1854 novel 'Hard Times' paint a colourful picture of education at that time: "The plain, monotonous vault of a school room… the little vessels then and there arranged in order, ready to have imperial gallons of facts poured into them until they were full to the brim." (as cited in: Jones 2005, 5). In contrast to the purely instructional model of teaching, contemporary learning theories today assume that learning is a social process (King 2002) with new knowledge actively being constructed in the mind of a learner (Jonassen 1999, von Glasersfeld 1998).

Those new pedagogical intentions again required mirroring material conditions. This can be clearly seen in the post-war period of the 1960s and 1970s in Europe. Walls and doors were considered barriers to connectivity, flow and creativity of children and thus replaced with more open variations of school building designs that 'exploded' the classrooms (Burke and Grosvenor 2008) as fixed units for teaching and learning. Burke and Grosvenor discussed the approach of the German architect Hans Sharoun to educational buildings as an example for a school design, where public areas for social interaction were seen as equally important as the classrooms itself, and the overall configuration was decidedly community-focused.

If we accept that "learning can and does happen at any time and in any place" (Burke and Grosvenor 2008, 172) and that innovative learning environments take the social nature of

learning into account (OECD 2013), school spaces other than classrooms where social learning, interaction and informal encounters can occur such as corridors as the "freest and most unprogrammed space" (Markus 1993, 94) should experience a renaissance in school design.

This is not exactly the case. While some scholars have begun to focus on the role of corridors, public areas and other so called 'interspaces' (Hörnqvist 2011, Sailer 2015), and additionally, research established the crucial social role of corridors, since pupils in schools with more accessible corridor spaces have higher numbers of friends across different classes and grades (Pasalar 2003), other research has negated the importance of wide and variedly used corridor spaces. The catalogue of criteria used to analyse the quality of school building designs in for instance Barrett et al. (2013) rated corridors more highly if they were wide (so that they allowed for quick movement flow), but downgraded corridors if they were used for breakout purposes. This assigns a purely functional role to corridors as circulation spaces and disregards the fact that spaces outside of traditional classrooms are spaces for learning, too, in addition to the important role they play for pupils' unsupervised activities, peer interaction and socialisation.

In practice, it can also be observed how particularly wide corridors which could be used for a variety of activities of teaching and learning including social interactions and peer learning were sometimes diminished during the design process of new school buildings as part of a 'value engineering' and cost reduction exercise.

This chapter recognises the importance of corridors and interspaces and aims to shed light on the configurational properties of corridors as well as the relationship between classrooms and corridors. It asks which pedagogical approaches are supported by the spatial structure of the school building and which role corridors play in this.

The chapter is structured as follows: the second section will argue that school buildings can be regarded as a pedagogical tool. Bringing Bernstein's sociology of education to bear, the section will lay the foundation for the following section three, which will trace the discussion for and against open or closed school buildings. It will maintain that a nuanced understanding of configurational properties of school buildings analysing degrees of openness in order to understand their educational and social consequences is required. Section 4 will focus on one spatial element – corridors – and propose that the relationship between corridors and classrooms give rise to different classifications of school buildings, which differ according to two dimensions: choice of movement and the connection between movement and occupation. Based on the methodological framework of Space Syntax, five contemporary school buildings will be presented to highlight how the relationship between corridors and classrooms impact the pedagogical models employed by the schools and give rise to specific social behaviours. A discussion section will bring all strands of the argument together and will critically reflect on the proposition that school buildings and pedagogy need to match for successful learning environments. A final concluding section will suggest paths for future research.

School buildings as pedagogical tools

Pedagogy is a very broad term. It is typically defined as the theory, method and practice of teaching. Etymologically, pedagogy comes from Middle French, but originally stems from Greek, where *paidagogia* derives from *paidí* (child) and *agōgós* (guide), so it translates as 'leading a child'. In ancient Greece, a pedagogue was a slave escorting boys to school and supervising them[i] and only later changed meaning to name a teacher or school master.

While teaching practice is part of pedagogy, pedagogy denominates the wider system – it was described by the educational sociologist Bernstein as "what counts as a valid transmission of knowledge" (Bernstein 1973, 228). Together with curriculum and evaluation, pedagogy realises what Bernstein calls an 'educational knowledge code', i.e. valid knowledge (curriculum), valid transmission of knowledge (pedagogy) and valid realisation of knowledge

by those taught (evaluation). Two Bernsteinian concepts, i.e. how educational knowledge can be classified and framed are of particular interest here. In both cases, the strength of the boundary between concepts is crucial.

Classification was originally defined by Bernstein (1973) as the degree of boundary maintenance between contents in a curriculum, however, it can be understood more broadly as the strength of differentiation between any two concepts, ideas or dimensions. In the context of a school, classification could describe disciplinary differences in pedagogy for instance between STEM subjects and Arts & Humanities, where a uniform approach to teaching would denote a weakly classified system and a highly differentiated approach strong classification. Similarly, other differences could give rise to strong or weak classification such as differences by role, for instance between teachers and pupils, or between junior and senior teachers, or in fact, differences in spatial layout. For instance, a segregated school building with different wings for different age groups could be seen as strongly classified, since it is built on stronger boundaries, whereas a more compact building that creates more opportunities for integration and exchange could be seen as weakly classified (De Jong 1996).

Framing was described by Bernstein (1973) as control over what is taught (selection) and how it is taught (organisation, pacing), i.e. to which degree is control in the educational system structured hierarchically, and to which degree may teachers or pupils decide. Framing therefore touches upon the social structures and relationships between different categories of people in educational systems. Depending on context, strong framing can for instance assign authority to individual teachers who control what is taught how. In a very strongly framed system, all control would lie with the head teacher. In a contrasting example, teachers working in a collegiate way with emerging coordination activities leaves individual teachers with decreased discretion and assigns authority to the collective, therefore denoting a system of weak framing. Again, this has spatial implications. For instance, a school with glass partitions or windows between classrooms and corridors allows for visual control and some degree of surveillance of teaching practices and therefore is more weakly framed than a school building with traditionally fully enclosed and segregated classrooms (Sailer 2015).

However, the relationship between space and pedagogy can also be discussed on a more general level.

In his later writings, Bernstein (1996) defines pedagogic practice as the general social and interactional context of cultural reproduction-production. This closely resembles the idea of a spatial interface, defined as the system of control and integration orchestrated by any building in order to bring different groups of people together or to keep them apart (Hillier and Hanson 1984, Hillier, Hanson, and Peponis 1984). "Buildings are spatially about social knowledge", Hillier and Hanson (1984, 184) would argue. A building assigns people a role, for instance as an inhabitant defining and controlling the social knowledge inscribed into the building structure, and whose role is mapped into the building, or in contrast, as a visitor with limited power over the social knowledge of the building and with only temporary access. In this sense, school buildings define its users as inhabitants (teachers) or visitors (pupils, parents), and order and arrange the ways in which the different groups of people interact and meet.

Taking this one step further and drawing an analogy to language, Bernstein (1996) discussed the principles of the transformation of knowledge into pedagogical communication as so called 'pedagogic device'. This was then interpreted by Hillier as "possible structures that turn institutional patterns into consciousness. It [the pedagogic device] defines the ways in which institutional differences become ways of thinking and acting in the social world." (Hillier 2001, 56) Hillier theorized that this may guide us towards a general 'social device' in that societal patterns could be thought of as large networks of relations, similarly to understanding spaces as relational, "a continuous system of interrelatedness shaped by and shaping the way we live" (Hillier 2001, 57). The social device would act like a social DNA that produced specific societal pattern of relations, which were reproduced through specific situated practices and space-time realizations.

We do not even have to go this far to recognise how closely space and pedagogy are intertwined. Buildings in their spatial logic are producing and reproducing social relations in similar ways to pedagogy being defined by social production and reproduction.

This relationship between space and pedagogy is a long established one, as for instance evidenced by the historic analysis of school buildings as systems of power: "To educational innovators the school building, down to its last coat hook, was as powerful as model lessons, timetables or systems of rewards and punishment." (Markus 1993, 94)

Likewise, the space of a school was called an 'educational tool' (Bjurström 2011) or, going back to post-war Italy, the school building and its materiality was considered the 'third[ii] teacher' (Burke and Grosvenor 2008).

Against this background, this chapter will consider spaces as relational systems that embed specific social interactional contexts and interfaces, thus producing and reproducing particular pedagogic principles. This becomes very clear in the post-war debate around open or closed school buildings.

Open and closed schools

In the second half of the 20th century, fuelled by the increasing prominence of alternative pedagogies and learning theories, classrooms as the only spatial setting for learning were 'dethroned' alongside the fixation on instructional teaching modes, and new, more open architectural solutions for school buildings emerged (Hertzberger 2008).

Hertzberger maintained that the demands of the knowledge society meant that the single, rectangular shape of the traditional classroom was no longer suitable for emerging new working modes in schools, for instance in smaller groups. Bernstein (1967) rooted the move towards openness even more clearly in societal shifts. He argued that Durkheimian 'mechanical models' were increasingly replaced with 'organic models' of social solidarity and cohesion. Under situations of mechanical solidarity, individuals integrate via a common belief system, which is maintained through ritual, punishment, discipline and status-based control. Mechanical solidarity also means clear boundaries; it distinguishes teacher from taught and teaching roles are insulated; there are fewer, sharply separated subjects, and teaching units are fixed. In contrast, individuals in an organic solidarity thrive on difference and relate to each other through complex interdependences and specialism, maintained by social control and negotiations. In this system pupils have more autonomy and choice; teaching is integrated and collaborative; subject areas dissolve, and teaching units become fluid. Bernstein realised the role of school buildings in asserting that new, open schools "ceased to have fixed references. Social spaces can be used for a variety of purposes and filled in a number of different ways. This potential is built into the very architecture." (Bernstein 1967, 352)

Spatially, floor plans supporting an open school education needed differentiation and an increasing complexity to make individual-based education possible. From a spatial point of view, an evolution of shapes from closed spaces to openness was outlined by Hertzberger (2008): from the traditional rectangular classroom to articulated classrooms with more corners, niches and bays; from the classroom to a more open home base; from corridors to 'learning streets', where partitions between classrooms and corridors became more open, or disappeared completely; and finally, the learning landscape which almost completely dissolved all fixed boundaries.

The dissolving of physical boundaries in the open plan movement has direct consequences. The change from a subdivided, closed school building to an open-plan one is described by Hillier and Hanson (1984) as a shift from power to control. Where previously inhabitants held a certain status, symbolised by their power over a classroom, which was segregated and maintained with sharp boundaries, teachers in an open-plan environment lose their inhabitant status and become visible, synchronised and controlled. They are more visitors than inhabitants and their social knowledge is no longer mapped onto the building structure. The

pupils become subjected to a control system that now operates globally on the level of the whole school rather than locally, bound to the classroom. What was intended as liberalisation resulted in a reinforced control regime. This is underlined by the observation that open-plan schools supported not just flexibility of teaching as intended, but also served important wider socialisation and education purposes, since the open plan school mirrored the electronic production in open-plan offices including their subtle demarcations of power (Markus 1993).

What is missing from this debate so far is the consideration of actual examples. Schools in real life are much more complex than the archetypical descriptions of mechanical and organic solidarity, or strong and weak classification, or open and closed schools. In fact, scholars have long called for an empirical verification of educational Bernsteinian theory and a disposition of ideal types in favour of more detailed and nuanced descriptions of the social reality of schools (Easthope, Bell, and Wilkes 1975).

One such example is the configurational study of 76 Japanese primary schools (Kishimoto and Taguchi 2014), which found that schools with more segregated and independent classrooms allowed teachers to employ more flexible teaching styles. Openness of schools did not seem to afford flexibility, but rather subdivision did. What this points to is not only the need for more empirical testing of theoretical reasoning, but also the importance of a nuanced understanding of degrees of openness or closure rather than categorical assumptions.

In order to pursue such a nuanced investigation, this chapter will focus on the corridor as a spatial element and use methods of space syntax analysis to draw a detailed picture of the spatial configuration of schools affording particular pedagogical approaches. Both aspects, the corridor as a spatial element, and the space syntax perspective will be captured in the following two sections.

The corridor as a spatial element

Corridors are first and foremost spaces of transport. They connect classrooms and other spaces in a school into a coherent spatial system. With the dissolving of boundaries in open schools and the parallel development of new and more varied ways of teaching and learning, corridors (or in broader terms, the spaces outside of classrooms, or even broader still, the spaces connecting to other areas) assumed a variety of functions: as break-out spaces, as places for socialisation, meet-ups and encounters, as places for learning and teaching, but also still of course as spaces connecting the different parts of school buildings being used for movement flows. International examples of uses and configurations of corridors with a focus on the Netherlands can be seen in Hertzberger (2008) while some Swedish examples are covered in Hörnqvist (2011).

More fundamentally, what corridors do is to act as the most common places that fulfil the primary social function of buildings, i.e. to bring people together, or to keep them apart. This is nowhere as clear as in Robin Evans (1997) essay 'Figures, doors and passages'. In this essay, Evans sketched the history of the corridor and linked its architectural appearance ("a device to remove traffic from rooms", 70) to a specific social agenda. Evans argued that typical renaissance architecture, for instance Palladian villas, were organised as a series of interconnected rooms, where no corridor existed. Instead, people moved from room to room and as they moved, they came into contact with activities going on in the buildings, hence movement and occupation were intertwined. The buildings by allowing for "company, proximity and incident" (Evans 1997, 69) corresponded to a society described as habitually gregarious, passionate and sociable. On the contrary, the corridor plan emerged to segregate people and activities. Houses such as Coleshill House in Berkshire designed in the mid-17th century contained several staircases and a hierarchy of circulation spaces, each created for a specific group of people (such as maidens and servants) to avoid encounters and the intersection of daily life patterns of different user groups. In fact it seemed that "all the occupants of a house, whatever their social standing, had become nothing but a potential source of irritation to each other" (Evans 1997, 73). Evans proposed that a compartmentalised corridor plan had to be

organised by the corridor as a form giving function, because movement was the only remaining thing giving the plan coherence.

Summarising Evans' argument and applying it to school buildings, the predominant corridor plan of traditional school buildings could be seen to channel movement and avoid coincidental contact, whereas more open spatial layouts go back to the Renaissance model of proximity and incident by bringing movement and activities together.

Taking Evans' work further in the context of school buildings and pedagogy, two criteria to analyse spatial layouts can be developed:

1. **What is the degree of choice for movement?** Is there only one possible path from A to B, or are there several? For instance, a double loaded corridor with a dead-end would allow for only a single path into classrooms, hence the degree of choice would be low and the layout would be considered more strongly classified (in Bernstein's terms) due to stronger boundary maintenance. In contrast, an open atrium would allow for a variety of paths and would speak of weaker classification due to higher levels of choice.
2. **What is the degree of overlap between movement and occupation?** Are spaces for movement used for other activities as well? How much potential is there for incident and encounter with other peoples' activities as a by-product of movement? For instance, a layout with many solid partitions and walls corresponds to a stronger classification, since the spheres of movement and occupation are strictly separated. On the contrary, an open spatial layout allowing for visibility means weak classification since both spheres are connected.

Those two criteria will be applied to several contemporary school layouts based on an investigation using space syntax methods.

Space syntax: A configurational analysis of spatial relationships

Space syntax is a theory and method based on the premise that the relationship between space and society can be studied through an investigation of the structure and connectedness of different parts of physical space.

As Hillier and Hanson argued, society "arranges people in space in that it locates them in relation to each other, with a greater or lesser degree of aggregation and separation, engendering patterns of movement and encounter that may be dense or sparse within or between different groupings" (Hillier and Hanson 1984, 26-27). Therefore, how spaces are arranged and how people move through them and encounter others on the way is consequential for social behaviours and for society at large. What matters most though, is the nature of those arrangements of spaces.

In analogy to language, where syntax governs the arrangement of words and phrases into meaningful sentences, in physical space, syntax describes the way in which spatial elements (such as rooms and corridors) are put together via doorways and staircases to form meaningful paths and a system of interconnected spaces that allow people to move from one place to another. Research in the tradition of space syntax has highlighted how movement often follows the configurational logic of a building: in more integrated places with shorter path lengths from one space to all others, more people are found moving (Hillier et al. 1996).

The core idea of configuration is that the shape, size and form of an individual space such as a classroom does not give the full story of how it may be occupied and how it will work for the emergence of social life. It is the relationship of spaces to one another and the location of a space in the overall fabric of a building that gives rise to sociospatial behaviours. Hillier (1996) uses the simple example of three spaces A, B and C to illustrate this point (see figure 1). In one configurational scenario, all three spaces are directly connected with one another, whereas in a second configuration, the connection between B and C is closed, so that B and

C are only connected via space A. Whereas the former configuration provides symmetry, the latter is asymmetric. Not only is power and control assigned to space A, which suddenly controls the access to space B (which could be the headmaster's office, separated from the corridor C via an administrator's office A), but also the relationship between space A and B shifts as a result of the overall configuration. Although a direct doorway still connects both spaces A and B in both scenarios, their relationship and function changes. This means the relationship between space A and B, which in scenario one was equal, suddenly becomes charged with power. Therefore, the idea of configuration not only means that the direct connection A – C or B – C matters, but that the relationship of A to B matters because of the way in which both spaces A and B are connected to the wider outside world C.
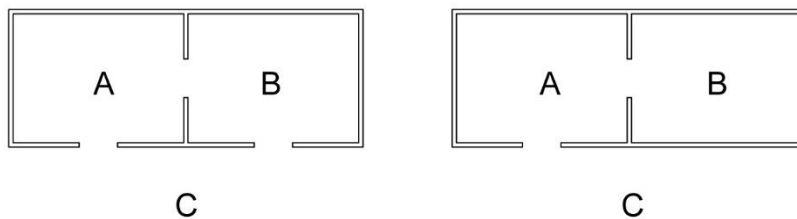

Figure 1: Basic configurational patterns of three spaces A, B and C (redrawn from Hillier 1996)

Spatial configuration will be discussed in different ways here. While the above mentioned criterion on the degree of overlap between movement and occupation will be discussed discursively on the basis of the openness of the layout, the detailed spatial configuration regarding the degree of choice is analysed quantitatively in two distinct ways, both of which build on investigating a single floor of each of the five school buildings in the sample by the following means: 1) through a segment analysis based on a so called axial line map; and 2) through the prevalence and ratios of different types of spaces, so called ABCD spaces.

An **axial line map** represents potential lines of movement through a building (Bafna 2003), so that a line runs through the whole length of a corridor and interconnects with other lines when corridors meet, or classroom spaces connect to a corridor via doors. Connections are modelled to depict reality as closely as possible e.g. the lines coming out of two adjacent classrooms are only connected via the corridor and not connected directly. In open spaces, the minimum set of lines is constructed in a way that all relevant areas of a floor plan are connected, reached and covered. Latest developments in space syntax analysis of urban areas, where long axial lines are broken into shorter segments at each intersection (Hillier and Iida 2005) are followed and an analysis of segments is undertaken. Of particular interest for this chapter is the measure of choice, which identifies those segments in a spatial system that show the highest opportunities for being chosen as a movement path from any single location to all other locations due to their strategic location. Based on the human propensity to favour straight lines in navigation and perception (Conroy Dalton 2003), the measure of Normalised Angular Choice (NACH) was calculated (Hillier, Yang, and Turner 2012), which models routes with less angle change as less costly and more likely to be followed. This analysis views choice as a global property and considers the location and connectedness of a space in the wider system of overall configuration.

The second analysis presented here is the categorisation of spaces into space types as distinguished by Hillier (1996) into A-spaces, B-spaces, C-spaces and D-spaces. This so called **ABCD space analysis** considers the strategic location of each space in its local neighbourhood with a particular focus on 'ringiness'. An A-space is defined as a dead-end space with only one connection to the overall spatial system. Classrooms with only one door are classic examples of an A-space. B-spaces have two connections and typically lead to an A-space. They do not lie on a ring of spaces. Corridors with a dead end that lead to two classrooms would be B-spaces leading to two A-spaces, the classrooms themselves. C-spaces have two or more connections and lie on a single ring, which means you can come into this space from one end and leave it through another space without having to retrace your

steps. Classrooms with two doors connecting to different corridors, or for instance, corridors around an atrium create a sequence of C-spaces, since they form one ring. Finally, D-spaces are characterised by lying on two different rings. They have the highest degree of local choice, since you can enter a D-space from one side and choose among at least two exits, which both connect back to the wider spatial system. Open spaces often create D-type rings, or also two parallel corridors with multiple links, for example via classrooms with doors towards either corridor. Thus, this analysis focuses on choice from the perspective of the local context rather than the global view taken in the segment analysis.

In the literature, an ABCD space analysis is typically based on convex spaces (rooms) and in many cases focused on museum buildings. For instance, Tzortzi (2007) discussed the importance of an ABCD type analysis in gallery layouts intensively by calculating ratios of A-, B-, C- and D-spaces and noting that most museums in her sample were dominated by C-spaces (more than 50% of spaces) with an almost complete absence of B-spaces. Museums with a lack of choice (low D-spaces ratio) often counteracted this with a high proportion of A-spaces directly connected to rings of C- and D-spaces in order to provide overall integration and compactness of routes, whereas other museums with a high D-space ratio enabled a diversity of paths available to visitors.

In this chapter, the ABCD space analysis was based on the segment map. All spaces were categorised, counted and ratios of A-, B-, C- and D-spaces were calculated. Results of the analysis are presented next.

Choice and Overlap: Five contemporary school buildings

A sample of five contemporary school buildings was chosen for the comparative analysis in this chapter. The cases were selected based on several criteria: they were recently built secondary schools, either in the UK or elsewhere in Europe; they were widely recognised as exemplary, best practice schools and praised either in official ratings (such as OFSTED in the UK) or publicised in both academic publications or more popular media; an account of user experience was available through prior research or coverage in the media; they were also chosen to represent a mixture of various degrees of openness in their spatial structures. The five schools, Chelsea Academy, Kingsdale Foundation School, UCL Academy, Ørestad Gymnasium and Hellerup School are now introduced.

Chelsea Academy

Chelsea Academy was designed by Feilden Clegg Bradley Studios and completed in 2010. Located on a constrained plot in the London borough of Kensington and Chelsea, it is a compact school building, raising over six floors and accommodating 1050 pupils aged 11-18 across a total floor space of 10,960 sqm. The building is composed of three different blocks of different heights, which are connected via interior corridors, but also open roof gardens. Open stairwells provide light and visibility across floors. Two parallel corridors with multiple cross connections run through the entirety of the overall L-shape of the building giving access to the closed classrooms, which are arranged around the edge of the building (see figure 2).

The school is structured in a rather traditional corridor and classroom layout. The segment analysis highlights the double corridor circulation system as the spaces of highest choice with an overall relatively hierarchical distribution of choice. The two parallel corridors attract high levels of choice and thus offer the highest potential for through movement, whereas all other areas clearly remain secondary. Despite the traditional corridor layout, the levels of choice in the spatial system are considerable with the highest overall choice values of all five schools (see table 1 below). The ABCD analysis highlights a predominance of A and C type spaces (see figure 7 below) with ratios of 43% and 35% respectively. The low occurrence of D spaces (12%) shows that locally there is often not much choice where to go.

Figure 2: Floor plan of 1ˢᵗ floor of Chelsea Academy (courtesy of Feilden Clegg Bradley Studios), overlaid with segment analysis showing the distribution of Normalised Angular Choice; segments in warm colours (red, orange, yellow) have higher NACH values, while segments in cooler colours (green, turquoise, blue) have lower NACH values

User experience at the Academy can be gauged from the discussion in the doctoral thesis of Williams (2017), which featured the school among three others designed by the same architectural practice. According to Williams, pupils commented on the layout of the school rather negatively. A particular concern of the pupils was the circulation system, since the school had to implement a one-way system to ease overcrowding between lessons.

Regarding the overlap between movement and occupation, as a closed classroom school operating a lesson based rather traditional curriculum, this is naturally limited, although the architects provided glass panels in the doors, so that a visible connection to the corridor is established. This is appreciated by the students, who commented: "I like how you can look in the window to see if your teacher or friends are in the class" (Williams, Sailer, and Priest 2015, 15).

On the whole, Chelsea Academy is rather strongly classified spatially, however offers some relaxation of classification with more weakly classified design strategies interspersed, for instance the double corridor, or the visual connections into classrooms.

Kingsdale Foundation School

Kingsdale Foundation School is a secondary school in the London Borough of Southwark, designed by the architectural practice dRMM in 2004. On three floors and a total floor area of 14,191 sqm, 1700 pupils aged 11-18 are educated.
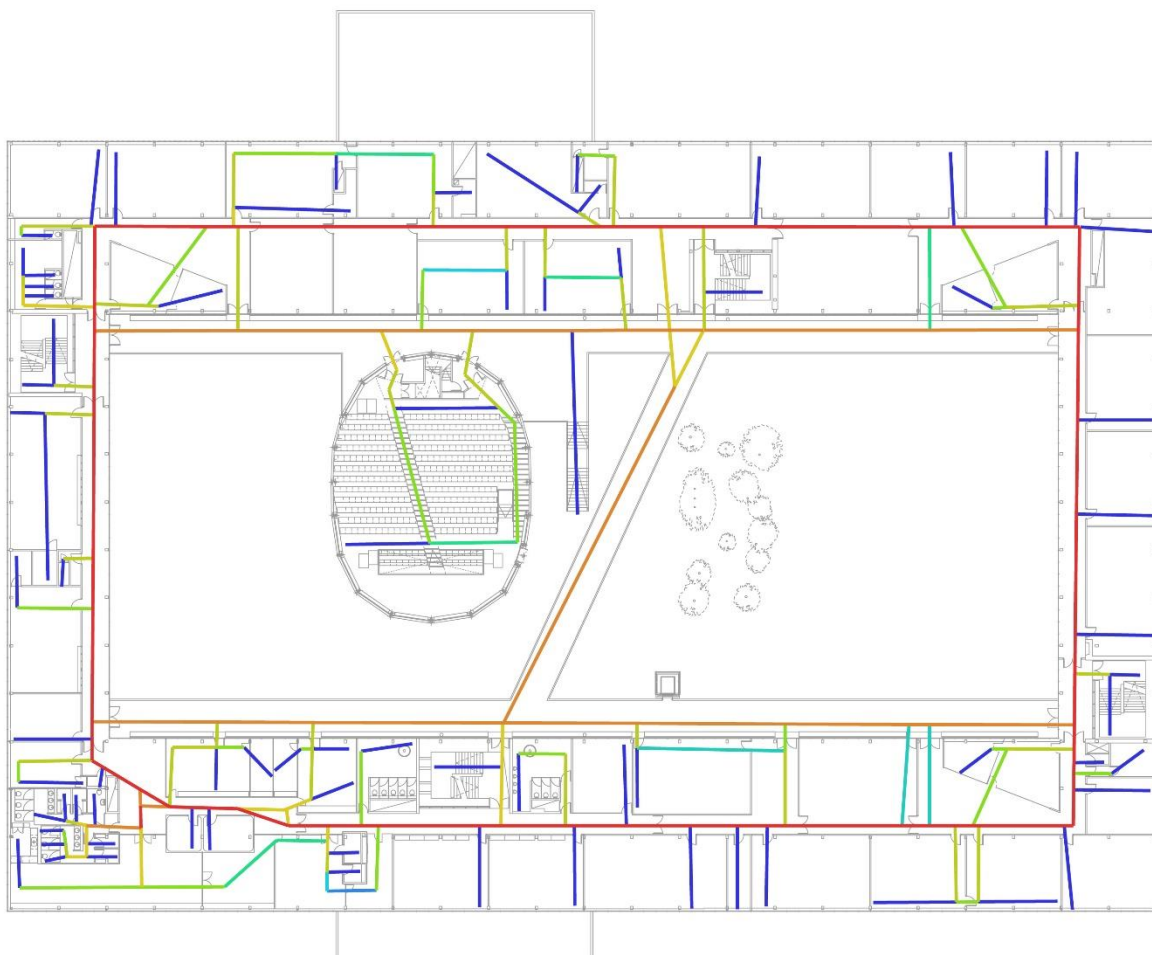

Figure 3: Floor plan of 1st floor of Kingsdale School (courtesy of drmm), overlaid with segment analysis showing the distribution of Normalised Angular Choice; segments in warm colours (red, orange, yellow) have higher NACH values, while segments in cooler colours (green, turquoise, blue) have lower NACH values

The school is centred around a large courtyard, which was turned into an interior space by a large roof introduced by dRMM in their 2004 transformation project. What was previously a failing school, notorious for bullying and exclusions, and known for very low achievement records and OFSTED ratings, was transformed by a new headmaster alongside an architectural intervention, as explained in the TV programme 'The Secret Life of Buildings' (Channel_4 2012). According to headmaster Steve Morrison, the old buildings' narrow corridors bred conflict, as pupils rushed towards classes, described as "an avalanche of bodies" by project architect Alex De Rijke. Therefore, dRMM introduced a new walkway on the first floor, as well as the atrium on the ground floor as crisscrossing space to allow for choice of movement, but also to calm down and 'deinstitutionalise' the space. Most classes take place in closed classrooms, but some spaces open up (mainly on the second floor, which is not shown here) and the corridors widen at certain points. Similar to Chelsea Academy, visibility links between corridors and classrooms are established through the use of glass panels. Thus, to some degree movement is brought into contact with occupation. The main

circulation space, a double loaded corridor through the core of the building attracts the majority of spatial choice, as evident in figure 3, yet the new walkways along and across the atrium double up and indeed provide a wider spread of choice in the spatial layout. Choice is rather widely distributed throughout the whole floor plate. The overall system ranks in the mid-range in comparison to the other schools regarding choice (see table 1) and almost a quarter of all spaces are D-spaces, which means choice is also available locally.

Judging by its website[iii], Kingsdale School seems to follow a rather traditional pedagogical approach, not unlike Chelsea Academy, yet with a stronger focus on respect, tolerance and diversity.

In summary, Kingsdale School is comparable to Chelsea Academy, yet with a wider spread of choice across the floor plate, the presence of the atrium offering lots of choice of movement paths, more D-spaces and also more overlap between movement and occupation, Kingsdale School could be argued to be less strongly classified spatially than Chelsea Academy.

UCL Academy

In 2012, a completely new comprehensive secondary school in London Camden opened its doors to pupils aged 11-18 in the Swiss Cottage area, supported and co-sponsored by UCL and designed by Penoyre & Prasad LLP. In 2016 the school reached its full capacity of 1150 pupils. Arranged across six floors and a total area of 10747 sqm, the school is structured into an elongated U-form and wraps itself around outdoor facilities on the ground and lower ground floor.
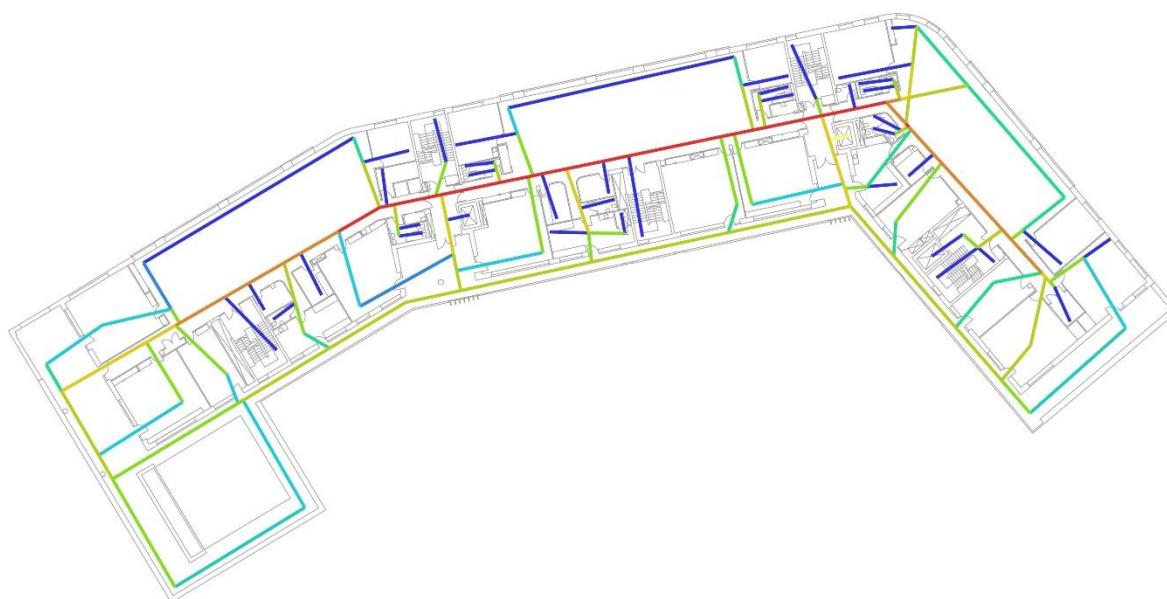

Figure 4: Floor plan of 4th floor of UCL Academy (courtesy of Penoyre & Prasad LLP), overlaid with segment analysis showing the distribution of Normalised Angular Choice; segments in warm colours (red, orange, yellow) have higher NACH values, while segments in cooler colours (green, turquoise, blue) have lower NACH values

The central corridor running through the whole length of the building is doubled up by an exterior corridor, both of which are cross connected multiple times via classrooms and corridors. The interior corridor acts as main point of access to all classrooms, staff offices and staircases and it also leads past the open 'superstudios' arranged on the outer side of the building. Thus, it attracts the highest choice values in the system (figure 4). In contrast, the exterior corridor plays a secondary role due to fewer strategic connections, clearly evident by

lower choice values (see figure 4). This is reflected in how the corridors are used. Anecdotal evidence from conversations with teachers suggests that the exterior corridor is used less frequently than the interior one, despite teachers preferring students to take the exterior path. With the highest maximum NACH values (see distribution in figure 7), a total of 37% of D-spaces (the highest in the sample) and the lowest proportion of A-spaces (28%), UCL Academy offers a lot of local choice for movement. Combined with a rather high overall average of normalised angular choice, this school can be considered rather weakly classified regarding choice for movement. Overlap between movement and stationary activities is also maintained through the superstudios, which are open learning spaces, holding up to 90 pupils at a time. UCL Academy uses an approach of a combined cross-disciplinary pedagogy, where three classes can be brought together to work on a challenge from different angles (e.g. Maths, History and English). In this setting, pupils work on various tasks, alone or in small groups.

The openness of the central corridor towards the superstudios brings teaching and learning activities into a rather close connection with movement and as such highlights a spatial system of medium to weak classification.

Ørestad Gymnasium

Designed by the Danish architects 3xn, Ørestad Gymnasium is a secondary school in the Ørestad district of Copenhagen. It was opened in 2007 and teaches 1200 pupils from the age of 16-19 with a curricular focus on natural sciences, social sciences, languages (including Mandarin), journalism, media and arts. The building spans across six floors and with 12,000 sqm is the second largest in the sample.

The centrepiece of the design is a large circular staircase. Boomerang shaped floor plans are rotated around the central staircase, so that multiple views up, down and across the spaces are created. Each floor plate accommodates different study zones, which are generally open with only few traditional classrooms. Instead, a multitude of areas are created to host different teaching and learning activities, often supported by the use of technology.

The highest levels of choice for movement are found around the staircase (figure 5) and choice is distributed across the whole floor plate. Despite its high degree of openness, choices for movement are rather limited with overall low values of NACH and only 14% of D-spaces. Instead Ørestad is characterised by a high proportion of C-spaces (41%) in combination with many A-spaces (34%), which makes for a compact and integrated layout, similarly to what Tzorzti (2007) discussed for museum spaces. In effect, movement is efficient, but rather pre-determined regarding choice. Due to its open plan layout and the predominant use of glass panels instead of solid partitions for the classrooms, there is a relatively high degree of overlap between movement and activities.

Architect Kim Herforth Nielsen of 3XN described the staircase as a catalyst for social life, a catwalk, where students like to spend time in informal settings and find their friends (Ørestad_Gymnasium 2013). In the same video, the school was also compared to a business, where students collaborate to produce knowledge. Principal Allan Kjær Andersen made an explicit link between the building structure and teaching practices: "It is a building that fits the pedagogy we're aiming for and that forces us to work differently" (Ørestad_Gymnasium 2013). According to teachers, a third of lessons take place in completely open spaces and often require the teachers to be more structured and plan ahead. The teaching practices require adjusting, for instance communication is often mediated via technology, so that noise does not become an issue (WISE_Channel 2015). Despite the promise that pupils and teachers can always find an intimate place to be (Ørestad_Gymnasium 2013), supported by the diversity of spaces, teachers reported issues with privacy, for instance when the need to lead difficult or confidential conversations with a pupil arises (Sylvest 2016).
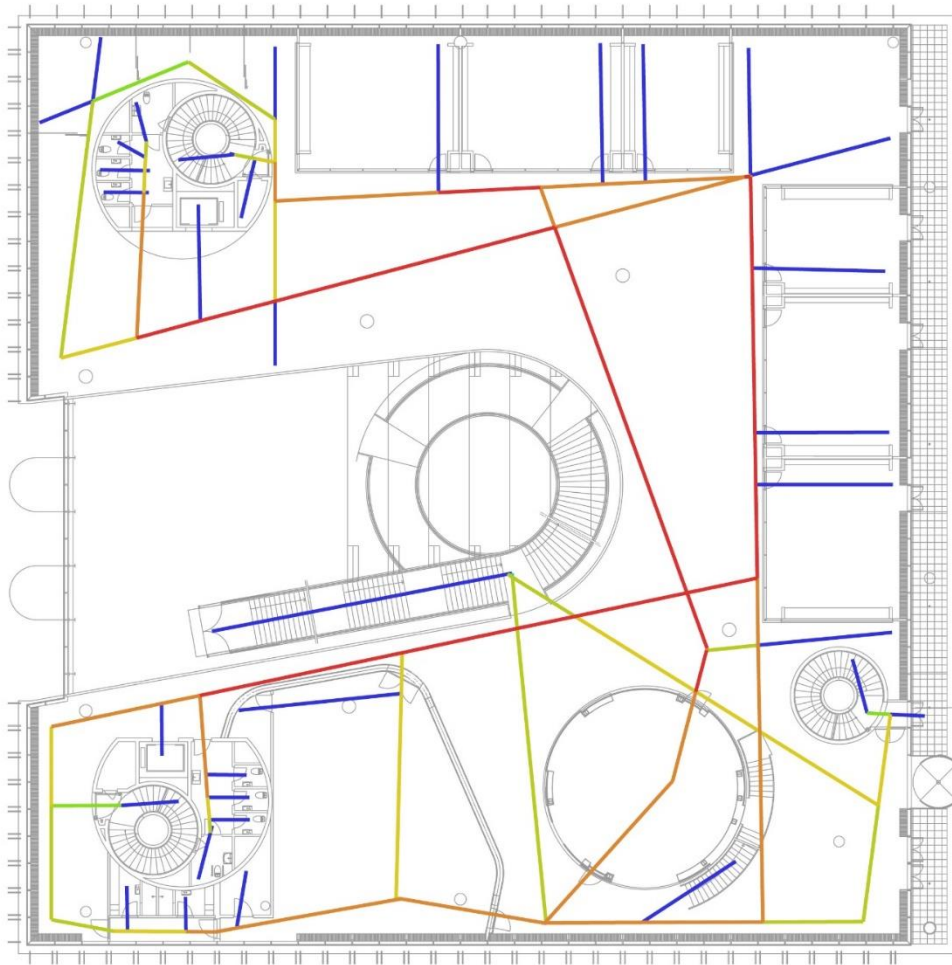
Figure 5: Floor plan of 1st floor of Ørestad Gymnasium (courtesy of 3xn), overlaid with segment analysis showing the distribution of Normalised Angular Choice; segments in warm colours (red, orange, yellow) have higher NACH values, while segments in cooler colours (green, turquoise, blue) have lower NACH values

On the whole, the spatial system of Ørestad Gymnasium can be characterised as weakly classified concerning the overlap between movement and occupation, but rather strongly classified regarding choice of movement. It seems that both factors jointly contribute to the aspired culture of collaboration and interaction, where openness allows for people passing to be part of the activities of others while the limited degree of choice brings people together on fewer concentrated routes rather than distributing them throughout the floor plate. This is described by a teacher as follows: "I think it is so cool when you walk around, that you can see your co-workers: 'Oh, someone is teaching there, what is he or she doing?' Then you can stand there and watch and think: 'okay, that is another way, I could also have done it like that'" (Sylvest 2016, 117). Therefore, the school's unusual degree of openness in its layout matches its aspirations to implement forward thinking and constantly developing ways of teaching[iv].

Hellerup School

Built in 2002 on the outskirts of Copenhagen, Hellerup School is a combined primary and secondary school for a total of 750 pupils from the age of 6 to 16. It was designed by Arkitema Architects as a compact, square shaped open-plan school across three floors and a total area of 8,200 sqm with each floor dedicated to one age group (6-9 year olds, 10-13 year olds and 14-16 year olds). Instead of classrooms, home areas are shared between different classes

and act as a base from which activities can then spread across the different spaces. A central staircase connects the floors and also acts as a place for pupils to sit on, both for social and learning activities. The architects have described the school as a "network school, in which the physical and psychological distances have been minimised" (Weissenborn 2010, 5).

The spatial analysis reveals a well distributed core of high choice values around the central staircase (figure 6), yet compared to the other schools in the sample, with the lowest overall average NACH values. This means that on a global scale (for instance moving from one corner to another) movement choices are slightly limited. This is compensated by high levels of local choice due to the high proportion of D type spaces (29%; the second highest figure in the sample). If C and D spaces are taken together, 64% of spaces are covered, which highlights the many local loops in the system of potential movement paths. In effect, actual movement flows as observed in a study by Weissenborn (2010) are rather distributed across the floor plate. Regarding choice for movement, the spatial system of Hellerup school can be considered rather weakly classified.

Figure 6: Floor plan of 1st floor of Hellerup School (courtesy of Arkitema), overlaid with segment analysis showing the distribution of Normalised Angular Choice; segments in warm colours (red, orange, yellow) have higher NACH values, while segments in cooler colours (green, turquoise, blue) have lower NACH values

Due to the very open layout, activities and movement are inseparable. Even in spaces traditionally considered purely for circulation such as the staircase, learning and socialising activities take place frequently (Cohen 2010). Two particular aspects of appropriation and usage highlight how pupils and teachers successfully work with the high degree of visibility and lack of privacy (Weissenborn 2010): firstly, pupils seek more segregated and smaller spaces for individual, concentrated work, especially on the upper floors; secondly, teachers report using furniture actively to create more intimate spaces: "We as teachers and the children [create small intimate spaces with inventory] on a daily basis. We use mobile partition walls to eliminate visual and audio-based noise. Sometimes it also helps us induce a clarity or a feeling of something a bit more defined […]. It is helpful for the children – especially the

younger children, or the not-so-integrated children – to have a sensation of 'this is us, this is where we are!'. It is not just about closing off a section during a class, it is also about creating a sense of joint ownership." (Weissenborn 2010, 26)

In summary, Hellerup School brings movement and occupation into close connection. Combined with high levels of local choice for movement, this makes the building weakly classified according to both criteria discussed here.

Comparative Discussion: Choice and Overlap in School Buildings

Finally, to bring the case studies together into a comparative discussion, table 1 summarises important facts and figures of each school again, as well as aggregate syntactical metrics as discussed above (average normalised angular choice, numbers of A-, B-, C- and D-spaces), whereas figure 7 illustrates the distribution of choice values and the proportion of space types alongside the footprint of the floor plates of the five investigated schools.

School	No of pupils	Tot. Area [sqm]	No of floors	Ave. NACH	Space Type Analysis				
					A	B	C	D	Total
Chelsea Academy	1050	10960	6	0.890	55	13	45	16	129
Kingsdale School	1700	14191	3	0.851	77	35	77	57	246
UCL Academy	1150	10747	6	0.852	39	12	45	57	153
Ørestad Gymnasium	1200	12000	6	0.819	34	11	42	14	101
Hellerup School	750	8200	5	0.788	34	8	42	34	118

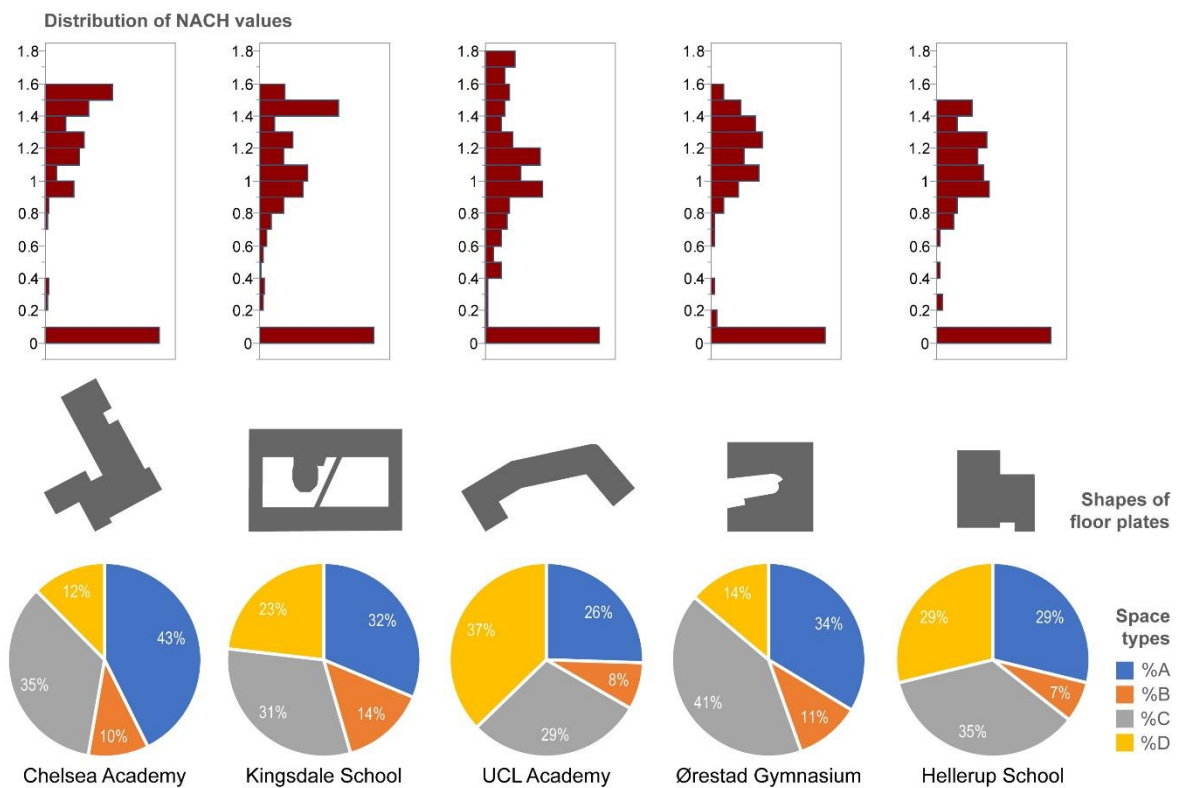Table 1: Facts and figures for each school

Figure 7: Overview of the five schools: distribution of NACH values, representative footprints of floor plates and pie charts of proportion of ABDC type spaces

It was shown in the analytic evaluation of each school building how levels of choice varied. Looking at global choice (i.e. which routes building users are most likely to take when moving across the space of a floor plate from any location to every other location) as well as local choice (i.e. the degree of ringiness allowing building users to choose going left or right, or via one route or another), it became apparent that some school buildings may offer high degrees of choice on both scales (UCL Academy), whereas the majority of cases presented here do one or the other: allowing local choice, but not so some global choice (Hellerup School); or in contrast enabling global choice, but rather limited local choice (first and foremost Chelsea Academy, but to some degree Ørestad Gymnasium too). Similar to UCL Academy, Kingsdale School presents a rather balanced model of local and global choice, yet on an overall lower intensity.

It was also highlighted how the school designs differed regarding openness and bringing movement and occupation into close connection. Hellerup School was the most open and connected building, followed by Ørestad Gymnasium and UCL Academy. Kingsdale School and Chelsea Academy were seen as keeping movement flows and other activities more strictly apart.

Taking all of this into account, the schools can now be placed in a 2x2 matrix (see figure 8) with the degree of choice on the x axis and the degree of overlap between movement and occupation on the y axis. The schools occupy different quadrants of the matrix: Hellerup School and UCL Academy show weak classifications for both criteria, although Hellerup excels more on the overlap, while UCL Academy is more open on choice. In the opposite corner, Chelsea Academy and Kingsdale School can be found, where both criteria were considered rather strongly classified, albeit more pronounced in the case of Chelsea. Ørestad Gymnasium sits in the top left corner, more strongly classified regarding choice, but with a weak classification on overlap of movement and other activities.

Pedagogical approaches coincide with this classification. While Chelsea Academy and slightly less so Kingsdale are rooted in more traditional teaching approaches, the other three schools embody more experimental and forward-thinking pedagogies.
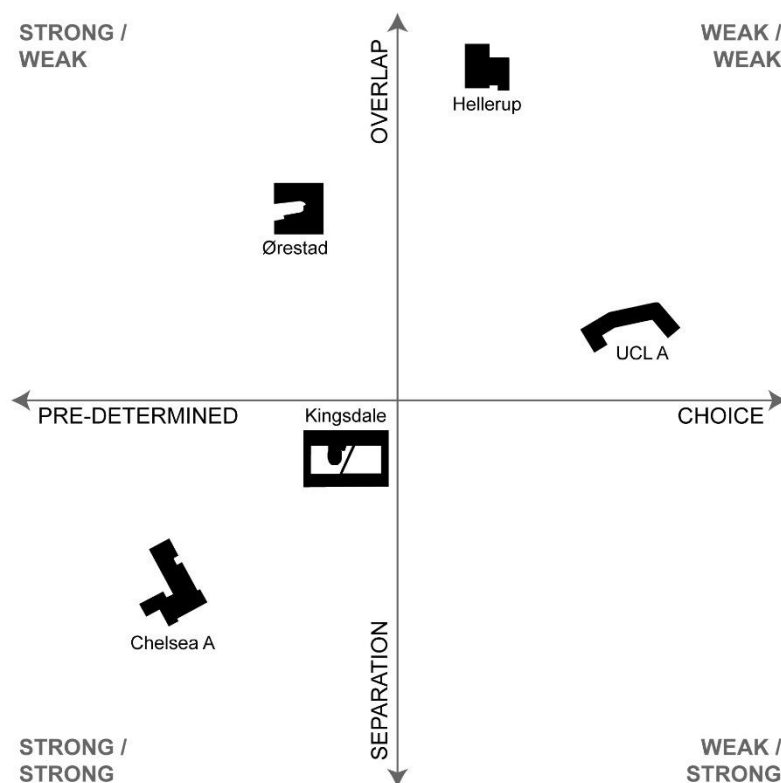

Figure 8: Characterisation of the five schools as weakly or strongly classified according to both criterion of choices for movement and degree of overlap / separation between movement and occupation

No school in the sample fits into the corner of high choice but strong separation between movement and occupation. However, this does not mean this combination is impossible. It would be easy to think of a school building with a traditional closed classroom structure with solid partitions and no visibility between teaching / learning and movement flows, but at the same time offering global movement choice (for instance through multiple staircases and parallel routes and corridors) or local choice (for instance by arranging multiple doors leading into each classroom). This model can be found in larger, more complex pedagogical buildings, such as universities, but also for instance in the fictional school building of Hogwarts School of Witchcraft and Wizardry (Sailer 2015), as featured in the Harry Potter novels and movies. Hogwarts is described as a labyrinthine school, where pupils frequently get lost in the myriads of corridors and staircases, but also where classrooms are closed and no visual connections between corridors and classrooms exist. This is paired with a dysfunctional pedagogic approach (Tiffin 2015). However, Hogwarts is not a strictly sealed off school though, as shown in an analysis of learning episodes by Sailer (2015), which highlighted that classrooms only accounted for 10% of learning with almost half of all learning taking place in public spaces of the school such as corridors, courtyards, the Great Hall or outdoor spaces. It would still be a school with overall rather strong classification in the overlap of movement and activities combined with weak classification regarding choice.

Two main lessons can be learnt from the analysis and evaluation presented here for designing school buildings in the future.

Firstly, the often-made distinction between open and closed school buildings may be less useful than commonly assumed. The analysis presented here draws a much more nuanced picture of the spatial layout as an interrelated system of affordances for various social behaviours. It is noteworthy that the differentiating factors discussed here do not split the sample neatly into open and closed schools. It is rather the orchestration of the overlap between movement and occupation in conjunction with different degrees of choice that seems to give rise to different types of weak or strong classification.

Secondly, the discourse on school buildings and pedagogy often focuses on providing a close match between the envisioned pedagogy and the school design. It is argued that traditional pedagogy is best accommodated in more traditionally structured school buildings, while more open school buildings are best suited to innovative pedagogical approaches. The analysis presented above gave glimpses into a different understanding of pedagogy and space. Following the argument of Peatross and Peponis (1995) it could be maintained that space does not just reflect pedagogical principles, but can also complement them or even shift pedagogical codes. For instance, the adaptations made by teachers in Hellerup School to provide more intimacy in a flexible way shows how space can be used to temporarily counteract the overall agenda of openness. Another adaptation is the rule-based intervention in Chelsea Academy implementing a one-way system of movement in the corridors, which counteracts the high levels of choice present in the spatial configuration and introduces a stricter form of classification, which creates reverberations for behaviours but also pedagogical principles such as the interfaces between pupils outside classrooms.

Conclusions

This chapter took the idea of the corridor as an important element in school design as basis for a configurational analysis of the relationship between corridors and classrooms (or spaces for movement and spaces for learning / teaching). It compared five contemporary school buildings regarding two criteria: the degree of choice for moving around, and the degree of overlap between movement and occupation. The Bernsteinian concept of classification was applied to understand configurational differences between the schools. It was shown how the interplay of various spatial features had consequences for social behaviours in the school buildings (seeing others, learning from others), but also how design choices supported or complemented pedagogic principles.

The present study has limitations to consider. Firstly, only five buildings were studied and comparisons across different cultures and countries have to be interpreted with caution. Secondly, the availability of source material differed across the sample. Not only were some schools studied more rigorously and in depth than others, but also the methods used in the underlying secondary sources differed, so that the sketch of social behaviours and pedagogic practices in the schools necessarily remains limited. Future research would benefit from a larger sample and a more unified approach in capturing behaviours and pedagogy. Another related topic of great research interest has barely been touched by this chapter and that is the relation between school design, social behaviours, pedagogy and good pupil outcomes. Previous work highlighted how difficult it is to relate school design and attainment (Williams et al. 2014, Fouad and Sailer 2017), and this is supported by the analysis presented here which showed very different layouts and design choices implemented in different schools, which are all considered award-winning, innovative or highly successful. This warrants further investigation. In addition, the role of culture and atmosphere is often not considered strongly enough in research. It could be hypothesized that a forward thinking pedagogical approach can only then operate smoothly in an open school building if it is supported by a positive and adaptive organisational culture. Further research is needed here.

To conclude, the configurational analysis presented here has challenged the clear-cut categorisations of schools as open or closed and instead has drawn a nuanced picture of different spatial qualities giving rise to different social behaviours. While this marks the beginning of an increased understanding of how space (in its various forms, factors and dimensions) relates to behaviours and pedagogy, much remains to be done to more fully grasp the role of a school building as an enabling, easing, facilitating or speeding up pedagogical device, or in contrast one that may also hinder, slow down, or make things harder.

Acknowledgements

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[i] http://www.etymonline.com/index.php?term=pedagogue (Last accessed: 31 July 2017)

[ii] Interestingly, the first teacher in this context was seen as the child with adults acting as second teachers.

[iii] http://kingsdalefoundationschool.org.uk/Vision-Values/Our-Aims-and-Values (Last accessed: 30 September 2017)

[iv] Ørestad Gymnasium collaborates with different pedagogical research institutes in Denmark to actively develop its teaching practices. See: https://oerestadgym.dk/in-english/out-teaching-2/ (Last accessed: 30 September 2017)