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BUILDING *AEDIFICATORES*. CROSS-ANALYZING SOME TEACHING APPROACHES IN ARCHITECTURE AND CIVIL ENGINEERING

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Abstract: *Education may be a tool in mastering the changes that permanently occur. Therefore, re-evaluating and updating teaching approaches plays an important role and in view of the solid bond between architecture and civil engineering, a cross-analysis seems useful. The paper cross-examines some established, instituted teaching approaches rendered through the filter of personal experience: analysis through synthesis, background reference, critique, brainstorming, jigsaw and R.A.I.. In terms of comparison, this dynamic examination improves the professional relation between the two domains and their relative understanding. In terms of particular observation, each field may gain from transposing and experiencing suitable approaches from the other one.*

Key words: *teaching approaches, architecture, civil engineering, update, cross-analysis.*

1. Introduction

In the light of significant, continuous and global transformations that have impact on the building industry, the issue of keeping education and instruction in this field up-to-date is of great interest and actuality, being the core of many debates.

Three questions must be raised before entering the subject, questions that are intended to clarify the reason and meaning of the proposed topic.

First of all, *why facing architecture and civil engineering in terms of teaching methods*? The two mentioned fields go hand in hand. Mostly after ending the education period, and barely before. Of course, different fields require different approaches, but somehow regarding the roots of each domain's knowledge transmission, namely the beginnings constituted by teaching, it can be of significant help for the future collaboration of the domains. Peter Buchanan observes that, in spite of the multidisciplinarity shown by the act of building, 'architectural education is still geared to producing the solitary genius, rather than today's collaborator' [3, p. 92], although he points out the necessity and benefits of such a genius in terms of guidance and final judgments. So, building valuable and adaptive professionals in both architecture and civil engineering has its foundation on education, putting these

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domains face to face for better understanding and cooperation. Focusing on teaching methods in such diverse, still complementary fields enables a different approach on mediating the relation between them.

A second question would be, *why the use of the word aedificatores*? The Latin word *aedificator*, meaning builder, refers to both architecture and civil engineering, dating from a time when the two professions were one. Even the word architect, through its Greek etymology shows a close meaning: master builder, *arkhi* - chief and *tekton* – builder.

Specialization has changed the situation, each field having developed so much, that it would be hardly possible to superpose and unify them today. However, a thorough sensing and understanding of both architecture and civil engineering might clarify issues and improve their collaboration.

Another reason for the latin word in the title is the fact that it recalls a remarkable building treatise dating from the Renaissance, *De Re Aedificatoria* of Leon Battista Alberti. This writing shows a different perspective of approaching education in the domain of building. As Frank Weiner emphasizes, this model, although opposite to the former ancient model - Vitruvius, *De Architectura* - may form along with it, a complete perception on the art of building. 'Vitruvius's formulation has to do with the relationship of an architect to the idea of an educated life, whereas Alberti's formulation is about the relationship of life to the idea of a professionally educated architect' [13, p. 21]. On the one hand, the ancient model, proposes a wide and diversified (multidisciplinary) education, and on the other hand, the Renaissance model focuses on a specific, thorough education, creating, together, a benefic tension.

The last question is *why cross-analyzing*? There are some teaching approaches that fit both architecture and civil engineering, but there also are others, that are specific to each field. Those peculiarities seem interesting to look at, to understand in their context, to investigate their mechanism, in order to transpose observations into the other field.

By means of comparison and cross-analyzing both domains can be improved and the relation between them can be bettered. Of course, teaching methods, that work very well in one field, may not give the same results in the other one. The purpose is to follow the *how* and not the *what*, so as to provide information that can suit on one hand, similar situations appearing in architecture and civil engineering, and on the other hand, very different situations, that by being so particular to one field are hard to be understood by the other one, and that through such a cross-analysis may be softened and clarified.

In the light of these questions, the paper cross-examines some established, instituted teaching approaches rendered through the filter of personal experience: analysis through synthesis, background reference, critique, brainstorming, jigsaw, R.A.I.

2. Analysis through synthesis

The architect's way of thinking is not defined by a linear process, which implies first analysis and then synthesis. The architect's way of thinking is a looped process, where analysis and synthesis are integrated [6], where the work is simultaneously done one the problem and on the solution [5]. Jadwiga Krupinska observes, that ' analyzing by synthesizing is a very apt description of the actual method that architects use-one that gives them better opportunities for handling the complexity and uncertainties' [5, p. 125].

But how does this way of thinking interfere with the formative process? Analysis through synthesis may be understood as a flexible 'back and forward' between understanding a problem and generating a solution, developed on multiple views. Flexible, because design problems, being most of the time unstructured and ambiguous, require an open perspective, that includes juggling with different solutions. Back and forward, because sometimes, you realize that a previous solution is better, and you have to reset the process from that point on.

This method's connection to educational process is observed by Bryan Lawson [6], who conducted an experiment on groups of first year and sixth year architectural students. The results suggested that problem-understanding and -solving is a quality acquired through education, rather than being naturally present.

From personal observation, many of the architecture students tend to over analyze, and replace or diminish the synthesis part. They try to explain and develop information without, in most cases, dropping a conclusion, even temporary one, unless they are asked how that information influences them, or what connections do they see between the task they are given and the amount of information. Of course there are students with a native sense of analysis trough synthesis, but for the rest, there is the hope that, through education, they will assimilate this working method.

Or maybe, it is like Lawson amusingly states: 'it rather resembles one of those chaotic party games where the players dash from one room of the house to another simply in order to discover where they must go next' [6, p. 28]. Chaotic game or not, still students must learn to blend intuition with understanding possibilities and finding solutions. This enables a positive approach to all kinds of difficulties, not necessarily only to those belonging to architecture, but also to those coming from other domains.

A different use of analysis and synthesis appears in the process of teaching within the civil engineering domain, one that arises specially in the technical disciplines. Compared to the previous observations made on the method, which imply a looping process, this time the structure is that of a linear process.

Through analysis (analytical method) the problem is examined from the required actions to the given facts, and by synthesis (synthetic method) the problem is solved starting with the given facts towards the requirements. Analysis and synthesis may be used separately, or together. The first one offers a perspective on the problem 'from above', as a whole, which has the effect of stimulating students ' creativity. The second one opens gradually the perspective 'from inside', which leads to a thorough understanding.

3. Background reference

In both fields of architecture and civil engineering, the background reference is of great help. These domains have a practical side and deal with issues that surround the everyday life. Architectural understanding grows from architectural experience, which starts with one's room, house, street, town, etc. It is like Peter Zumthor emphasizes: 'Students have to learn to work consciously with their personal biographical experiences of architecture' [14, p. 57] and construction, we may add.

Why does this teaching approach work so well? Background reference means explaining a new concept by evoking the personal experience of the students that is connected to the new presented information. In this way, the students build the new concept on the basis of their own background, they grasp it better, because

they have experienced it, parts of it, or another concept related to it.

For example, teaching abstract concepts or geometries to the students in civil engineering has been noted to be more difficult, due to several facts. The amount of information is less absorbed, the attention of the pupils decreases. The solution acquired through practice was that of linking such a new concept or geometry to the personal experience of the students: the roof of one building which they have seen, a particular space they knew, or the shape, structure, properties of an object they are familiar with, information that can be extrapolated to the new taught subject.

Dirk Hebel in an interview-shape introduction to the book Deviations, draws attention on the following fact: 'Based on the students' experiences in the world, we can instigate certain processes whose logics are consistent and controllable but whose outcomes are unpredictable' [1, p. 14]. In this manner, relying on the students' experiential background, provides also a tool in stimulating and widening processes, not only in solving or explaining problems. The accent drops on the students' *naïveté*, which should be encouraged and even cultivated.

The efficiency of this teaching approach in architecture as well, has been validated through an experiment. It was the case of teaching a new design-concept to the students. Although explanations were offered, examples were shown and debated, the students did not seem to fully understand it. They only recovered after making them conscious about their personal experience related to the problem, which was asked to be outlined in their own words, and not using the concept itself. The result was a dynamic discussion between the pupils, who involuntarily compared their experiences, and thus created a solid context for their understanding the concept. The experiment ended successfully with the return and emphasis on the initial concept.

4. Critique, Critical Thinking, Trans-critical Pedagogy

With these teaching approaches, we enter a largely debated, informed, fresh and solid subject, which, of course needs no further presentation. Thus, only some aspects will be highlighted, regarding the use and importance of the matter in relation with architecture and civil engineering.

To start with, critique is more popular in the architectural sphere than the civil engineering field, being encountered from the education years to the rest of the professional life. That is why it is so important and worth of attention. Critique does not mean necessarily negative response. Etymologically, it means being able to make judgments, coming from the Greek *kritikos*, and further from *krinein* - to separate, to decide. So, it may also imply a positive and constructive response. Well made critique has the power to improve processes, to surpass difficult moments, to encourage, to develop. On the other hand, poor critique can bring to disappointment, can lead to superficiality, can lower the excellence level.

An interesting fact to mention comes from the history and evokes the teaching approach in the first official art academy, Accademia e Compagnia delle Arti del Disegno, Florence. Theoretical training was blended with practical work in workshops under the master's guidance and the occasionally under the critique provided by three other professionals chosen by the academy [5]. From personal experience, both from the student years and the teaching period, this working method is indeed very stimulating and appropriate to architecture. It suits very well the independent work.

Jadwiga Krupinska dedicates a great part of her latest book, to critique. She notices that, one of the first purposes of criticism is to develop the subject by consolidating the analysis through synthesis methodology, 'because that is what leads to conscious, appropriate choices' [5, p. 168].

Critical thinking, a more general concept, may be found in architecture as well as in civil engineering, unlike critique, which is mainly related to the first domain. Chet Meyers offers an attempt of definition for teaching critical thinking: 'to provide – or give students the conceptual tools to develop – a basic framework for analysis of materials in that discipline' [8, p. 8].

Our personal experience has proved it to be right. Some students have a native critical basis, and finding the framework and then applying it in different situations brings no difficulty to them. However, helping students that do not naturally poses this critical foundation, needs a special attention. Experimentally, teaching those students to think critically, improves with emphasis on the *how*. Asking simple and sequent questions helps to reveal the working principle. Suggesting distinct examples or applications of the same framework also was experienced to stimulate the critical thinking. And always asking the students' own opinion, even though at the beginning hardly anyone seems to share it.

Trans-critical pedagogy is a concept mentioned by Ashraf Salama, which articulates principles and values of transformative pedagogy and critical pedagogy. 'Transformative pedagogy in architectural education is about harmonizing the act of creating ideas and solutions with the social and environmental responsibilities that should be embedded in this act [...] it builds on the perspectives of critical pedagogy'[11, p. 12].

It is also of great help to insist in both architecture and civil engineering teaching approaches, upon the importance of the social, real world, and not only to keep students in the hypothetical bubble of the project. As far as it can go, it is a positive experience for the students to start connecting the virtual projects with possible, real social and economic facts.

According to Ashraf Salama's latest book [10], trans-critical pedagogy calls for the following aspects: thinking globally and acting locally, reconciling lectures and studios, utilizing the built environment as an open textbook, developing students' abilities to search and think critically. As an observation, it is interesting that most of the previously discussed issues are part of the trans-critical pedagogy. It seems that these ingredients put together lead to an updated teaching methodology, that better reflects the contemporary context and its dynamic changes.

5. Brainstorming

Changing the orientation of the discussion, there will be analyzed some teaching methods, that match the domain of civil engineering, but, as it will be observed, that could show similarities or offer alternatives to architecture formation as well.

Brainstorming may act as a bridge between the two questioned domains, as it reveals many common points to the previously mentioned approach – critique, the one that suits so well teaching in the architecture field. Bringing to light numerous and diverse solutions, working on parallel positions, stimulating creativity and fluidity of thinking, checking the students' ideas one with each other and with the teacher, reveals a certain flexibility, that is benefic to learning activities in both domains.

This method suits very well the domain of civil engineering and can be used both in lecture and seminar, as it has been

experimented. For example, at the launching of a new problem, students were invited to share their proposals and ideas, which were taken into consideration as they were, good or bad. Through critical analysis, with the help of auxiliary questions, argumentations or counter argumentations, the students found possible solutions. They were engaged, active and showed more interest than in other situations. Of course, this method is more appropriate for multi-solution problems, or uncertain issues, and not for simple, clear, well defined tasks, which are easily solved through problematization or conversation for example.

Brainstorming is somehow encountered also in architecture education under critique. It appears slightly different, for ideas are mostly mingled only by the student and the teacher, and hardly by all students. The use of traditional brainstorming could bring an improvement to teaching in this field, by engaging all the pupils in the action and thus gaining a larger amount of ideas. However, in this case, the attention of the teacher has to increase, because the opinions of the students on a completely new subject may not be hundred percent valid, and so, the teacher should be careful to avoid misleading and to direct the discussion in the right way.

6. Jigsaw

Starting as a research-based cooperative learning technique for primary education the Jigsaw strategy also came into the attention of higher education [7],[9], being adapted and experimented, offering other perspectives to the academic teaching.

According to Elliot Aronson [2], the developer of the concept, the process of learning from each other diminishes the competitiveness between the students, as they mutually enhance their performance instead of inhibiting it. The interdependence among students which transforms each student into a valuable resource for the others renders the jigsaw strategy very suitable also for academic education. As the name informs, the amount of knowledge to be taught acts like a puzzle: different pieces form together the whole picture. Each piece is essential, no piece is superior or inferior. Its qualities as a teaching strategy enables jigsaw to be suitable for almost every field, and therefore also for architecture and civil engineering in particular.

Applying this method in the domain of civil engineering education has provided some observations regarding the role of the teacher. On one hand, the teacher had the part of initiating the activity, settling the main discussion themes and divide the frame topic into smaller subjects. On the other hand, the teacher stepped back and transferred his position to the students in charge with the presentation. The result was a visible change of attitude in the students' way of acting: they became attentive, responsible and really tried to make themselves understood to their other colleagues. In some cases, the teacher's role was also to support the presentation with guiding-questions or to manage the subsequent discussion. Finally, the teacher's role was to draw the conclusions and to point out the facts regarding both the *what* and the *how*, both the content of the presentation and its realization.

This method has also been experimented in the architecture domain. As an illustration of its first stage of implementation, students were assigned different topics in order to cover one subject. Even though the content of each presentation was not complete and sometimes not even in the right direction, the questions that arose between the students changed dramatically the situation and brought a positive feed-back. There is

a fact, that excellence is achieved by means of practice. Experience has proved that after insisting on this method in various contexts, students started to respond very well, got used to their role of temporary teachers and treated it with seriousness, better understood what they were required.

7. R.A.I. (Round Associated Ideas)

Although this method doesn't have the popularity of the previous other approaches discussed, through practice it has proven its efficiency. As it is an assessment method, it has been used on one hand, in the last few minutes of a lecture or seminar to obtain a feedback on the freshly taught information, and on the other hand, at the beginning of the class in order to go over the students' knowledge.

As an illustration from the experience with the civil engineering students, stands the following: one student had to ask a first recap question to one of his colleagues. If the given answer was correct, this second student had to formulate a new question. On the contrary, if the response was inadequate, the task of answering the question resided with the first student, who also had to ask a new question. There was also the case in which the question-asking student didn't know the response to his own question, or answered only partially. In that situation the rest of the class was involved and only lastly the teacher interfered by checking and completing the answer or naming another student. The result was the awakening of the students' interest and their attention within these hours, the improvement of their capacity to concentrate on putting questions, but also on finding the answers for them, the discovering and clarification of the students' weaknesses and confusions, as well as the enhancing of the taught knowledge.

A main observation on this experiment was that, by using this method both during the semester and in the end, as a final recap before the examination, the students' motivation increased and the results at the testing were much better. It is a noticed fact that, 'when succeeding, the student will improve his opinion on his competence and will value more the learning activity' [4, p. 91].

With regard to this method's application in the other discussed field, the one of architecture, it may be useful to some disciplines as an evaluation of the students' knowledge with ameliorative purposes.

8. Conclusions

Education may be a tool of mastering the changes that occur in both professions. New situations call for new measures. There are more and more professionals and educators who noticed that in a changing context education cannot stay the same, it has to fit the transformations, it has to improve, it has to be up-dated. Hence, 'the contemporary society requires a new type of culture and civilization. The teacher training must redefine itself according to the new standards of society and students' needs' [12, p. 129].

Therefore, re-evaluating teaching approaches plays an important role in the contemporary context. Also, taking into consideration the solid bond between architecture and civil engineering, a cross-analysis of the teaching approaches in both domains seems useful. In terms of comparison, this dynamic examination improves the professional relation between them and their relative understanding. In terms of particular observation, each field may gain from transposing and experiencing suitable approaches from the other one. As it has been shown, some approaches like background reference, critical thinking or jigsaw are situated on

the overlap of the architecture and civil engineering education, functioning already almost the same in both fields, some others, like brainstorming or analysis through synthesis are situated at the tangency, developing the same root in slightly different ways. And, finally, approaches like critique or R.A.I., which are more specific to one domain, open the possibility to offer new ideas of education in the other one.

Also, another important observation refers to the link between assessment methods and teaching methods. On one hand, as a supplement part composing the teaching methods, evaluation approaches may offer feedback regarding the strengths and weaknesses of the teaching methods, and on the other hand, as a complement part of the specific educational process, enhancing or experimenting new assessment methods coming from a different field may lead to improvement.

The creativity of the teacher leads to the application of these methods and approaches in interactive versions, which transform students from spectators to actors.

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