Conversational Model for a Digital Tectonic Architectural Education

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Abstract

Structural education is a key piece for that architectural students think about the relations between form, materiality and tectonics, since they aid in the reasoning of physical procedures for design, leading to a point of convergence between the disciplines of architectural design and structural engineering. The fragmentation between the disciplines of architectural design and structural engineering corroborates to an atectonic design thinking, favoring the simplistic application of technique and the generation of fashion images[1]. The structural education in architectural schools emphasize that the dialogue between professionals is what should be raised as the point of connection between the conception of the structural morphology to be carried out by the architect and its validation and construction by the structural engineer. However, is this dialogue occurring? The proposal of this work is to study the possibility of proposing a new educational model for architectural design teaching through the integration between architecture, structural engineering and emerging digital technologies of design, through transdisciplinary participation and collaboration procedures in order to explore a digital tectonic process in architectural education.

Introduction

For decades, structural education in architectural schools has trained architects to the routine of structural engineers, in which there is no critical, reflexive, and dialogical knowledge. With disciplines focused mainly on quantitative aspects, they are too abstract, and do not offer to architectural student's adequate tools to appropriate itself to the relationship of material behavior to design a structural system and consequently to develop a tectonic design conception. Thus, they fail to develop a structural reasoning from an analytical understanding of the various possible solutions to a design problem.

Structure in a tectonic design conception is not an autonomous object that must suit the space or vice versa, but is the result of the dialogue between spatiality, materiality and construction technology. Emergent digital tools offer an opportunity to promote an open common chanel between agents and develop a tectonic design conception. For Oxman and Oxman[2], tectonics in digital architecture means a cultural definition of the symbolic relationships between material, structure and architectural form, constituting itself as a hybrid process in which the technical context is altered through the combination of the interaction between material and construction, structure, and performance aspects of architecture.

The emphasis on procedural interaction is what brings to digital practice a tectonic condition, in which, according to Andersson and Kirkegaard[3], is where the architect transforms into a modern *tekton*, controlling both technological and technical aspects of the building. Therefore, the concept of tectonics transposed to the digital medium emphasizes the orientation towards the process through iterations and interactions between aesthetic and technical aspects in response to the context, science and the shaping forces, enabling a mediation between form, structure and property of materials, which makes tectonics again a

fundamental and operational concept of the design process.

Interaction with computers serves to cooperate in making decisions in complex situations. In advanced design environments, using *human-machine* interaction and iteration between multiple agents, it is possible to create a conversation process with multiple feedbacks and recursion. This process would have the potential to transform the relationships between architects and engineers, where through a common language provided by the digital medium, values would be explicit, and both would share the same goal.

The software visual resources allow the visualization of the behavior of the structures, leading to a recognition of the concepts learned through analytical mathematical models, which, because they are too abstract, are generally not well understood. Incorporating technology as a conversation interface tool provides participants with a shared language for a cooperative dialogic process, facilitating the development of an interactive, iterative, circular, and recursive process.

Thus, the purpose of this work was to experiment the development of hybrid disciplines through the architectural design in conjunction with the structural education, testing integration procedures via digital tools and their theoretical-conceptual possibilities Hybrid disciplines have as a proposal to open dialogues, not eliminating the possibility of maintaining the current disciplines of structures, on the contrary, stimulate students to look for these theoretical tools to better understand how to use the resources of analysis and iteration provided by structural analysis software`s.

In this paper, the focus is to demonstrate de principles that it was used to construct the methodology to develop this hybrid disciplines which it was used the Conversational Model of Pangaro[4] based on the concepts developed by Gordon Pask's Theory of Conversation[5] as a model for a digital tectonic architectural education. With this, it was possible to propose a pedagogical conversational model among these disciplines that effectively allows a dialogic practice of design, instrumenting the architects to elaborate new project systems that propitiate a practice of collective construction of knowledge through participatory and collaborative processes, in which architecture becomes a knowledge, not an autonomous discipline[6].

Conversational Theory

Dubberly and Pangaro[7] use Gordon Pask's cybernetic models of conversation theory because they are based on an in-depth study of the interaction between *human-human* and *human-machine*, in which it is believed that in conversation it is only possible to learn new concepts, share and evolve knowledge, and, confirm agreement. In conversation the *output* of one learning system becomes the *input* to another.

In conversation systems, humans, machines, and environments can be engaged in collaborative information exchange. The conversation process occurs when its participants perform the following tasks[7]:

1. Open a channel by sending an initial message of common interest;
2. Commit to engage with a symmetrical relationship between participants;
3. Construct meaning, in which the basis of the conversation must be the sharing of contexts, with common language and same social norms;
4. Evolve, since the conversation affects both participants, in which changes brought about by the conversations have lasting value;
5. Converge on agreement through common goals;
6. Act or transact, developing cooperative relationships;

The Conversion Theory applied to teaching practices requires that the methodology developed have a cyclicality that allows the student to reconstruct a concept and a consistency, allowing all the approached topics can be identified separately[8], opening new processes of conversation. In the Conversation Model[4] show in Figure 1, the *Participant A* is the one who initiates the process of collaboration through the conversation, defining the initial goals according to his point of view, articulating the logic of conducting the conversation considering that new goals or new opportunities can emerge during the process. The *Participant A* has access to a learning structure but is ignorant of some topics. The *Participant B* should have the answers to the questions of *Participant A* providing

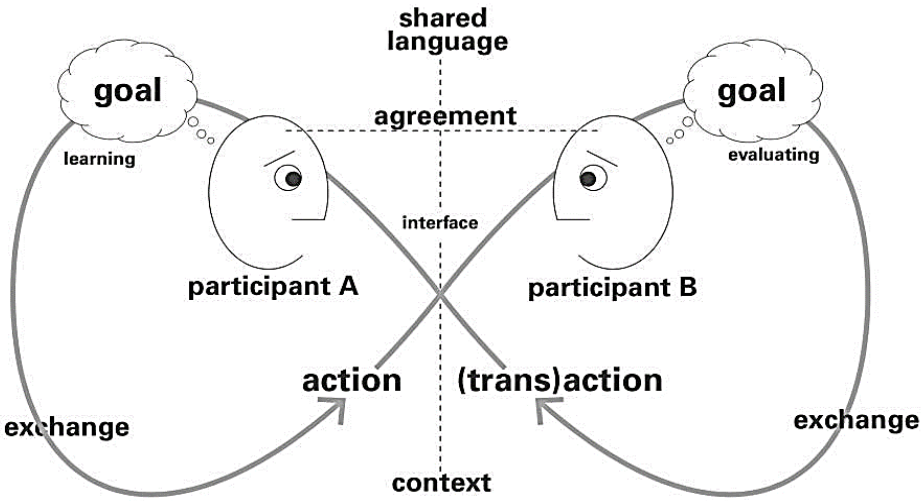

Figure 1. Diagram of Conversational Model[4]

appropriated demonstrations[8]. The conversation begins only if one of the participants have a goal, specific or general, articulated or without form.

In the current model of structural design education, there is no possibility of feedback, and a process of linear causality is created, which does not allow the iteration, the correction of the error, and the convergence of objectives among the participating agents, limiting design to simplified feedbacks. In this way, for the proposition of a conversational model between the architectural design teaching and structural education, it is important that there is a context that allows the possibility of multiple feedbacks, promoting circularity and recursion. For this, it is fundamental that the interaction of *Participant B* in the context of *Participant A*, developing a common language, with explicit objectives, in a context that facilitates the exchanges, in which these will serve as the basis for a joint action and for the creation of new values.

Conversation as a Digital Tectonic Architectural Education Method

The proposal of a new Conversational Model between the architectural design teaching and structural education seeks to promote a common language among the participants for the development of approaches aimed at the recognition of material and constructive issues. For this, it is fundamental that *Participant B* promote its (trans) action within the same environment of design teaching (*Participant A*). *Participant B* can be machine (use of structural analysis software) or human (teacher of structures disciplines). In this way the proposed conversations are about promoting *human-machine* interaction, or *human-machine-human* interaction.

In the first hypothesis, focusing on *human-machine* conversation, the proposal was to develop a teaching model in which students use structural analysis software to develop performance-based design methodologies with focus in optimization, generation or computational form-finding. This model, as elucidated in Figure 2, consists of involving *Participant B* in the conversation (structural analysis software) through *human-machine* interaction.

In this process, the analytical method still remains as the common language among the participants to analyze and evaluate the outputs generated by the software so that these data inform the project synthesis. In this way, the deficiencies in the understanding of the analytical method resulting from a fragmented

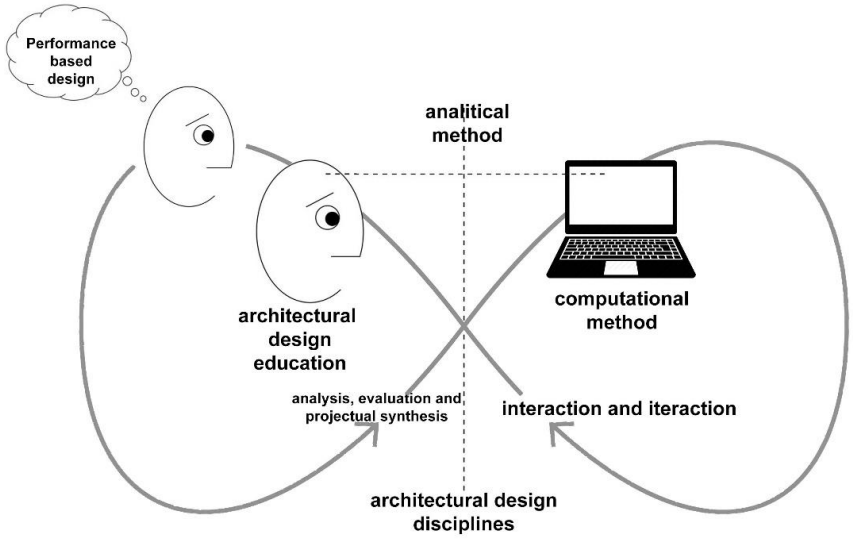

Figure 2. *Human-Machine* Conversational Model

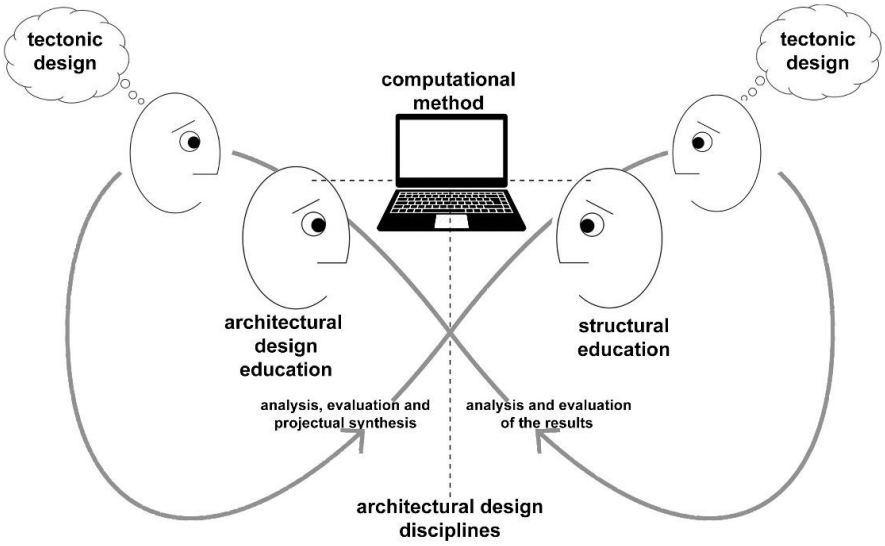

Figure 3. *Human-Machine-Human* Conversational Model

and emptied teaching path makes the students perceive in a more accentuated way the absence of tools for the evaluation of the structural models, which demands more directly the inclusion of a structural teacher in the design process to assist them in interpreting the results obtained in the simulation of the structural behavior generated by the software. Thus, recognizing the limits of the *human-machine* conversation, what can be seen with the construction of this model is that the information exchange that has occurred has only one dialogical characteristic, not constituting itself as a dialectical practice, since the machine does not indeed a subject, but only a tool that facilitates interaction and iteration with the structural model.

In a second hypothesis, expanding the interactions to a *human-machine-human* conversation model, the structure teacher is included as an agent with intentionality in the figure of *Participant B*, which opens up new channels of interaction to be worked on (Figure 3) . We can consider that the demand for inclusion of the engineer makes up for the inability of the machine to understand the context, as approached by Negroponte[9]. In this way, the participation of one more agent in the model, promotes the expansion of interactions that can occur simultaneously, allowing that the exchanges that occurred with *Participant B* are not only dialogical, but also dialectical.

The architectural design teacher that conforms together with the students as *Participant A*, has a fundamental role in this model, since he must promote an agreement and an engagement among all through the construction of a common goal, and must be carried out in order to avoid noise and, consequently, conflicts of values and objectives between the participants. If there is no agreement and engagement with *Participant B* in the figure of the structural teacher, the entire process can lead to a conflictual transaction, or even make it unfeasible. In the case of the experimentation carried out, the role of the architectural design teacher is to promote the engagement of all participants through the development of projects with a tectonic bias.

In this way, the *human-machine-human* conversation enabled students of architecture to not only partially unlock the technical code, but also enabled them to dialogue with the engineer through the learning of a common language, making it possible, by agreement and engagement, effecting communicative exchanges of action and transaction. These students seek the theoretical knowledge offered in the traditional disciplines of structures (some return to attend classes in disciplines such as resistance of materials and structural analysis), seek dialogue with other structural engineer teachers, seek other structural analysis software`s, other professionals in the field and until getting involved in a critical dialogue with the construction industry, which led to the development of a project guided by tectonic issues.

Conclusion

The modern division of labor has led architects and engineers to develop a collaborative relationship through help or support. That is, the architect develops a project and the engineer helps or assists him with his work, not acting jointly in his development. The change of relationship in the sense of developing a cooperative work redefines the positions of professionals and re-approximate the work of both, where the action takes place jointly for the same purpose.

The pedagogical proposal to develop conversational models for teaching design and structures goes through what Montaner[6] purposes for a practice towards an architecture of action. For Dubberly and Pangaro[7], the conversation for action promotes an ethical (in agreement with goals), cooperative (in agreement with means), innovative (creating a new language) and responsible (creating a new process).

In order for structural education to be part of a conversation within the design disciplines, it is necessary that the architectural design teaching is also open to substitution of a typological model, with a correctness of the linear form, for a topological performance model, in which the architect does not have control of the designed object, but rather of the process, allowing architecture to emerge from participation and emergence between a variety of agents. In this process unexpected results can emerge, not foreseen initially, creating novelty for both participants.

The creation of collaborative design processes in which knowledge is built collectively through the participation of other agents leads to a paradigm shift. Established conversations can

transform individuals and organizations by changing values and modes of arrangement, and conversation initiated in teaching can be replicated in professional practice. For Pangaro[10], when a conversation begins, it never ends. In this way, we believe that the conversation initiated in the teaching environment has the capacity to transform professional practice, thus modifying the relationships between civil construction agents (architects, engineers, workers and users) and their forms of participation through the emergence of dialogical practices, in which the discussion is oriented by the object that connects them or can connect.

Endnotes

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