

Understanding of the logic of nesting of the different realities of architectural space: pedagogical approach

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PRELIMINARIES

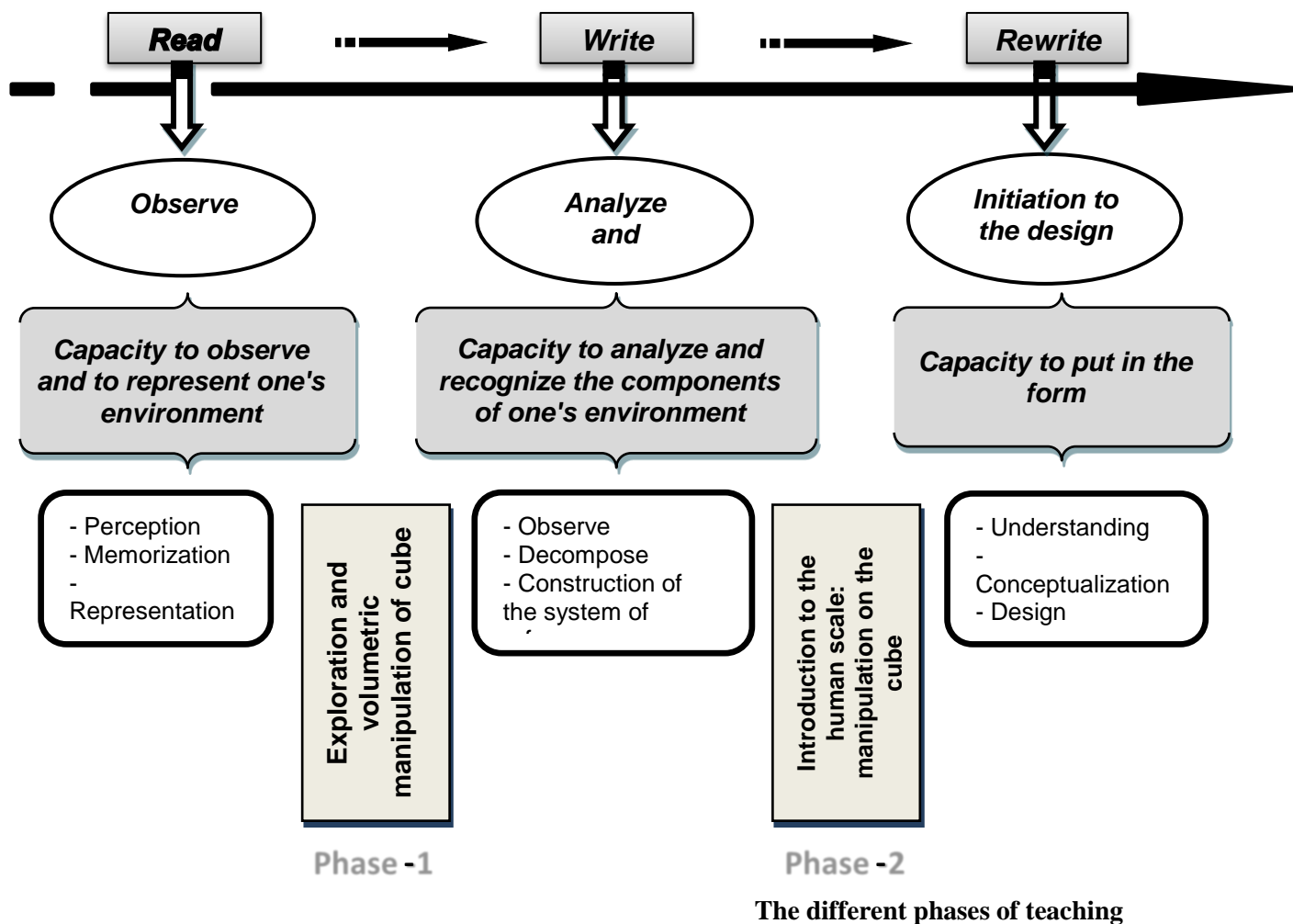
Education of architecture in the first year at the national school of architecture and urbanism of Tunis is subject to different experiences drawing their theoretical foundations in several disciplinary fields. Considering the work of several scientists¹ dealing with the perception of space, geometry, as well as effects of sense and the anthropological dimension of architecture, we have introduced a pedagogical approach to deal with architectural space according to the geometric tripartition: topological structures, projective structures and metric structures².

The object of this article relate to the pedagogical approach of an exercise registering upstream from the last chapter '*an introduction to architectural design*'. This exercise is the accompaniment of the students in the understanding of the different types of apprehended spaces and the mechanisms underlying their relationship development.

Share our belief in the correlation between the work of research and pedagogical approaches and share the interactive quality of our teaching, we define our scientific position relatively to the conceptual framework determined by the works of Manar Hammad. We tried on the occasion of this exercise to test educational tools that derive from basing our approach on three assumptions:

1. The approach of space through the meaning: the pedagogical orientation that we pass through this communication will provide significant value to all the facts of mental life and the creative spontaneity of images of the student; assuming that this spontaneity is based on internal and secret mechanisms that are far from random. The 'subject' student is thus considered the producer of significant facts in the form of concrete representations and formulated through his speech, thus allowing to resurface the procedure adopted meaning.
2. The distinction of a sense of 'external' meaning space which is correlative to a sense of 'internal' is relative to the action depending on whether it is considered from the outside or the inside.
3. The analysis of the construction of the meaning of an 'external' meaning space definition includes three geometric abstraction levels, projective, topological and metric.

The significant facts produced by the students are the documents that we have tried to classify, to compare and through which we attempt the underlying mental space. We intend to approach these mechanisms that are likely to hold the values abstract; 'concepts' related to the mental space, which are likely to give meaning to the architectural space. We then look at the space in its definition of mental construction which is likely to be analyzed according to two semiotic and analytical perspectives corresponding to two semiosis of space.



We'll be looking, as part of our investigation, on the presentation of our pedagogical approach that fits into the general framework of the teaching of the first year of the module architecture workshop: *methodology project*, and matter entitled *introduction to implementing shaped* at the National School of Architecture of Tunis. The teaching of first year workshop aims the initiation of the student reading of architectural space through specific and targeted exercises to acquire basic tools and basic concepts. It contains three main chapters: introduction to the architectural expression, the analysis of the architectural space and the introduction to

architectural design. This approach fits in the establishment of a mechanism for reflection that marks the initiation of the design of the architectural project learning and ingest in a learning process that deals with the concern for balance between: technique/reason and sensitivity/intuition. They are both complementary and necessary to the formation of a young architect.

To raise student's awareness about the stratification of the effects of sense and to considering the architectural space lived " perceptible and sensitive", as the product of a logic of nesting of different realities of existential space, we tried to accompany the students to approach in turn different realities of our space: space geometric relatively projective "figured and ordered" geometry, The metric space "quantifiable and measurable", and the topological space 'limited and discontinuous', these realities of space have approached attesting the correlation and interaction between the different levels³ and all entering the conceptual level determining the mental space which is the genesis of the logic of nesting for the different realities of the architectural space. However, we postulate that geometry as a mean of abstraction, allows presenting a logical order to apprehend the conceptual level underlying correlated with sensitive data.

THE METHODOLOGICAL TOOLS

As a general frame of reference that could be described by the geometry, space is considered content from a container; it contains objects and human beings and offers instead of their existence. In this sense we adopt the point of view of mathematician Felix Klein in the distinction of three main levels of abstraction: A topological level, a projective level and a metric level. The adopted tripartition⁴ was implemented by mathematicians, its application to the architectural space 'social space' has been tested by several researchers (architects, psychologists, computer scientists, semioticians), however, the particular interest in the topology has been documented by several researchers architects to elucidate the question of the significance in architecture. Without adopting the formalisant hypothesis of the phenomenon of the meaning⁵, let's first experiment this tripartition compared to an 'external' definition of meaning space and independently of the action of the user.

We subscribe so on the occasion of the first phase of an exercise of exploration and volumetric manipulation of a cube, object of our publication, in an outside view to the 'object-space', ignoring what is happening there. The definition of 'object-space' respects the correlation of full and empty, the material and the immaterial and gives priority to the full to set the vacuum. Full serves to delimit the void by giving it shape, it is through this approach

that we will try to address 'object-space' from an external perspective. Space is the challenge of an action, to give it meaning and apprehended through manipulation of students. This action is supported from the outside. The actions performed by the students on the cube determine what they do with 'object-space'. These actions are thus implemented on the cube as it is considered as envelope, as all figures and reports of proportion or as a set of measures; angles and distances. In the second phase of this exercise, the action will be apprehended according to its accomplishment of the Interior.

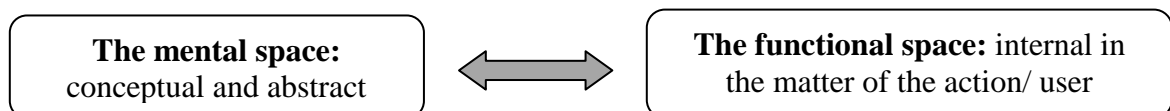
The result of these manipulations in the models and sketches will be the subject in the framework of this publication of an analysis which tries to approach the concepts that have been implemented by the students through their manipulation of the cube based on three levels of approaches presented in this exercise. This investigation is designed to introduce the student to the acquisition of skills for the apprehension of the architectural space through consideration of the interaction between its reading: through perception, and his writing: through design.

So let's try to accompany the students to approach in turn different realities in our 'architectural space' relatively geometry considered both as a science of the properties of figures and as a science of the properties of space. We are thus adopting the definition of Manar Hammad « *L'espace est descriptible à différents niveaux cohérents d'abstraction, et l'on peut distinguer trois niveaux principaux au sein desquels des distinctions plus fines peuvent être faites : un niveau topologique, un niveau projectif, et un niveau métrique* »⁶.

We then look at three levels of geometric abstraction for the spatial description that we have chosen to present and discuss under a new order:

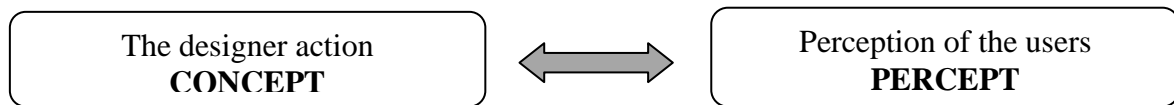
- **The projective space:** oriented, appeared and ordered: properties projective/projective figures
- **The metric space:** quantifiable and measurable: metric properties / metric figures
- **The topological space:** limited and discontinuous: topological properties/topological figures

These spaces will be approached in connection first with the mental space; conceptual and abstract, and secondly with the functional space; in the matter of the action of the user.



We will thus test educational tools, compared to a previously defined conceptual framework, to sensitize students to the stratification of the effects of sense and updating the abstract values giving shape to the mental space and to make significant our report to the space as a mental construct.

Note however that space conceptual and abstract geometrically definable is in perpetual interaction with functional space defined by the action that takes place there.



PEDAGOGICAL APPROACH

Our pedagogical approach of the 'object-space', assimilated in this exercise to the cube, is staggered in two phases:

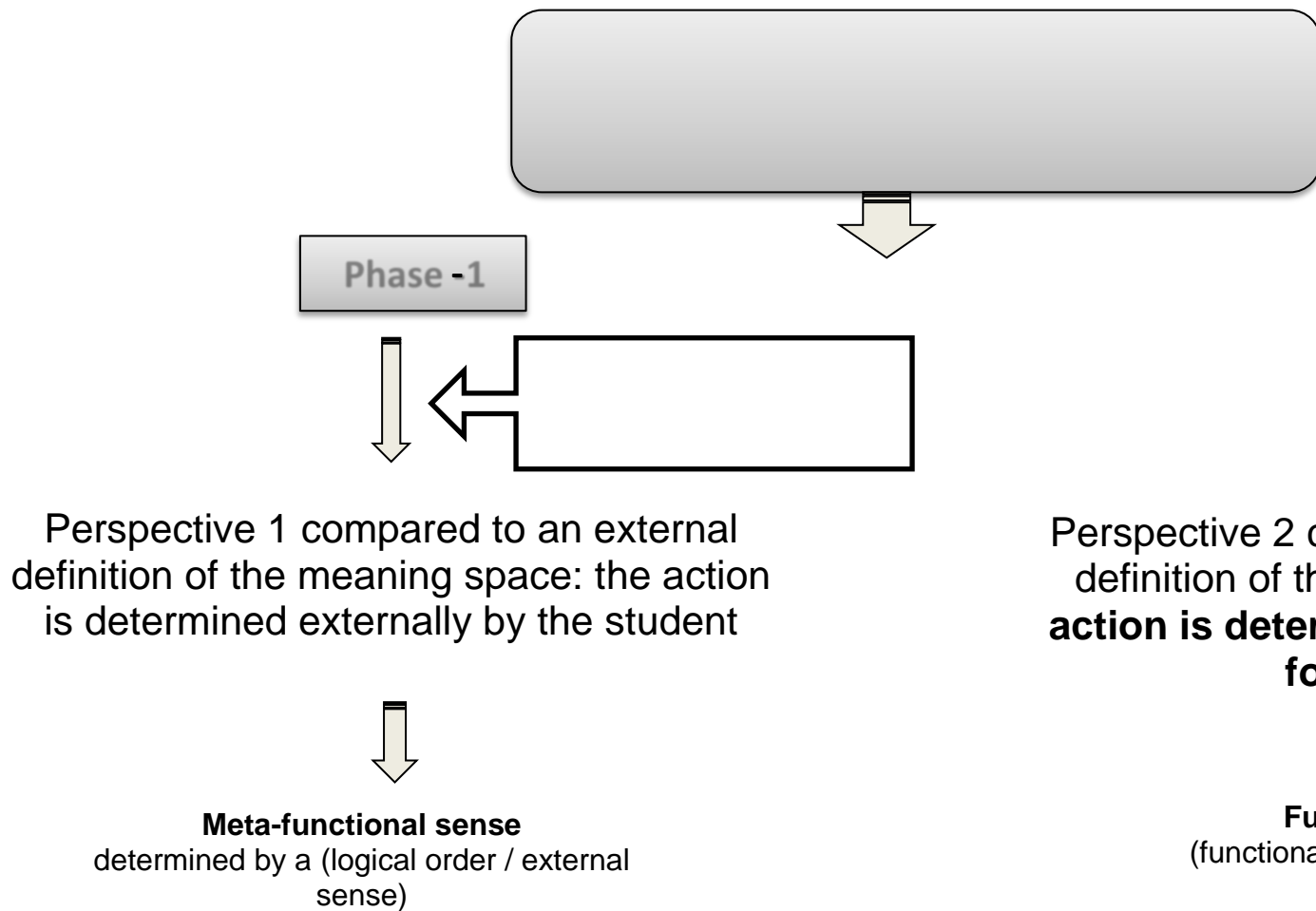
Phase 1: External perspective, corresponding to an 'external' meaning space definition. In this perspective, the action is determined externally by the student and approached according to the three levels of geometric abstraction. « *La pertinence du sens « externe » se trouve placée à un niveau méta-fonctionnel et non fonctionnel, au sens que l'on donne habituellement au préfixe méta pour désigner un niveau logique d'ordre supérieur* »⁷ the 'object-space' is considered independently of what is happening inside. The student is thus considered at the centre of the construction of the conveyed meaning effects. He is also considered as recipient-interpreter of what is 'told' by the expression of the 'object-space'.

Phase 2: Interior Perspective concerning an "internal" definition space meaning. The action is determined from the inside for the user. The generated effects of meaning fall within the functional sense, they are determined by a functional order in respect of the internal sense.

Our exercise is divided into two steps at the same time different and consequential corresponding to the two aforementioned perspectives:

- **First step:** It was asked the student to develop three different interpretations having as starting point a cube of 10 cm aside. Each variant will be to support the interpretation of one or several intrinsic properties of the cube relating to the levels: geometric, topological and metric. The student is called to act on the 'object-space' to build the desired meaning effects. The action is determined externally by the student and generate effects of corresponding external meanings relating to descriptive values of the 'object-space' successively considered as object to guide, volume to qualify or mass to quantify.
- **Second step:** the student will have to choose a model to consider it from the inside, by choosing the corresponding use; the action is thus determined indoors by the user. The student is required to approach the notion of human scale in relation to the function

selected for the user. The begotten sense effects are directly related to the inner action attributed to the 'object-space'. Examples: book-box, bus shelter, newspaper stand...



Two different and consequential phases

1. The external perspective

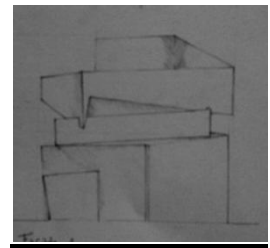
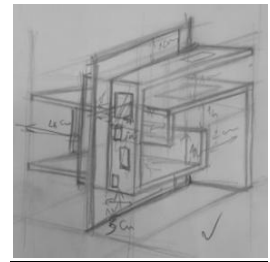
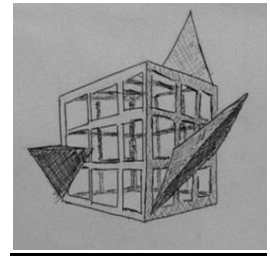
On the occasion of the first operation and in part from an external perspective, we adopt an 'external' meaning space definition. : «*L'espace est l'enjeu (direct ou indirect) d'une action qui, au lieu de s'y accomplir (à l'intérieur), le prend en charge (de l'extérieur)*»⁸. This is the meaning of the action, which is usually likely to be accomplished indoors: functional meaning, does not interest us in the first phase of this approach. What interests us is the sense that the student gives through his manipulations of the cube; otherwise, what does the student with the space as an object and can learn about the passage of 'abstract value': from the concept to the percept across the volumetric handling. We are thus trying to approach the mental space for the student through the concrete representations. We implement the three levels of geometric abstraction:

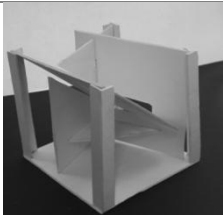
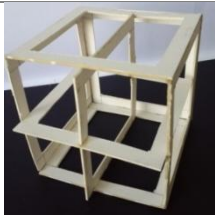
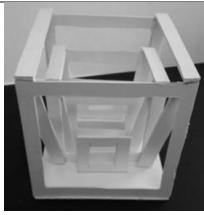
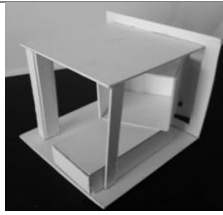
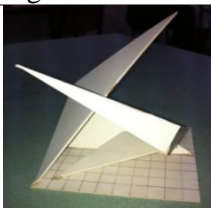
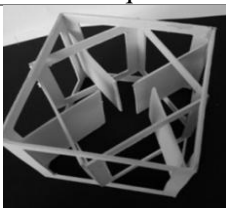

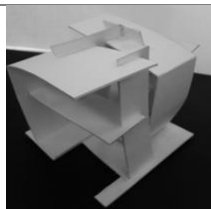
a) The projective level

The cube is thus approached as a geometrical volume, characterized by elementary forms, it has six square faces and eight dihedral angles and it is decomposable in point, line, surface. « *Les propriétés au sens de la géométrie élémentaire qui sont projectives sont soit des propriétés intrinsèques des figures, soit des relations relatives à ce système d'éléments réels ou au cercle imaginaire à l'infini, ou enfin simultanément aux deux* »⁹.

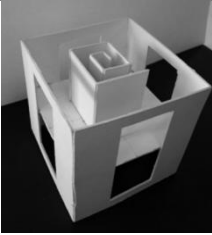
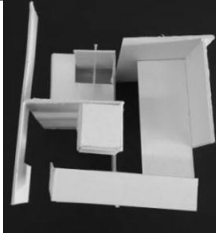
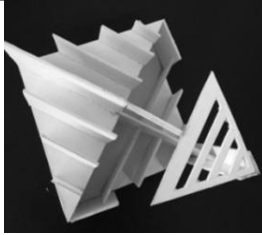
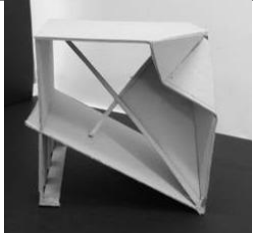
Projective geometry taking into accounts the perception of space allows to place the 'subject-observer' student at the centre of the construction of the effects of meaning through its choices of direction and guidance he will assign to the cube. The apprehension of the cube as a geometric entity starts with understanding of the intrinsic characteristics of the figure of the square.

It is the student who chooses the reading order of the model, he will be obliged to orient his cube by choosing the direction of gravity. The student becomes the observer-performer with the ability to differentiate and distinguish the verticality: up-down, the laterality: right-left, and the prospectivity: inside-outside. Perception is a mean to achieve the level of meaning of the 'object-space'.



 <p>Diagonals and the edges suggests the edges of the cube.</p>	 <p>Materialization of the edges and the medians of the squares</p>	 <p>Repetition of several squares highlighting the centrality</p>	 <p>Line, plan, volumes</p>
 <p>Diagonals allows to suggest the different edges of the cube.</p>	 <p>Rotary motion of the square around medians and diagonals</p>	 <p>Balance between fullness and emptiness: stability</p>	 <p>Up/down vertical/horizontal report</p>

Student's work: Suggestion of the cube: forms of spatial expression

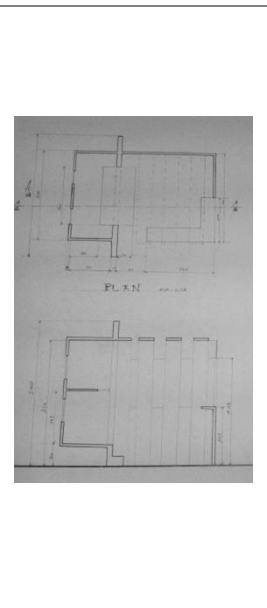
Centrality		Orientation sense	
			
The work on the walls is not put in touch with manipulation on the center: spiral motion	The center enables linking of the various elements of the cube and unify its reading	Frame and repetition of the triangle. Work on the diagonal of the square	The dynamic movement on the wall.

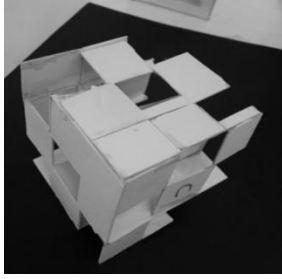
Understanding of the geometrical characteristics of the cube, will allow the student to develop his means of action 'know-how' and "power-making" to strengthen or refute them. He will develop a research about the various modalities of representations of the cube by involving the following geometric entities: points, lines, surfaces, elementary forms.

b) The metric level

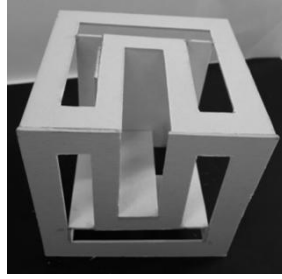
It comes to develop the concept of measurement reported to a reference module; measured by internal reference. The student will have to deal with notions of quantification and sizing to determine metric relationships and proportions reports between the component parts.

The 'object-space' is characterized in this approach by the length of its sides and its reports of proportions: he will be approached as a measurable mass. The student will have to act on the 'object-space' with the operations: addition, subtraction, multiplication, division. The description of the actions that can be made on the 'object-space' will provide an inventory of action.

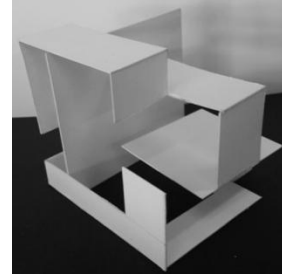




Frame in three dimensions: the module has dictated the composition



Work on the wall with a repetitive module rectangle: **nesting** of full and empty



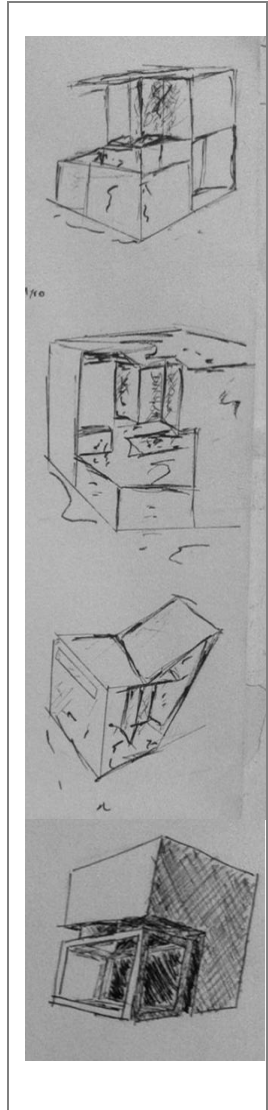
Frame materialized in three dimensions with the walls that fits from the envelope to the center

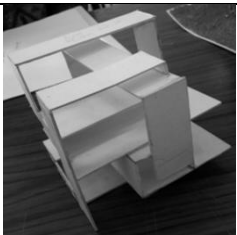
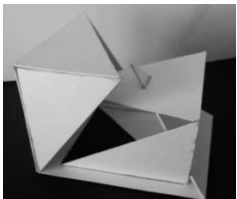
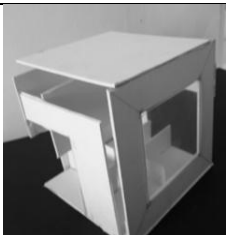
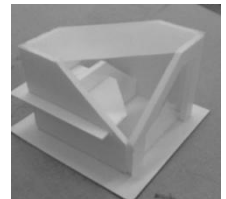
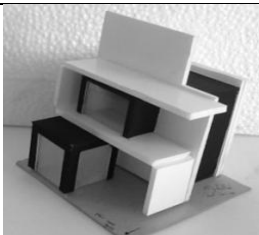

The description of the actions that can be done on 'space-object' allows an inventory of action and spatial expression

c) The topological level

The 'object-space' is characterized in this approach by its envelope defined as a continue surface, it is considered as a delimited volume. Concepts of limit and as a result of envelope and wall involve taking account of topological relations determined by qualitative reports of the component parts in the space. The student can thus move, eliminate or rotate the geometric envelope segments to organize actions such as: opening / closing, continuity / break... He will be led to reflect on the relationship between the inside and the outside.

The effects of meaning obtained following this manipulations are descriptive values of the shape of the space term determined by the degree of opening or continuity of the limit. There is a direct correspondence between the action carried out by the student, the descriptive value of the expression form; the degree of opening and closing of space, and the effect of sense got. The boundaries can be more or less explicit, constitute continuous surfaces or on the contrary only a few benchmarks between which the observer establishes relationships to interpret a virtual limit. The limit can thus present itself in different aspects in its degree of materialization: real/virtual/potential.

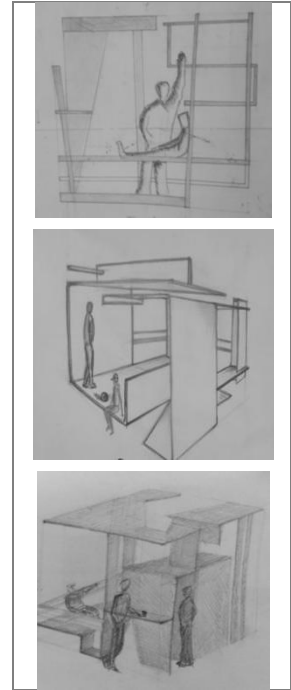


 <p>By cutting and bending of surfaces creation: work on the envelope</p> 	 <p>Qualification of limits by ensuring the relationship between the outside and inside</p> 	 <p>Relationship between the Interior and outside and thus created spatialities</p> 
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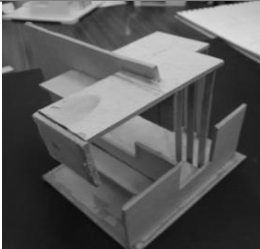
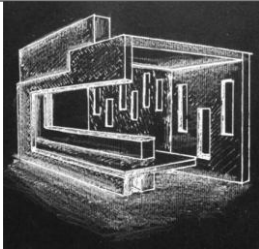
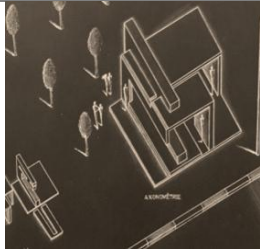
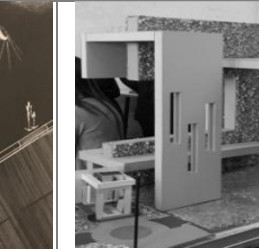


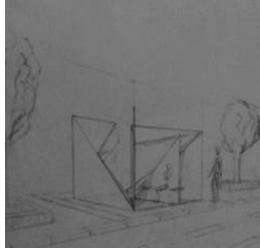
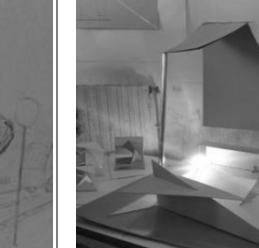
The external perspective: forms of spatial expression

2. The internal perspective

From this perspective, the action is envisaged of the interior according to an 'internal' definition of space meaning and corresponding to the actions performed by users, which are considered to be at the centre of the construction of the meaning effects conveyed by the 'object-space'. Arrived at this stage, it is required from the student to reflect the function that he will give to his model, through the design of a space dedicated to a set of practices organizing around actions: sit, lie down, shelter, read, discuss... The student is led to approach the notion of human scale as a measure to external referent in relation to the 'object-space'. The description of the actions that can be done in the 'object-space' will provide an inventory of actions.




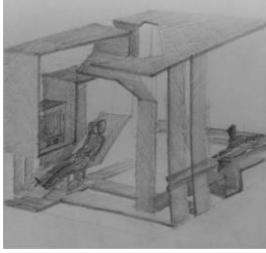
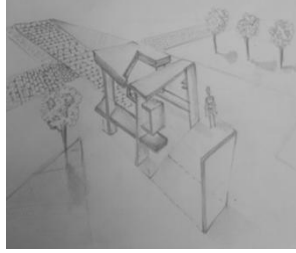

Internal perspective: Device shelter: bus stop

			
			
The initial object	Think the scenario	The imagined physical context	The final device

Make significant mental space: The action of the designer becomes perceptible and invested by the user

On the occasion of this second phase, the student discusses the cube as 'object-space' and living space. He works on the outside of the object and at the same time he incorporates the function and human scale, as well as the physical context in which will be implemented this device.

Device: blood donation

			
The initial object	Think the scenario	The imagined physical context	The final device

CONCLUSION

The progression in learning allows the student to understand, identify and acquire the different phases of the design process. He also learns to develop his design to achieve an architectural object seen, lived and performed by users.

These two perspectives allow to build two points of view both different and correlative and corresponding to two semiosis of space. From the first perspective, we tried to highlight the different realities of our architectural space according to an 'external' definition of the meaning space and considering the collector-designer student at the centre of the construction of the meaning effects conveyed by the object-space. Considering the space as a carrier of meaning, which cannot be summarized only at the completion of an internal action, we accompanied the students in the construction of the effects of spatial sense through an inventory of actions operated on the 'object-space' according to different levels: projective, metric and topological. Our interest in the geometry comes from a desire to elucidate mechanisms of meaning conveyed by the space and reported to a logical sequence determined by the geometric space. However, we found the correspondence between the effects of meaning obtained from two perspectives. The external perspective supports the internal perspective and determines the effects of meaning. We intend however to deepen the pedagogical relevance of these levels relatively to an "internal" definition of the meaning space. Which involves the use of a different approach to projective, metric and topological space, considered from inside and putting the user's space in the centre of the construction of the effects of meaning relatively to the action accomplished in space.

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¹ Jean Piaget on genetic psychology, Josep Muntañola Thornberg on anthropology and semiotics of space, Manar Hammad on semiotics of space, Dominique Raynaud on the anthropological dimension of architecture...

² Klein Félix, *Le Programme D'Erlanger*, Jacques Gabay, Sceaux, 1991

³ Klein has introduced an order and hierarchy in the geometry by the distribution of the properties of the figures into classes each one corresponding to a group of transformation. According to this perspective « *la géométrie est désormais plutôt considérée comme l'étude, non plus des propriétés ainsi ordonnées des figures de l'espace euclidien, mais des divers groupes de transformations, à chaque groupe correspond un espace* », page 66.

⁴ This tripartition presented by Dominique Raynaud in his book « *Architecture comparée, essai sur la dynamique des formes*, Paris, 1989 », wholesale resumes the works of Jean Piaget on the construction of the space, and itself inherits from the division that is practiced in mathematics between topological, projective and euclidean structures.

⁵ This hypothesis has been adopted by the structural semiotics of Greimas « *approche formelle du sens* ».

⁶ This definition is considered to be 'internal' meaning space definition. Hammad Manar *La sémiotisation de l'espace, Esquisse d'une manière de faire*, semiotic acts n ° 116, 2013, page 8..

⁷ Ibid, page 13.

⁸ Ibid, page 13, Manar Hammad distinguishes two semiotic and analytical perspectives that correspond to two semiosis of space: functional perspective 'the meaning is in things' and meta- functional perspective "the meaning is in the outside" and under a logical level of higher order.

⁹ Klein Félix, *Le Programme D'Erlanger*, Jacques Gabay, Sceaux, 1991, page 11.