

#33

SPATIAL CONFIGURATION SHAPES STUDENT SOCIAL AND INFORMAL LEARNING ACTIVITIES IN EDUCATIONAL COMPLEXES

XIANFENG WU

University of Nottingham
xianfeng.wu@nottingham.ac.uk

STEPHEN LAW

University College London
stephen.law@ucl.ac.uk

TIM HEATH

University of Nottingham
tim.heath@nottingham.ac.uk

KATHARINA BORSI

University of Nottingham
katharina.borsi@nottingham.ac.uk

ABSTRACT

Notable gains have been made in understanding the factors that influence student experiences in higher education, particularly in the area of spatial configuration. Indeed, studies have found that spatial configuration affects spatial behaviour and movement patterns (e.g., Hillier et al., 1993). Increasingly physical and spatial supports are provided to ensure the efficacy and efficiency of learning activities in higher education (Higgins et al., 2005; Brown & Long, 2006; Dugdale & Long, 2007; Dugdale, 2009). Consequently, the informal learning spaces became a pivotal architectural design strategy for universities to enhance interior design quality and improve learning environments. It is definitely an effective way to improve learning performance in the higher educational facilities if well-designed informal learning spaces could improve student experiences within them. Even though the development of purpose-built informal learning spaces is a strategy to enhance student experiences, it is becoming more prevalent. The empirical research in this area is still lacking. What appears to be missing in this enquiry is how the built environment, namely the shape of the learning environment, influences student activities.

Using Hillier's (2007) definition of intelligibility as the relationship between local and global configurational factors, this paper aims to examine the impact of spatial configuration upon frequency of student activities in an educational complex based on space syntax theory and behavioural observation. In order to achieve this assumption, we correlated the data between the observation data of the frequencies of six student activities: Focused Informal Learning, Serendipitous Encounter, Intermittent Exchange, Focused Socialising, Dietary Related Activities and Ambient Sociality. The spatial attributes were derived from space syntax theory in an educational complex of the University Park campus in the University of Nottingham: Coates Building - Pope Building - ESLC area. More specifically, there are five informal learning spaces in the educational complex in total. The frequency of the six types of student activities were

examined in five informal learning spaces in this educational complex. The findings confirm that spatial configuration and patterns of spatial usage are related to each other. The main finding is that there is a correlation between the degree of connectivity of the area and frequency of student activities. The finding suggests that spatial configuration may play an important role in determining frequencies of students socialising and informal learning activities.

KEYWORDS

Informal Learning Spaces, Space Syntax, Student Experiences, Educational Complex

1. INTRODUCTION

Due to technological advancements, there appears to be an increasing amount of blended learning experiences happening in informal learning spaces. Learning is moving towards being more collaborative (active learning with hands-on experience), integrated (multidisciplinary), blended (learning take place anywhere/anytime, mobile technology with social activity), immersive (with simulated or real-world experiences) and Hybrid (activities, combining online with fact-to-face, augmented with mixed reality experiences) (Dugdale & Long, 2007). Combining Informal learning within social spaces is an effective way to improve learning experiences in the campuses. What appears to be missing in this enquiry is how the built environment, namely the shape of the environment, influences informal pedagogy.

This paper looks at an educational complex – the Coates Building - Pope Building - ESLC area of the University Park campus in the University of Nottingham. The roles of the informal learning spaces on student experiences are compared. Three stages of the study were conducted separately. Firstly, the observational data of student experiences, including six degrees of learning processes and consisting of Focused Informal Learning, Focused Socialising, Intermittent Exchange, Dietary Related Activities, Serendipitous Encounter, and Ambient Sociality, were accumulated through behavioural mapping in these informal learning spaces, to record where and what behaviours happened. Secondly, investigations of spatial configuration were analysed using space syntax accessibility and the intelligibility of buildings through the space syntax methodology. Lastly, the relationship between the space syntax indices and observed behavioural data were correlated.

In complex educational buildings, spaces such as cafeteria, atriums and courtyards, cannot be solely understood as simple passageways or links between formal learning spaces, since they achieved another role in the everyday life of the learning environment - informal learning. Both social interactions and informal learning consist of student experiences in the complex educational buildings. The importance of a non-designated space for students to work together outside the classroom is increasingly being recognised for its educational value and contribution to creating a sense of community (Dugdale & Long, 2007). In order to create informal learning spaces to improve student experiences, it is imperative to recognise where and what students do when they are staying outside of the classrooms by means of revealing the relationship between student experiences and spatial configuration for the educational complex design and plans. This research seeks to identify the usage of informal learning spaces in the learning environments and to examine the value of the spatial configuration of informal learning spaces in all the learning environments for student's activities.

2. LITERATURE OVERVIEW

One strand of enquiry in the built environment is the application of space syntax methods in educational settings. These techniques were found to be appropriate metric for studying spatial usage (see Bullock et al., 1968), wayfinding (Bafna, 2003; Hölscher, Brösamle & Vrachliotis, 2012; Montello, 2007) and in relation to social effects such as social and spatial organisation, complexity of circulation, and adaptability in educational spaces. (Coelho & Kruger, 2015; Da, Dong & Guo, 2015) "Social transformations and technological innovation encouraged the rising of new ways of working and socialising almost without functional space layout constraints

challenging typical patterns of space usage in educational environments by considering the diversity of behaviours where socialisation plays a central role in learning processes (Pera Vieira & Kruger, 2015). Educational practices require a more advanced and innovated learning environment to achieve pedagogical goals.” This innovation changes the spatial configuration of campus planning and results in transformations of people’s study and work habits (Capille & Psarra, 2013). In other words, spatial configuration is reshaping students` habits in the educational settings through technology. Therefore, more informal learning opportunities are required outside of the classrooms.

Crook and Mitchell (2012) propose a more nuanced conception of the ‘social’ in learning and engagement. Focusing more on student activity in the informal learning spaces. They use audio diaries, behavioural observations and on-task conversations (including individual interviews and Focus Group interviews) to suggest that informal learning spaces should be designed for a mixed economy of student choice and a consideration of modes of encouraging diversity in their use. The research identified six categories of activities and the sub-categories, which were coded in each case. From an informal learning process to socialising, four types of social engagement and interaction were listed and layered, based on different degrees of learning processes as shown in Table 1.

Four types of social engagement and interactions	
Focused collaboration	Occasions of traditional, and relatively intense joint problem solving. There are likely to be planned and strongly outcome-oriented.
Intermittent exchange	Whereby students convene for independent study that permits an occasional and improvised to-and-fro of questioning or commentary.
Serendipitous encounter	That is, chance meetings with peers in which study-related issues (and perhaps other matters) are discussed briefly and on the fly.
Ambient sociality	Students identify the importance of simply ‘being there’ as participants in a studying community.

Table 1 - Four types of social engagement and interactions

Source from: *Ambience in social learning: student engagement with new designs for learning spaces* (Crook & Mitchell, 2012)

The research explores a strategy to identify specific student activities in the informal learning spaces. There is also research on specific activities in public spaces (Jung, et al., 2009; Mehta, 2013; Lee, & Lee, 2013) and learning environments (Nair & Gehling’s, 2010; Muslim, 2011). Based on their contribution and a pilot study, this research divided socialising and informal learning activities into six sub-categories according to the degree of the informal learning processes (Table 2). The degree of frequency of the socialising and informal learning activities cannot represent the student preferences of selecting and using the space while it can be determined to examine the degree of engagement. The more the frequency of socialising and informal learning activities occur, the higher the rate of using the space and thus the more the communication happens. There is a series of factors impacting the frequencies of socialising and informal learning activities. The design quality of informal learning spaces is one of the most important factors based on the environmental psychological theory. The next session will focus on what the design quality of informal learning spaces should focus on and what methods researchers use to examine the impact of the frequency of socialising and informal learning activities.

Different degrees of informal learning process (Learning Process & Socialising) (adapted from Crook and Mitchell, 2012)	Learning activities: (The letters in brackets refer to the used sources)
Focused Informal Learning	Prepared coursework Discussed ideas from reading books or lectures Worked with others on coursework Study alone
Intermittent exchange	Talked about career plans Study alone, but with occasional interaction with others Worked with others on activities other than coursework Received prompt feedback from faculty on your academic performance Tutored or taught other students Had serious conversations with students of a different program or department than your own
Focused Socialising	Taken a call Use of tablet, laptop or phone Casual Chatting Taken a break from studies with friends
Dietary related activities	Had a meal Had a snack
Serendipitous encounter (Seeing, greeting or short chats with each other because of encounter)	When you meet a friend of someone you know, but neither of you planned to
Ambient sociality	Attended event such as Exhibitions, Open Day or Coursework Show Found a way to lecture room or gathering for going to another place together Used as a meeting point before or after lectures Peoplewatching Had a rest

Table 2 - Student activities based on the degree of informal learning process

Source from: Adapted by author

3. DATASETS AND METHODS

In order to answer this research question, this paper aims to examine the extent to which informal learning occurs and the impact spatial configurations have upon student experiences in an educational complex based on space syntax theory. Space syntax is a set of theories and techniques which link space and society (Hillier & Hanson, 1984; Hillier 2006). It addresses where people are, how they move and how they adapt. It also addresses how they decorate space and how they are fundamentally influenced by the geometry and the configuration of space. Space syntax views buildings as geometry that orders spatial relations. These are represented as graphs in network science where centrality indices could then be applied. In order to answer the research question, we compare the correlation between the observation data of student experiences and the spatial network properties. Through this we attempt to discover insights for the creation of informal learning spaces to improve student experiences.

3.1 CONTEXT

The studied educational complex was based in the University of Nottingham. The research fieldwork occurred in them with 24/7 access. Despite their discipline specialisms for engineering, the Coates Building - Pope Building - ESLC area includes the most popular and recognised informal learning spaces. Their informal learning spaces were widely used by the students. The work occurred in the main five informal learning spaces (see CA/CB/CC/TEH/ESLC in Figure 1). They are core informal learning spaces in this area. The spaces were intended to support

informal learning activities and socialising but in a form that could be more fluid. The spaces offered seating facilities. As social corridor spaces, Wi-Fi was provided and students were encouraged to communicate in comfortable conditions.

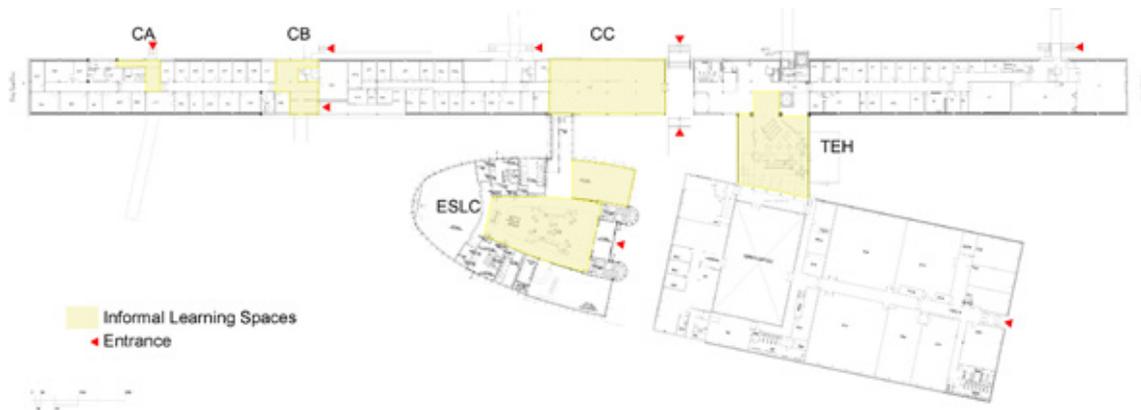


Figure 1 - Five social informal learning spaces in educational complex (CA, CB, CC, TEH and ESLC) (CA=Coates building space A; CB=Coates building space B; CC=Coates Cafe; TEH=Telford Exhibition Hall; ESLC=Engineering Science Learning Centre)

3.2 PROCEDURES

Fieldwork would take place over 10 days spread across one month in the term week. Prior to starting, notices were displayed announcing the presence of a researcher across the specified dates. Student activity and attitude data were collected according to the following three methods. All student participants were voluntary.

- Behavioural Observations

Behavioural observations are used to generate objective behavioural records, randomly sampled across users of informal learning spaces. The observations of informal learning spaces were carried out in the educational complex for a whole standard semester week (from 21st Nov, 2016 to 25th Nov, 2016). The walk-bys and timed observations could be employed in selected hours over 5 working days (from 8am to 10am, from 12pm to 2pm, from 5pm to 7pm and from 8pm to 10 pm). Each 'session' lasted two hours and there were 4x10x120-minute observations sessions in each case. One session occurred in the evening and three in the day during every day. Four vantage observation points were selected to ensure comprehensive coverage: a single observation session thus comprised six 20-minute 'cycles' of recording. The activity of each student in an area was scan-sampled (Altmann, 1974) four times, once every five minutes. A laptop was used to manipulate a visual map of the space which was constructed afresh and conducted in a PowerPoint file for each observation cycle. The spatial characteristics, six types of student activities, the location of each student and notes could be made using the PowerPoint note-taking tool. Pilot sessions using phone pictures presented a poor result while using PowerPoint software on the laptop proved to be a better way for managing data. The observation occurred in the core informal learning spaces. The participants were made aware of the observation process through the usage of posters displayed in the building. The posters were displayed on the information boards and other visible places. The posters illustrated the purpose of the usage of the data and the contact details of the researcher. All the methods used were strictly in accordance with the University of Nottingham's code of conduct and research ethics approval. Through the observation, the data of six types of student activities like: Focused Informal Learning; Focused Socialising; Intermittent Exchange; Dietary Related Activities; Serendipitous Encounter; and Ambient Sociality, were obtained. Finally, once during each observation cycle, the number of students was counted and the length of stay within the spaces of each student was calculated.

- Space Syntax Methodology

In order to examine the relationship between spatial configuration and the six types of student activities, the method of space syntax would be employed in the complex building. We would first construct what is known as a convex map graph (G) in space syntax made up of rooms as the nodes and the connections between rooms as edges. This study in particular would employ the space syntax measure of integration also known as closeness centrality in the network science literature (Hillier and Hanson, 1984; Hillier et al., 2012). The index measures the reciprocal average shortest topological path between every origin (i) to every destination (j) or, more simply, the average distance to reach all nodes in the system (Freeman, 1977). Empirically, closeness centrality had been found to associate positively to movement demand.

$$CC_i = \frac{N - 1}{\sum d_{ij}} \quad (1)$$

Where N is the number of nodes in the network
 CC_i is the closeness centrality at i
 d_ij is a measure of impedance between i and j
 Equation (1)

4. RESULTS

	CA	CB	CC	TEH	ESLC	Total
FIL	0	0	163	160	11	334
FS	33	54	144	183	124	538
IE	9	13	78	62	53	215
DRA	15	20	231	151	11	428
SE	97	80	57	64	87	385
AS	13	15	31	36	34	129
Total	167	182	704	656	320	N/A

Table 3 - Frequency of six activities in five core informal learning spaces (Number of people involved)

Focused Informal Learning (FIL); Focused Socialising (FS); Intermittent Exchange (IE); Dietary Related Activities (DRA); Serendipitous Encounter (SE); Ambient Society (AS)

Based on the observation methods, it can be clearly seen that CC, TEH and ESLC are informal learning spaces with more blended student experiences in the educational complex (Table 3). The main activities in the informal learning spaces are for socialising and the informal learning process require a higher requirement on basic facilities. More specifically, CC and TEH held over 67 percentage students in the whole educational complex, which included 42.3 percentage and 43.6 percentage of informal learning activities, respectively. The convex map is shown in Figure 2. There appears to be association between spatial configuration and student behaviours (Table 4). Spaces with greater integration such as CC, THE and ESLC have a greater frequency of student activities. This is logical as these are spaces that are more central and thus more accessible and legible to everyone. These are central spaces to wait in before classes start, to socialise with other students, to study, to eat and to meet others.

CC and TEH had more DRA activity. CC is the main food court in this educational complex while only vending machines are provided in the TEH. However, there are lots of spare and comfortable chairs and tables provided, which creates more attraction for students who may want to have a lunch, for example.

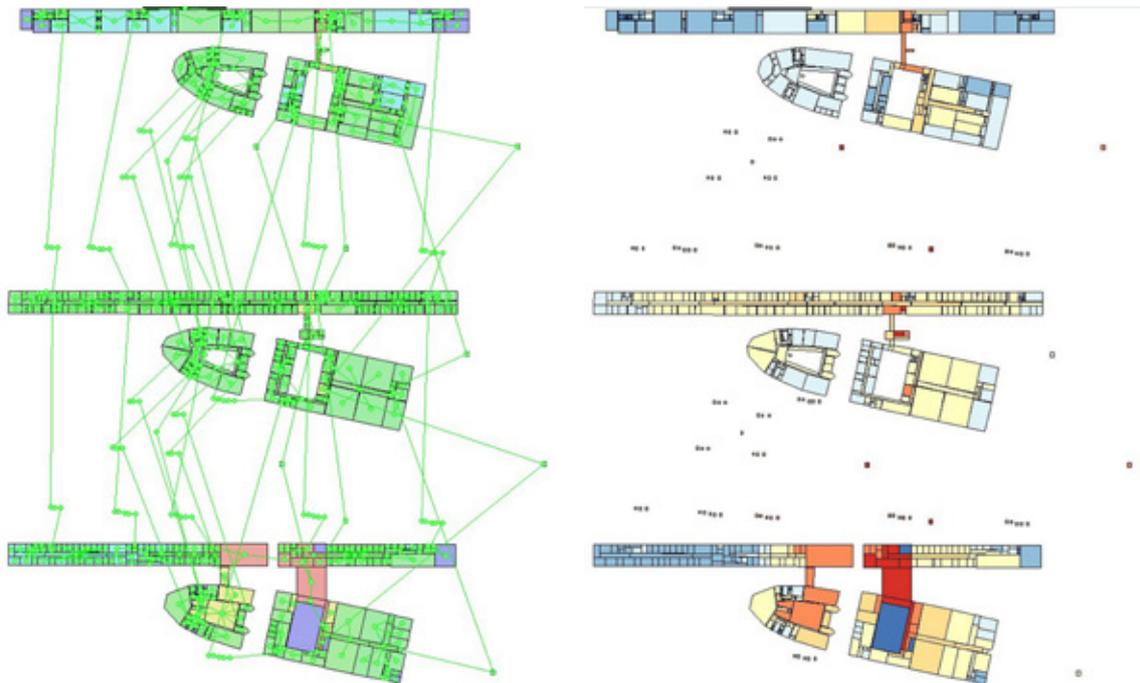


Figure 2 - Connecting Relations and Integration in the Educational Complex

	Integration (r=n)	
Focused Socialising	Pearson Correlation	.971**
	Sig. (2-tailed)	.006
	N	538
Intermittent Exchange	Pearson Correlation	.952**
	Sig. (2-tailed)	.013
	N	215
Ambient Society	Pearson Correlation	.961**
	Sig. (2-tailed)	.009
	N	129

Table 4 - Correlations of student activities with spatial configuration

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

The correlation analysis of the six types of activities and spatial configurations reveals that global integration has a significant impact on the patterns of FS ($r=0.971$), IE ($r=0.952$) and AS ($r=0.961$) in the educational complex while there is no correlation between the spatial configuration and FIL, DRA and SE.

5. CONCLUSIONS

Within observational analysis, it can be seen that students conduct diverse types of learning activities within the common areas of the educational complex (CA, CB, CC, TEH and ESLC). Therefore, spaces that originally are intended to be just links between the main academic areas, frequently provide areas for students to cross, to sit and to communicate, where they can encounter and interact with each other. The connectivity of educational complexes can indicate and promote frequent casual interactions. The most segregated areas in the educational complex were mostly the end spaces of corridor spaces (CA and CB), emphasising that the complex should be able to provide students with both formal and informal learning spaces,

where they can sit and focus on learning relatively with activities and social spaces where they can also relax and socialising.

The study on the usage of space made it possible to notice that the 'link' spaces happen to be the key parts meant for spaces to have social and informal learning activities, therefore it can be concluded that they are in fact social informal learning spaces. In this space, socialising and informal learning activities can emerge where students can socialise and exchange knowledge. The study concludes that space configurative properties on educational complexes, in particular the system of spaces for social and informal activities, are an important component of both informal and incidental interactions between students.

This study has shown five social informal learning spaces in one educational complex, which have different functions in usage and hold different number of different student activities. What is perhaps surprising is that the space deepest in structure or the least integrated such as CA, CB had the greater number of serendipitous encounter. The limitation of the size of space prompted an increase of greetings. That is to say, in general student activities correlate with the spatial configuration measure. This research also suggests there are also greater complexities when one disaggregates the student activities into types where different types of activities might be associated with different spatial conditions. Due to the sample size further work is needed to confirm the original hypothesis.

REFERENCES

- Bafna, S. (2003). Space syntax: A brief introduction to its logic and analytical techniques. *Environment and Behavior*, 35(1), 17-29.
- Brown, M., & Long, P. (2006). Trends in learning space design. *Learning spaces*, 9-1.
- Bullock, N., Dickens, P., Steadman, P. (1968), A theoretical basis for university planning. No. 1. *Cambridge University School of Architecture*, (Land Use & Built Form Studies).
- Capille, C., Psarra, S. (2013), Space and planned informality: Strong and weak program categorization in public learning environments. In: YO Kim, Park HT, Seo KW (eds.), Proceedings of the Ninth International Space Syntax Symposium, *Sejong University, Seoul, Korea*, pp. 009:1-22.
- Coelho, C., & Krüger, M., (2015), Towards a methodology to assess adaptability in educational spaces, the 10th International Space Syntax Symposium.
- Dai, X., Dong, Q., & Guo, J. (2015), Production of spatial complexity in an educational building.
- Dugdale, S. (2009). Space Strategies for the New Learning Landscape. *Educause review*, 44(2), 50.
- Dugdale, S., & Long, P. (2007). Planning the Informal Learning Landscape. *ELI Webinar*, 12.
- Freeman, L. C. (1977). A set of measures of centrality based on betweenness. *Sociometry*, 35-41.
- Higgins, S., Hall, E., Wall, K., Woolner, P., & McCaughey, C. (2005). The impact of school environments: A literature review. *London: Design Council*.
- Hillier, B., Penn, A., Hanson, J., Grajewski, T., & Xu, J. (1993). Natural movement: or, configuration and attraction in urban pedestrian movement. *Environment and Planning B: planning and design*, 20(1), 29-66.
- Hillier, B. (2007). *Space is the machine: a configurational theory of architecture*. Cambridge: Cambridge University Press.
- Hölscher, C., Brösamle, M., & Vrachliotis, G. (2012). Challenges in multilevel wayfinding: A case study with the space syntax technique. *Environment and Planning B: Planning and Design*, 39(1), 63-82.
- Montello, D. R. (2007, June). The contribution of space syntax to a comprehensive theory of environmental psychology. In *Proceedings of the 6th International Space Syntax Symposium, _Istanbul, iv-1–12*. Retrieved from http://www.spacesyntaxistanbul.itu.edu.tr/papers/invitedpapers/daniel_montello.pdf.
- Pera Vieira, A & Kruger, M (2015), Space codes in architectural teaching and learning, the 10th International Space Syntax Symposium.