Developing Spatial Configuration Abilities Coupled with the Space Syntax Theory for First Year Architectural Studies

Ref 082

Francisco Olmos Reveron
Universidad de Los Andes, Department of Architecture, Mérida, Venezuela
fco.olmos@gmail.com

Keywords
space syntax; architecture education; training program

Abstract
The Space Syntax Theory has been taught at the Bartlett School of Postgraduate Studies at University College London as a tool for architects to explore the relationship between spatial configuration and social form. It has also been used successfully as a design tool to explore and understand, during the design process, possible effects of design ideas on people interaction with space. However the introduction of Space Syntax Theory in the first stage of architectural training as a learning resource for developing spatial configuration abilities has not been explored in detail yet. This paper is going to discuss some of the implications and an experience of training architectural students using the Space Syntax Theory.

Herein is discussed the findings from introducing first year architectural students to Space Syntax. For this experience a Space Syntax training program was designed to perform specific design training exercises, based on a learning strategy and an interactivity model for virtual object manipulation in design training. The analysis of data gathered from design exercises performed by new students in a control group (based on the use of traditional media and not trained in using Space Syntax spatial analysis tools) and an experimental one (using the Space Syntax training program and Space Syntax 'ideas to think with') was carried out through a comparative analysis of design outcomes and contrasting student proposals with a architectural professional design. The experiment's results suggest that the introduction of Space Syntax Theory could be a powerful learning resource for developing spatial configuration abilities in new architecture students.

Introduction

Space Syntax is a spatial analysis theory that was born inside the architecture field. It is rooted mainly in architecture knowledge neither philosophy nor mathematics however it has a strong philosophical foundation and mathematical base of evaluation tools. Even though Space Syntax is a subject of postgraduate studies and it is a high complex spatial analysis research tool, it is feasible introducing novel architectural students to its 'social logic of space' (Hillier and Hanson, 1997). This is so, firstly because 'one of the great advantages of space syntax models: the model that is used for research can be used, without modification, for design experimentation and simulation' (Hillier, 2006:9). Secondly, because design training is mostly performed through making and testing design ideas base on a mental process which is a sort of simulation.

The Space Syntax Theory studies how spatial configurations embody social or cultural meanings and how a spatial configuration itself is able to generate or inhibit social interactions in built environments. Its basic concepts can be introduced to novel students as a 'raw material' for design ideation, as 'ideas to think with', imaging spaces and understanding how they will really work from the point view of social interactions. Space Syntax is as useful during the design process as for a post evaluation of built spaces (Hillier, 2005) and it has the ability to make the deployment of

intuition during the design process more rational and therefore more discursive (Hillier and Hanson, 1997).

The spatial analysis graphic tools used by Space Syntax are a combination of meaningful drawings including the convex breakup, axial lines the isovist and the justified graph, that are able to embody key ideas about space itself and how people use it. Space Syntax place the space itself and its social logic at the centre of the design process, consequently the introduction of this knowledge in design education implies a re-thinking of some traditional ideas implicit in architectural training that have a crucial effect on 'the design dialogue' (Schön, 1983) and its products. Design is a process that is based on 'ideas to think with' and theories that summarize experience into abstract principles. It also depends on how the designer manipulates these ideas. Therefore, the understanding that architects have of how people use and perceive the space is reflected in the creation of building and cities so the weaknesses and the failures of any design arguably can be traced to the ideas from which they were based. Therefore, there is no doubt that 'better theories of space mean more freedom for the designer because they bring the deep structure of architectural and urban space into the realm of rational debate and creative intuition' (Hillier, 1993:2). The study of the relationship between form and function and the role of the user and the idea of space will be discussed here, exploring how Space Syntax Theories can introduce a new point of view over these key issues for architecture education.

The form function predicament in modern architecture education

It can be argue that a modernist approach to architectural design based on the idea adopted by Louis Sullivan "the form ever follows function", assumes a drastic distinction between the spatial configuration and the formal configuration and how people understand space and what people do in buildings. This linear cause-effect assumption can be argued to goes against the nature of the design process. The design process is not a linear one, neither in the problem definitions stage nor in the reflective practices process. On the other hand 'the form ever follows function' presupposes a distinction between formal configuration and spatial configuration that from the user's point of view effectively disappears. It can be argued that locating the function at the centre of architectural design has left behind consideration over the relations between the user and the spatial configuration and its social life. In the worst interpretation of this motto, the formal configuration of the building has been reduced to a sort of 3D wrapping for functions, a practice that arguably is one of the downsides of the international style because 'Considering formal configuration of building as a sort of addition of a surface appearance to buildings is a degeneration of the plastic dimension of architecture.' (Hillier, 1997:11)

This functionalist idea inspired most of the post WW2 architectural education in the international context, hand by hand with the development of the "design methods" as some kind of intellectual disection tool that could allow bringing some logic to what had been seen as an intuitive activity (Rittel, Webber, 1973). Architectural education was inspired also by the famous quotes from LeCorbusier "The house is a machine for living in", and the minimalist motto adopted by Mies Van Der Rohe "Less is more". Consequently modern architecture education has focused its efforts in training novels students for designing buildings as functional as a machine could be, leaving beside in many cases the user and its social life.

The LeCourbusier idea of space as another element to be put in order as a spatial element without intrinsic properties unable to be considered by itself, by its own intrinsic properties, nowadays still seems to be prevailing in many cases. However 'it has become clear that a lack of understanding of the precise nature of the relation between spatial organization (morphology) and social life is the chief obstacle to better design.' (Hillier and Hanson, 1984) An approach to architectural education base on modern ideas about order, form and function can be argue, was an easy way to avoid the elusive nature of space and the contradictions that arise in the design process between form and function, between user spatial cognition and spatial configuration and social solidarity in the guise of rationality. Herein is going to be argued that designing a space and therefore ordering space based on functions and objects is not the same as doing it when inspired by how people used it and by the intrinsic characteristics of space itself.

Beyond the modern idea of function: the generic function

It can be argued that one of the sources of contradictions for novel architecture students understanding the relationship between form and function comes from the linear interpretation of the form function relationship, as discussed previously. A second source of contradiction comes from the narrow definition of function itself as it is going to be discussed here. A look into some of the most popular architecture hand books for architecture students like the Neuffer Architecture's Data in Europe or the Time Several Standarts in the USA or the Plazola in Latin America, suggests that the function is approached in architectural design mainly as a sequence of human actions coupled to equipments in order to satisfy specific practical requirements on a daily basis inside a given spatial unit. If the form follows functions, then space is seen as a container, as an element subordinated to objects and functions not with intrinsic properties and, therefore, as a secondary component in the design process.

This architectural hand books´ approach to design seems to be based by the idea that architecture is a combined process that identifies the right place of objects and how many square meters people need to use them. Then, once an area is defined and combining areas properly would be enough to generate architectural forms. Arguably an approach to architectural training based on functionalist ideas of design in the guise of a rational and efficient use of materials and square meters, forgets the most fundamental fact of space. Space is generated in the midst of social activities, constraining and representing society and 'it constitutes a form of order itself' (Hillier and Hanson, 1984:9) which is perhaps the most important form of order that architectural students should learn to be able to achieve in their designs.

The basic assumption of Space Syntax Theory, that human spatial cognition in some sense is determined by spatial configurations and spatial cognition, again determines human spatial behavior (Hillier and Hanson, 1984) is an idea that, arguably, contains the hint for an approach to architecture training that goes beyond the traditional linear idea of form follows function. Here spatial configurations and human activities are seen as a continuum, not as a linear action-reaction. On the other hand, Space Syntax has a different approach to the idea of function in architectural spaces. Instead of focusing on specific functions for a given space or for the overall configurations of spaces, the focus is in its functionality. Functionality is 'define as the ability of a complex to accommodate functions in general and therefore potentially a range of different functions, rather than any specific function' (Hillier, 2007:248). Arguably the Space Syntax approach to function based on the idea of functionality erodes the paradox form-function because it introduces a different understanding of the function itself. But space Syntax goes further with the definition of 'generic function'.

'Generic function refers not to the different activities that people carry out in buildings or the different functional programmes that building of different kinds accommodate, but to aspects of human occupancy of buildings that are prior to any of these: that to occupy space means to be aware of the relationships of space to others, that to occupy a building means to move about in it, and to move about in a building depends on being able to retain an intelligible picture of it. Intelligibility and functionality defined as formal properties of spatial complexes are the key 'generic functions', and as such the key structures which restrict the field of combinatorial possibility and give rise to the architecturally real.' (Hillier, 2007: 223)

It can be argued that the idea of 'generic function' as 'idea to think with' allow to unfold intuition of architectural students in a broad field of spatial possibilities than the traditional modern idea of function. This is because the 'generic function' leads design actions to search not for placing a specific set of objects in a space in order to fulfill some functional requirement 'but it searches from what makes it possible for a complex (of spaces) to support any complex of occupation or any pattern of movement' (Hillier, 2007:246). The definition of 'generic function' arguably will allow novel architectural students to understand the relationship between form and function from a point of view where there is no paradox or contradictions between the social space and the spatial form or spatial configuration in Space Syntax terms. In general, we may say that configuration takes priority over the intrinsic properties of the spatial element in relating form to function (Hillier,

2007:221). The next point is going to be discuses the differences between the traditional idea of form and the Space Syntax idea of spatial configuration.

Beyond the modern idea of form: the spatial configuration

It is important to see how Space Syntax redefines the modern idea of form. Instead of considering the form of a building, and therefore the spatial configuration, as a mere consequence of recurring human activities or functions, Space Syntax defines the spatial configuration as 'a function of the form of social solidarity; and different forms of social solidarity are themselves built on the foundations of a society as both a spatial and transpatial system' (Hillier, 2005) These ideas presuppose a social point of view over space that takes precedence over the idea of space as a container for objects and functions, a commodity with a practical value. Based on this definition of spatial configuration, it can be said that the function that architectural students should be training to resolve first of all is the 'function of the form of social solidarity', therefore the space itself. Even more, this definition of spatial configuration in architectural training, can be argued to introduce a dramatic turn in the conceptual approach to architectural training. This is because in instead of considering the 'form following the function', it introduces the idea that the spatial configuration itself is the function, the 'function of the form of social solidarity'. It can be argued that it is so because human activities are not considered in Space Syntax as mere sequences of practical actions in order to satisfy daily basis but as 'different forms of social solidarity which are themselves built in the foundation of a society both spatial and trans spatial systems' . It can be argued that this Space Syntax approach to form erodes also the paradox form-function introducing a different understanding of the form itself From this point of view we cannot see any more order in space only as it has been seen in most of the introductory text for architectural design as for instance by Ching in his popular book 'Form space and order', as a set of form configuration rules that organizes planes and volumes in space. Instead it can be seen, as Hillier and Hanson has defined order in space 'as ordering relations between people and society' (Hillier and Hanson 1984:2) where the function is not a specific recurring human activity but a 'generic function' and spatial configurations as a form of order itself 'created for social purpose'. (Hillier and Hanson, 1984:12).

The user in architectural training

Here in is going to be discussed the absence of users in design training and how Space Syntax Theory of spatial analysis can introduce into architectural education ideas that brings the user at the centre of design training.

The relationship between architect and client most frequently is usually a poor one. 'The opinion of a specific user does not count much. Even worse, usage sometimes seems to disturb the beauty of a building in the eyes of some architects' (Sailer et al, 2007:2). There are some reasons for this situation argued by Sailer and his colleagues. Some of them are consequences of an established professional practice as the short period of time that architects and clients interact around the project. Once the building is built the architect, who can be working on several projects at the same time, leaves behind the client and any issues related with building occupancy or usage. This lack of interest of architects in user experience of their buildings arguably is fuelled by the academic context of architecture education where students had few opportunities, if is any, to interact with a real client or think about the user point of view over the space. Some tutors have argued that they take the clients' role who's necessities have to be fulfilled by the student. However it seems that the situation is the other way around as the training architect is in a weak position in experience and professional knowledge in the same way that the real user is in relation to the architect. Even more, relying only on tutor judgment arguably reinforces in the students a design bias called by Konceilik 'designing for the self'. 'If it's good enough for me (or for my tutor) it should be good enough for other people' (Konceilik, 1998: 113), and assumes that the designer's judgment can be used as an irrefutable measure about how things should be. This situation arguably can be improve with the introduction of Space Syntax Theory in architecture education. This is so because Space Syntax situates the user and its social encounters at the centre of spatial configurations allowing new architecture students to understand that space is perceived depending on the users' points of views.

The learning experience

In order to test the educational potential of Space Syntax Theory in training novel architects, a learning experience was carried out with first year architecture students at the Faculty of Architecture and Design of the Universidad de los Andes in Merida, Venezuela. The aim of the experiment was to test if the knowledge of Space Syntax Theory could make any difference in students' development of spatial abilities at the first stages of architectural training. The profile of the 30 participating students was quite homogeneous; they were from 17 to 21 years old and had no previous experience or training in architecture design.

The experiment was carried out with students working in two design studios from the first year course. The control group consisted of 14 students and the experimental group had 16 students. Both groups were studying the same foundational course on basic design concepts focused on architectural design. During the twelfth and thirteenth week, the experimental group only, was introduced to the study of the Space Syntax Theory of spatial analysis. A series of short lectures exposed the theory behind the basic Space Syntax graphic analysis tools, the convex breakup, the axial lines, the justified graph and the isovist. The experimental group of students performed four Space Syntax training exercises using a computer program designed for this purpose. The Space Syntax Training Program (Fig.1) was developed based on previous finding of my research on the introduction of virtual technologies in architectural training presented in a paper for eCAADe 2007 (Olmos, 2007) where the advantages had been discussed of using a training program in architectural education. This aspect will not be discussed here but this link shows how the program works.

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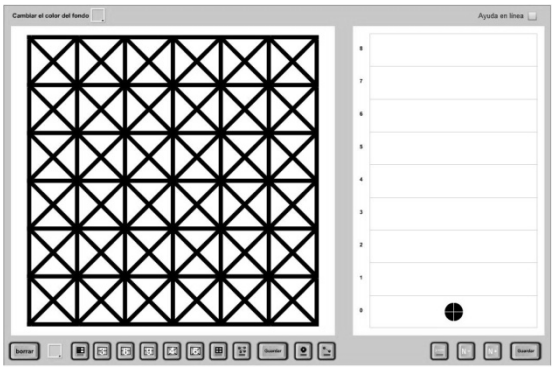

Figure 1
The Space Syntax Training Program interface

The aim of these exercises was to introduce students to the creation of spatial configurations coupled with the Space Syntax Theory and its tool of spatial analysis. The students were asked to design, departing from square grids of 3x3 cells, 4x4 cells 6x6 cells and 9x9 cells with and without diagonals, a set of different spatial configurations. No function or use was assigned to the spatial configurations during these exercises in order to focus students' minds on the idea of 'generic function' and the intrinsic characteristics of space. Figure 2 shows some of the students´ training exercises made with the Space Syntax Training Program. Students were asked to do the convex breakup, the relational graph and justified graph in each case and to analyze the differences between the same spatial configurations with one access or two. Afterwards they performed the axial line analysis of the two access spatial configurations and draw two isovists from the points where most axial lines intersected each other. Figure 3 shows some of the students' analyses.

A set of questions were proposed to the students in order to encourage them to think about the main spatial characteristics of the configurations they were working on: Where is the best place to

set a visual control point of the people inside the spatial complex? Where is the best place to set a control point of people's movement inside the spatial configuration? Which spaces are the most suitable for intimate or private activities? Which spaces have the higher potential for casual encounters between the people inhabiting in the spatial complex?

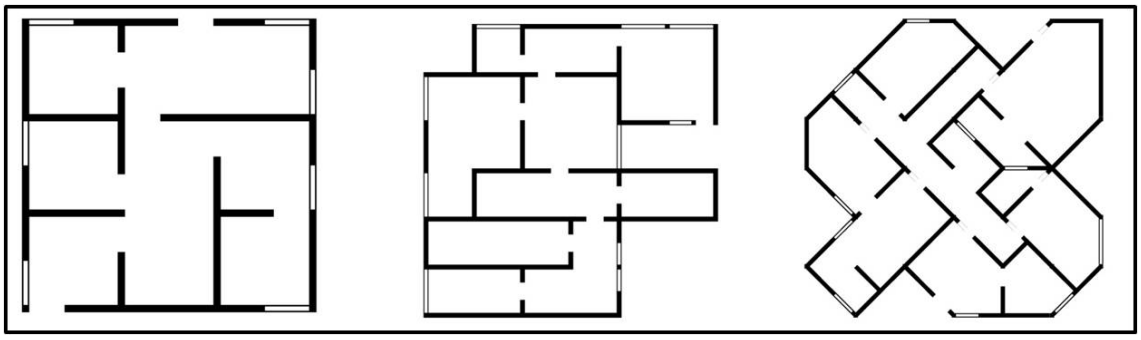

Figure 2
Examples of the students´ training exercises

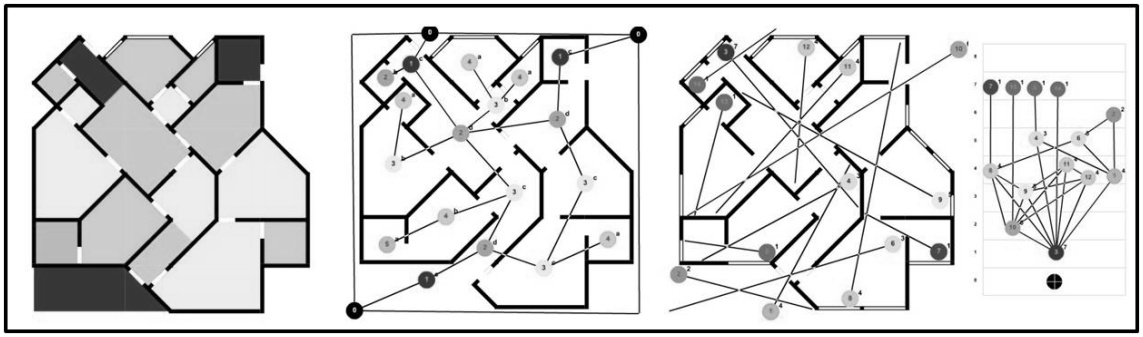

Figure 3
Examples of the students' analyses

Accessing the learning experience

Figure 4
The professional project by Aldington and partners

In order to assess the learning experience a Space Syntax test exercise was designed. The aim of this exercise was to test if training novel students based on Space Syntax Theory made any difference to the student spatial configuration abilities. The test was designed to contrast the experimental group design solutions against those of fellow students of the control group whom had not being taught about the Space Syntax Theory. On the other hand the design proposals of both student groups were contrasted with a design solution of practicing architects based on the same project brief. In order to achieve this goal a project brief was proposed the other way around, extracting information from a professional project for a general practitioner's surgery in Buckinghamshire by Aldington, Craig and Collinge" (Figure 4). This project is analyzed by Alan Penn in his paper entitled The system-user paradox: do we need models or should we grow ecologies? (Penn, 2005) The original project was not accessible to the students and the brief was presented with some minor changes from the original in order to fulfill some learning subjects. The project brief requested the students to design a general practitioner's surgery for kids including the following spaces.

- One office and reception: 20 m2
- Three consulting rooms: 20 m2 c/u plus a private toilet in each
- Waiting area: 36 m2
- Access and corridors: 27 m2
- Visitors' toilets: 6 m2
- Total area: more or less 150 m2

Additionally, the students in the experimental group were asked to fulfil the following spatial conditions based on Alan Penn's analysis of the surgery's spatial configuration. First, the reception should have a visual control over public access to the building, the waiting area and the corridors leading to the consulting rooms. Second, the consulting rooms' doorways should be hidden from public sight from the waiting area. Third, the public toilets' doorways should be hidden from public sight from the waiting area.

In this exercise the experimental group was asked to use the 9x9 and the 6x6 square grids with diagonals from the Space Syntax training program. On the other hand the control group was working based on the use of traditional design media and were free to use any grid. Herein the analysis of the test exercise is focused on the impact of introducing Space Syntax ideas to novel students but not on the use of the training program. This is so because of limited extension of this paper and the subject of the Space Syntax Symposia. Figure 5 shows three experimental groups' design proposals and figure 6 shows three from the control group.

The findings

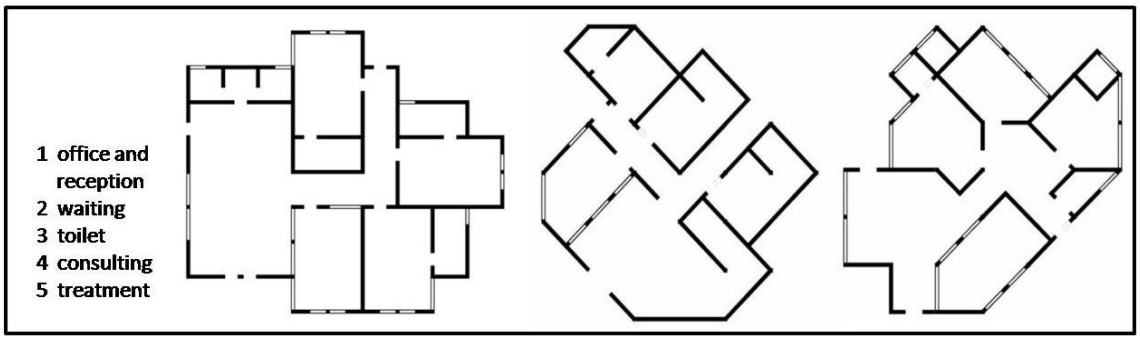

Figure 5
Examples of the experimental group's design proposals

A comparison involving the form configuration of the experimental and control groups' designs shown in figures 5 and 6 and the architects' design deserves a discussion which is outside from

the congress' subject. There are different levels of information that can be analyzed to figure out what degree of form and spatial design expertise the students had developed during the sixteen week course that I am tackling in my PhD dissertation. Herein the students' projects are going to be analyzed based on four Space Syntax calculations performed with the computer program AGRAPH (Manum et al). Constrained by the limited extension of this paper the analysis of the test exercises of both groups was carried out comparing the mean values of each student's design with the surgery project of Aldington, Craig and Collinge. The Space Syntax values selected were the Total Depth (TD), The Mean Depth (MD), Relative Asymmetry (RA) and the Integration Value (i) of each student design proposal.

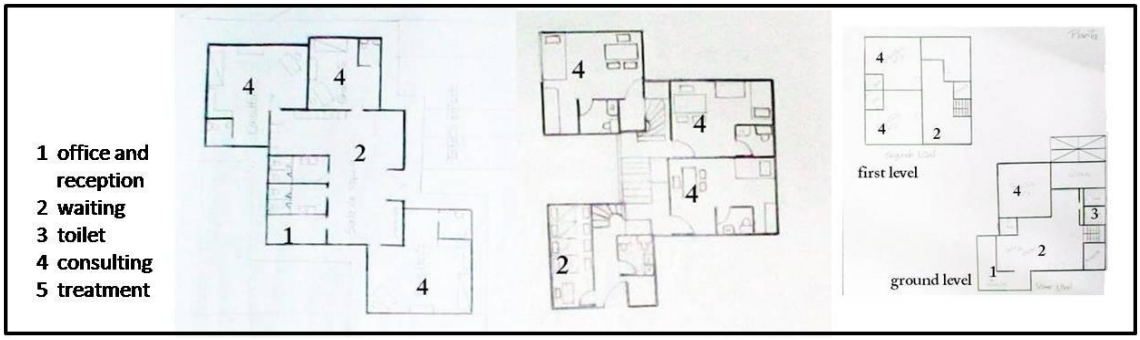

Figure 6
Examples of the control group's design proposals

Figures 7 and 8 shows four graphs designed to contrast the architects' design means values with the control and experimental group's design. The mean values of the architects' project is represented by means of a horizontal line, which is the referential value. One curve shows the control group's means values and the other one the experimental group's values. Both curves were plotted showing the students' design values in ascending order with the purpose of drawing as smooth a line as possible; therefore the numbers at the bottom do not represent the same student in each graph. This is so in order to create a representation that will allow seeing intuitively to what extent the students' design values of each group came close to the architects' design values.

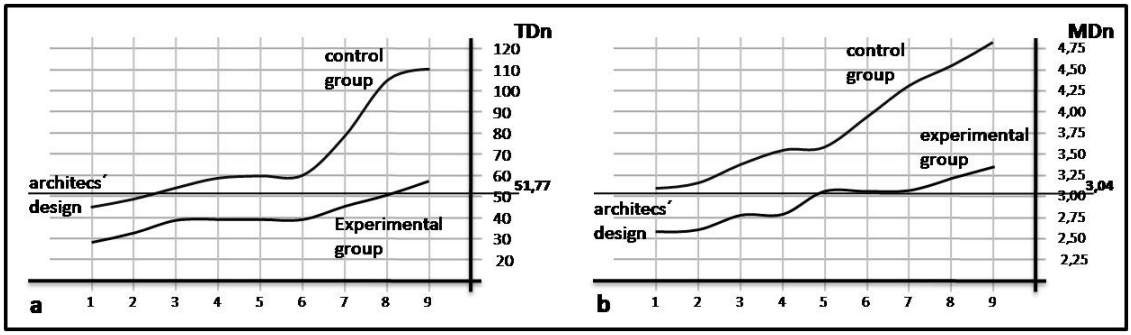

Figure 7
TDn and MDn means values

Figure 7a shows the TDn means values of the students with a clear difference. The control group's designs have a tendency to be deeper than the architects' design. In contrast the experimental group's designs tend to be shallower than the architects' design. On the other hand the gradient of the experimental group curve is lower than the control group curve.

Figure 7b shows the MDn means values of the students with also clear different tendencies. The control group's designs have a tendency to have higher MDn values than the architects' design. On the other hand the experimental group's MDn values tend to be closer to the architects' design MDn values. Similarly to graph 6a, the gradient of the experimental group curve is lower than the control group curve.

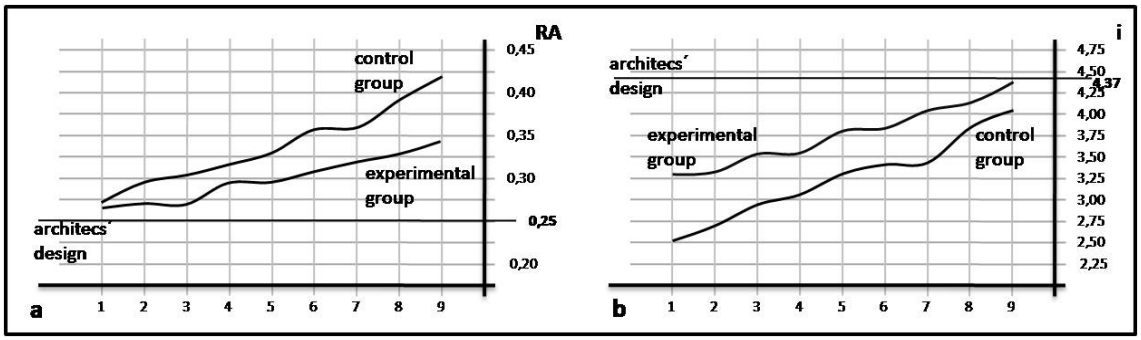

Figure 8
RA and i means values

Figure 8a shows both curves representing the RA means values of the control group and experimental group's designs with higher values than the architects' design. However the experimental group's RA means values tend to be closer to the architects' design RA values. Here, the same as the previous graphs, the gradient of the experimental group curve is lower than the control group curve.

Figure 8b shows the i means values of the students' designs with lower values than the architects' design. Likewise previous graphs the experimental group's values tend to be closer to the architects' design values and the gradient of the experimental group curve is lower than the control group curve.

Conclusion

These graphics show clear differences between the curves representing the means values of both groups, even though some values are similar. In each and every graph the gradient of the experimental group curve is much lower than the control group curve. Arguably this is confirmation that the experimental group's designs have a stronger tendency to have similar spatial properties than the control group's designs. On the other hand most of the graphs show the experimental group's curves closer to the architects' design means values than the control group's curves. In general it can be said that the students in the experimental group were able to create designs that were closer in spatial properties to the professional architects' design than the students in the control group. Taken into account the short time invested in studying and practicing with The Space Syntax Theory in the experimental group (14 hours) and the clear differences between the groups, it can be said that the introduction of Space Syntax Theory could be a powerful learning resource for developing spatial configuration abilities in new architecture students.

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