

SUSTAINABILITY AND HABITABILITY IN ARCHITECTURE. TEACHING COMPLEX CONCEPTS

María López de Asiain Alberich, Jorge Gonzalo Luna Montes

Universidad de Colima (MEXICO)

Abstract

This paper presents the teaching experience developed in the course Architecture Analysis IV of the School of Architecture and Design, University of Colima, Mexico.

Within the course, 30 hours are dedicated to work with the students on the concept of sustainability and another 30 hours to work on the concept of habitability.

The challenge of this course in terms of teaching lays on a teaching methodology based on projects, in such a way that students hardly receive any theoretical-conceptual lectures, but it is through the search of information and -most essentially- through debate, that knowledge gradually builds in a collective manner.

For this purpose, tasks are carried out in teams and also personally –during and outside class time- so that the work developed outside class hours is used in the next in-person session to discuss with others and progress, making students responsible for their own progress and with their schoolmates.

This method enables a deep study of concepts and themes and ensures participation and involvement of all the students in the definition of the concepts they will have to work on later, also in new subjects they will take in the future.

Surveys were carried out among students with regards to the methodology used and the results were largely satisfactory.

Keywords: architecture, sustainability, education.

1 SUSTAINABILITY AND HABITABILITY AND UNDERGRADUATE STUDENTS' EDUCATION

During the second half of the 20th century the western culture witnessed the growth of individualism, selfishness and greed, mainly based on modern market and consumption economies. However, the following question arises: can we ignore our responsibility over the future of those who are still not born but who will inevitably inherit a seriously damaged planet? The answer seems clear- though also polemic in some cases: NO.

The foundations of the above mentioned lies in the impossibility of keeping an infinite development based on finite resources. This premise supports the report of the Brundland Commission (1987) regarding the paradigm of sustainable development: "*[That which] can meet [the] needs of the present generation without compromising the ability of future generations to meet their own needs.*"

That said, following Brundtland premises, the following question that constitutes the core of this learning unit (Architectural Analysis IV) arises: Is it really relevant for the undergraduate students to have training regarding sustainability and habitability concepts? YES.

This answer is based on solid evidence as the building industry uses nearly 50% of the total world resources, among which we can mention the following ^[1]:

- Materials: 50% of the total world resources are used in construction
- Energy: 45% of the world energy generated is used for heating, lighting and conditioning buildings, and 5% for building them
- Water: 40% of world water supply is used for sanitation facilities and other uses in buildings
- Land: 60% of the best quality arable land that is no longer used for agriculture is used for building
- Wood: 70% of the world wood products are used for building

Nearly 80% of our lives takes place inside buildings, and most part of the rest in the urban space ^[1]. It seems evident that current everyday life revolves around a great variety of buildings; hence the increasing importance of the role of the architect.

Following this reasoning, cities are expected to first show environmental problems such as pollution, food and energy shortages or health problems related to water contamination. In this sense, architects have a very relevant role in the effort to establish a cooperative relation with the territory. Although it is true that architects alone cannot solve the world environmental problems, they can significantly contribute to the creation of sustainable human habitats.

It is this relation creation-improvement of the habitat's conditions that is approached in the conceptualization of habitability, which is defined as: *"the degree to which the qualities and characteristics of spaces and their buildings meet the expectations, needs, life patterns and preferences of inhabitants."* ^[2]

This learning unit is based on the close connection between these two concepts –sustainability and habitability- as both themes aim at improving life quality.

In addition to the conceptual approach mentioned above, Architectural Analysis IV approaches the use of intelligent technologies, a greater respect for the natural resources, the shift from non-renewable resources to renewable and self-sufficient practices, etc, in order to contribute –within our sphere: Architecture and Urban Planning- to a prosperous development of human habitats in a symbiotic relationship with our planet.

To this end, the use of the following techniques is proposed: life cycle analysis, knowledge of the ecological footprint and the concept of ecological backpack, among others.

- Life cycle analysis (LCA): it is a process by which ecological principles are incorporated to the project development. In the case of a building, the LCA is centred on the complex impact of its construction, use and later removal.
- Ecological footprint: it is an indicator of the environmental impact caused by human demand of the existing resources in the planet's ecosystems in relation to the ecological capacity of the Earth to regenerate its resources. It represents the land or water area environmentally productive (arable land, grass land, woods or water ecosystems) needed to generate resources and also to assimilate the waste produced by each population according to their life style.
- Ecological backpack: it is the total of all the mobilised and transformed materials within the life cycle of a consumer good, from its creation to its role as waste.
- The four R's: Reduce, Reuse, Recycle and Rehabilitate

All the above said supports the statement about the importance of the knowledge and practice of the concepts of sustainability and habitability within undergraduate education.

2 ARCHITECTURAL ANALYSIS IV LEARNING UNIT

The learning unit titled Architectural Analysis IV –taught during the fourth semester- mark the end of the Architectural Analysis learning units and the beginning of further units such as Sustainable Architecture I & II, which belong to the same academic educational approach. As the final point of this tetralogy, Architectural Analysis IV has the following objectives: consolidate aspects already studied in previous units; link the studied material to its parallels –such as Design Workshop II; and be a referent as far as the perception and appraisal of the natural and social environments are concerned.

The above mentioned is approached by presenting the "sustainability paradigm" and its relation with urban planning and architecture. Similarly, the concept of "habitability" is presented in its urban dimension and its relation to the architectural object.

Architectural Analysis IV points to contemporary analysis issues: namely the analysis of life cycle and knowledge about the ecological footprint, among others, whose aim is to create consciousness about the social and environmental responsibility of the architect in the development of prosperous human habitats.

The syllabus that structures the learning unit not only focuses on the appraisal and efficient use of the resources shaping the architectural and urban space, but it also encourages students' ability to identify, pose and solve problems which lead them to provide ideas for the improvement of the natural and social environment. To this end, a series of tours around the city of Colima, Mexico, are proposed,

for the students to comprehend the architectural phenomenon and its interactions by direct experience.

3 ORGANISATIONAL CRITERIA FOR THE IMPLEMENTATION OF METHODOLOGY

Analysis IV learning unit is organised around two weeks. During the first week, the focus is mainly on the concept of sustainability; the second week focuses on the work around the concept of habitability and its relation to sustainability.

The starting point in each weeks is the presentation of the whole task, as well as its main objectives. The target of both weeks is the development of a conceptual framework –mainly graphic- that summarises each of the concepts presented. The graphic conceptual framework is handed and presented in class the last day of each week, and is evaluated –both my teachers and students- according to objective criteria established by an assessment rubric. This assessment constitutes 60% of the final grade of the students.

During the work week, partial objectives are approached every day, with specific tasks to carry out and hand in before the end of the session. These can be both personal and group tasks and they are all included in the student's dossier and, evaluated and assessed to ensure their correct development during the whole learning unit.

Similarly, each day the student is asked to search for information related to some topic that will be approached the following day. This allows them to start finding answers to the questions posed by the teachers.

The activities carried out each day are previously planned and well defined. The deadline for handing in the tasks is known by students beforehand, who have access to a simplified version of them. Such planning is carried out minute by minute to avoid long pauses, waste of time and also for students to avoid being distracted. The activities combine different strategies and groups of students and students are always asked to keep notes of them.

The planning of activities should be flexible enough to allow modifications and adjustments according to the groups' progress and special needs in terms of teaching support. The methodological strategy of project-based learning (PBL) states the need to work in terms of resolution of questions and problems; to this end, students are always asked to look for information on the topics and concepts that will be dealt with, to develop discussion and debate in a collaborative way and to share results with their mates.

Finally, teachers define, redirect conclusions or present in a synthetic way the concepts previously worked by the students. This methodology allows to keep concentration on the part of the student, who uses the final information they receive to synthesize and clarify concepts. Thus they are able to interiorise the information to a greater extent and therefore improve their ability to keep such information and to comprehend it from a critical point of view.

4 ON THE TEACHING METHODOLOGY IMPLEMENTED

The methodology implemented is mainly based on project-based learning (PBL) and collaborative learning (CL). It has been attempted to follow a strict methodology following the principles of PBL and CL, with the purpose of testing the efficacy of such methodologies in this sort of learning units in real terms.

Architectural Analysis IV is a learning unit that could be regarded to have a high degree of theoretical content. However, from the starting point, the methodology used by teachers meets the need to engage is essentially practical activities, allowing fluency in the development of contents and preventing students' exhaustion. This is especially important if we bear in mind that the subject is developed during only two weeks, with six hour daily sessions with only one 45 minutes break for lunch.

The methodology used implies the need to inform students from the start about the objectives of the subject and especially about the projects that will broadly define the final assessment of that particular subject.

The priority project of this learning unit consists of two conceptual schemes that summarise graphically and textually –by means of short texts and comments- the concepts of sustainability and habitability, respectively.

These projects account for 60% of the final grade. The outstanding 40% corresponds to the assessment of the whole set of activities carried out by students day by day, which are complementary to the final projects.

The general criteria and strategies developed and proved suitable by the methodology followed can be summarised as follows:

- From the beginning, the final projects to be developed by students are presented and its scope defined.
- These projects will have a greater weight in the final grade, should be clearly defined and the criteria used for their assessment should be clearly established –preferably by means of a rubric, as proposed in this learning unit.
- In order to be able to evaluate and control students' progress during the learning process, complementary activities and tasks which are handed in daily prove to be necessary.
- There may be different sorts of such tasks and activities, both practical and theoretical, but all of them should support and be developed around the study, reflection, debate and finally the knowledge of the issues and subjects to be dealt with in the final projects. It is not advisable to deal in this exercises with issues which do not correspond or are vaguely related to the final project, as this may cause the students become unfocused. Students should devote full attention to the priority subject of the unit.
- To keep the students' interest and focus throughout the different tasks, they should be assigned a limited and not very long period of time.
- Tasks should be handed in during or at the end of each teaching session, avoiding them to prolong in time.
- To give continuity to the tasks developed in class, it is advisable to set complementary tasks to be done outside class-time, for the following day. It is also important that these tasks are evaluated and used within the activities of the following day.
- It is convenient to propose a mixture of individual and collective activities to be carried out in groups, in order for the tasks to be dynamic and avoid students getting bored or exhausted.
- For the development of group tasks, students should share responsibility by being assigned different roles. The assignment of roles can be done by the teacher or chosen by the students and should vary in time according to the different activities.
- This favours that all students get involved, as they need to assume their responsibility towards the group.
- For the development of collaborative work in teams, specialised groups must be organised, which will later make up work teams and projects counting with at least one specialist on each subject previously dealt with. This way, the first teams of specialists are responsible for sharing with the project team the conclusions gathered around their subject of specialisation.
- To keep the students' attention and interest about a specific subject for debate, development and reflection, they should feel the need to know 'something', 'a lot', 'more' on that specific topic, with the purpose of progressing towards their final project's assessment. For this purpose, it is advisable to ask a few questions for them to think over and find information. Following this, reflection and debate among students should be encouraged; the teacher should help conduct this process so that the objectives are not diluted.
- Teams engaged in work, debate and reflection should be small enough for students to feel free to express their opinion, avoiding possible situations of stage fright. The size of the groups may be gradually increased in order to share reflections and discuss them later, also for the final data sharing between the whole class and bringing together of conclusions and remarks on the part of the teachers.
- It is advisable to ask students to provide their own personal reflections on the most important questions under study to evaluate their progress in the development of activities and detect any

possible lack of involvement, dispersion or any other question that may have a negative effect on the students' final assessment.

- Self-evaluation or evaluation of certain class-mates activities are advisable, to make students aware of their own process and allow them to reflect on their improvement and deficiencies. These tasks should be carried out with the help of detailed rubrics that help students understand the minimum objectivity criteria they should put into practice.
- In order for these evaluation activities to be accepted and are carried out with precision, the assessments carried out by students should be taken into account by the teacher's evaluations and assessments

All these strategies and suggestions have been put into practice during the development of Architectural Analysis IV learning unit and have proved to be highly advisable for its good educational and teaching results.

5 STUDENTS' OPINIONS

The methodological experience of Architectural Analysis IV learning unit has been well received by students in general terms. To be able to state such fact, surveys were carried out to students, whose analysis drew the following conclusions:

With regards to the question "do you consider you have acquired knowledge through this learning unit and do you think you reached the proposed objectives?" 63% of students answered "very much" (maximum positive score) and 37% of students answered "quite a lot". No students answered "nothing", "little" or "enough".

Regarding the question "was it interesting and fun the methodology used?" 67% of students answered "very much", 30% answered "quite a lot" and 4% answered "enough". No students answered "nothing" or "little".

With regards to the question "Would you have rather used more traditional methodologies where the teacher gives lectures and assessment is carried out through a final exam or project?" 56% of students answered "nothing", 41% answered "little" and 4% answered "enough". No students answered "quite a lot" or "very much".

With regards to the question "how hard do you consider you have worked during classes?" 15% answered "very much", 63% answered "quite a lot" and 22% answered "enough". No students answered "little" or "nothing".

With regards to their grades and the question "do you think your grades mirror your effort?" 22% of students answered "very much", 48% answered "quite a lot", 26% answered "enough" and 4% answered "little". No students answered "nothing". It is not specified whether students answering "little" consider it positive or negative.

According to this data, we can conclude that most students have learnt a lot or quite a lot and the learning unit met the targets set initially. The methodology is also considered fun and interesting and they prefer it to other traditional methods based on master classes by teachers.

Most of the students consider they have worked "quite a lot", so that the work load is not excessive but rather achievable. It should be remembered that we are dealing with Architecture students who are used to hard work.

With regards to the final qualification, most of the students are quite satisfied, others claim to be very satisfied and others enough satisfied. Only one student claims to disagree this his final grade.

In general terms, these data can be considered positive for a learning unit within de Degree in Architecture, in comparison with the previous evaluation carried out in other learning units. With regards to the dynamics and activities during class-time most valued by students, we can draw the following conclusions:

- Experimental field trips during which they worked on the feelings, characteristics and factors of habitability of urban spaces and buildings.
- The experience of projecting, defining and drawing at 1:1 scale (with chalk in the school's main square) an architectural space previously assigned, and explaining its habitability qualities to their mates.

- The experience of group debates with class-mates was also highly valued.

Regarding those questions which students liked the least about the methodology and/or class sessions, most students liked the sessions as a whole and they would not change or improve anything. Few students (1 or 2) have stated they do not consider appropriate the way the teacher expresses themselves, the fact that occasionally they finished sessions later than the time planned and, as a very isolated fact, some students do not find the research part or the presentation of their work to other students any fun.

All these comments have been gathered in a very personal and partial manner, so that they should be taken into account but in no way mirror the general opinion of students. They should be used for improving class development in future editions.

6 CONCLUSIONS

It is clear that the professional training of architects needs to be linked to the concepts of sustainability and habitability, especially considering the significant role of the architect in the creation of the human habitat and the inhabitants' development.

This educational proposal had the objective of approaching the concept of sustainability –following Brundtland Commission's approach of 1987: "*[That which] can meet [the] needs of the present generation without compromising the ability of future generations to meet their own needs*"; as well as the concept of habitability, understood as the interrelation of the whole set of qualities and characteristics of the architectural space as it is perceived and valued by its inhabitants.

The approach to both concepts convey a great deal of complexity. This is why we chose a teaching method that embraces the essential characteristic of complexity, namely the interrelation between its elements. Mainly based on project-based learning (PBL) and collaborative learning (CL), this methodological proposal gathered students around a good number of work teams whose participants changed daily. In these groups, all of the subjects approached interweaved, to be later brought to discussion –with the help of the teachers in charge- in class.

The methodology used had widespread acceptance among students and it succeeded in meeting the teaching targets set in the course syllabus, as was reflected in the surveys carried out, described in point 5.

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