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COORDINATOR: Anda-Ioana SFINTEŞ
TRANSLATED BY Florina TUFESCU

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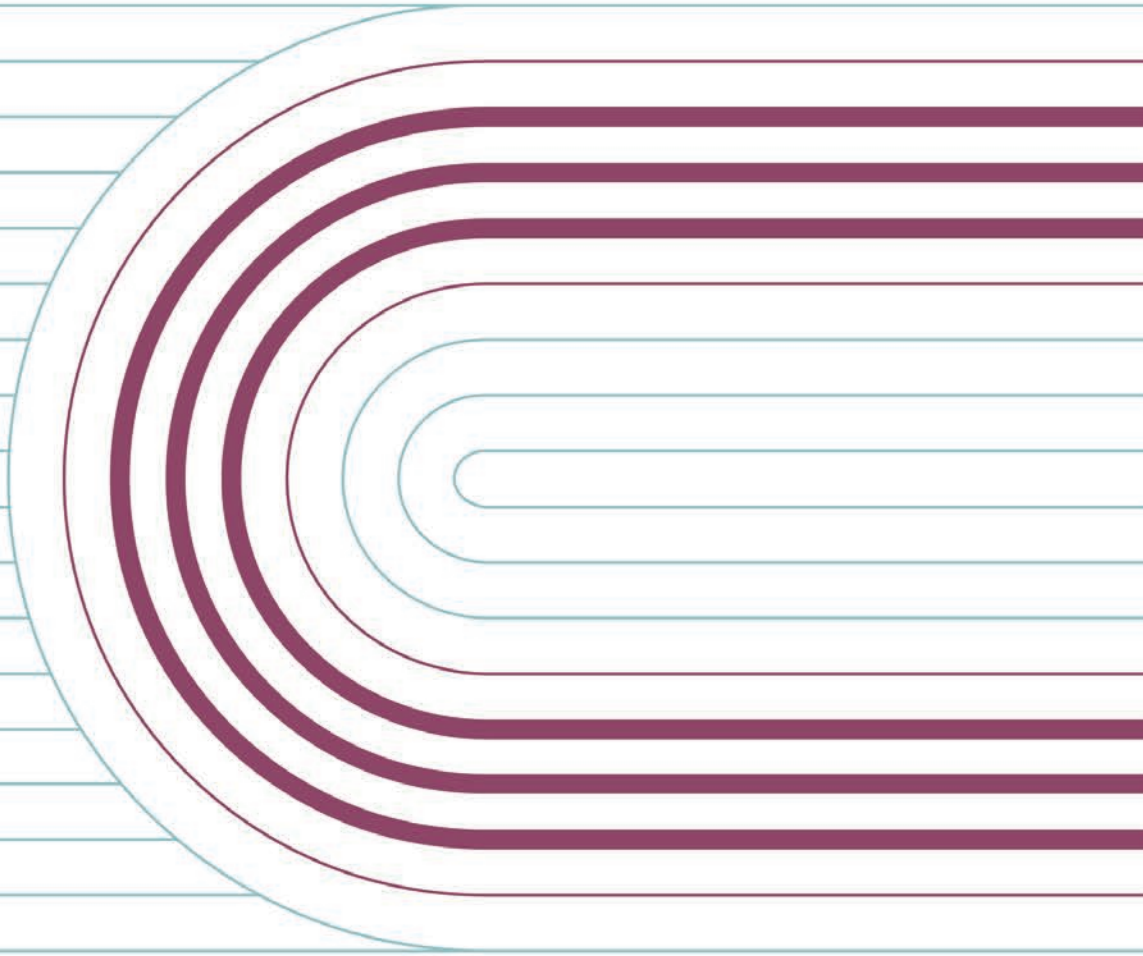

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Adrian MOLEAVIN
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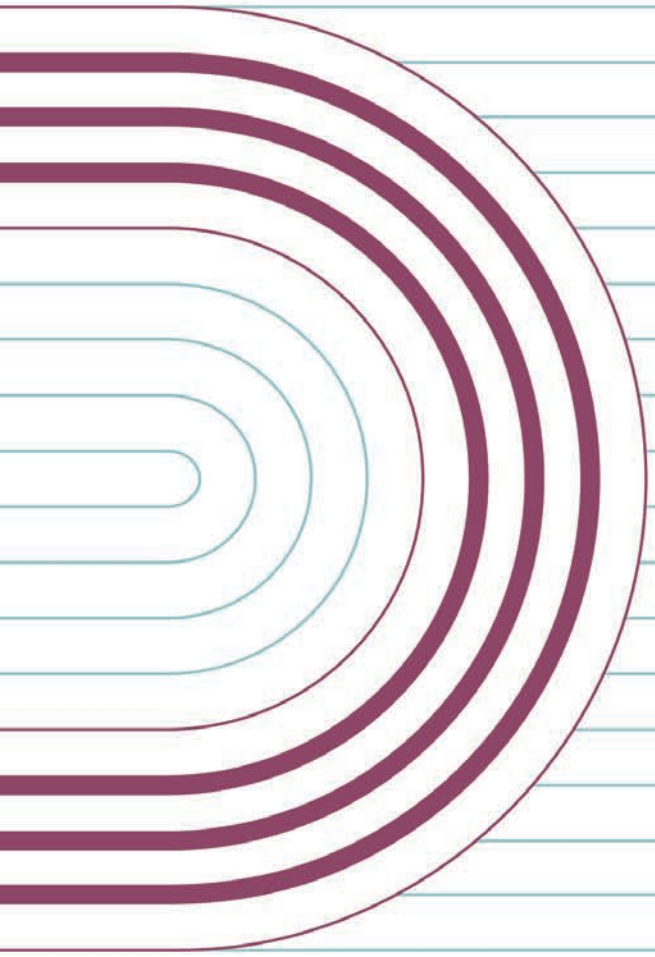
Gheorghe CLITAN



Architecture. Critical thinking

Critical thinking – a brief history

Critical thinking has been, for over a century, a widely accepted educational objective, which has revolutionised the teaching of university and school students regarding how to approach their intellectual formation in order to guarantee professional success, the appropriate capacity of analysis and argumentation and, from a broader perspective, the premises of exercising democratic citizenship.

The use of the "critical thinking" term to describe an educational aim originates with the North American philosopher John Dewey, who more frequently called it "reflective thinking", "reflection" or simply "thinking". He defined it as the active and attentive consideration of any belief or alleged form of knowledge in light of its foundational elements and of the conclusions it tends towards (Dewey, 1910). The complex trajectory of this approach can be identified with the structuring of a scientific attitude of the mind that has an educational aim, with Dewey supporting his hypotheses with the help of quotations from John Locke, Francis Bacon and John Stuart Mill in order to demonstrate the necessity of setting up this kind of process.

An exhaustive definition of the concept has not yet been accepted, but the partial definitions that are operational can be identified as different concepts of the same approach: *careful thinking oriented towards a goal*. Sharon Bailin (Bailin et al., 1999) supports this definition and argues that the educators who employ this method usually understand critical thinking as having at least three features:

> _it is performed with the aim of forming a person's mind so as to enable them to decide what to believe or how to act;
>
> _the person involved in this type of process attempts to follow the standards of appropriateness and accuracy specific to reflective thinking;
>
> _a person's thinking complies with certain standards, relevant up to a certain level.

These features seem applicable to all the examples of critical thinking identified by researchers, who add that this mechanism must be applied by excluding the immediate leap to conclusions, the suspension of judgement regardless of the strength of the evidence, the routine use of an algorithm to answer a question and the favouring of reasoning from an ideological or religious perspective that is considered indubitable. Yet if we admit that the essence of the process is *careful thinking oriented towards a goal*, we should also mention the fact that it has particularities which may vary depending on the presumed goal, on the criteria employed and the sphere of application, as well as on the specific thinking component involved. Thus, a person may be inclined to critical thinking only in relation to certain types of problems – for example, they might be open-minded about scientific issues but not about religious ones. Likewise, someone might be confident in a person's capacity to reason about the theological implications of the existence of

evil in the world but not about their capacity to reason about the virtues of sustainability in the architectural field or the appropriate design of a structure that withstands seismic shock.

Dewey (1933) analysed several mechanisms of action and identified a fundamental process, specific to critical thinking and universally applicable, which consists of five stages, initially called "action steps", a designation later discarded by the author to nuance their compulsory character:

> _the confrontation with *suggestions*, wherein a person's mind has the tendency to jump forward toward a possible solution;
>
> _the conceptualisation of the difficulty to know or of puzzlement as *a problem to be solved*, the identification of a question whose answer must be found;
>
> _the use of a flow of successive suggestions, which becomes a leading idea or *hypothesis*, to initiate and guide observation and other operations of collecting the factual material;
>
> _the mental formulation of the idea or presupposition as being the necessary idea or presupposition to solve the previously identified problem (*reasoning*, in the sense in which reasoning is a part, not the whole, of the inference);
>
> _testing of the hypothesis by *a direct procedure or by an imaginative action.*

The reflective thinking process, which always incorporates these stages, is in its turn preceded by a perplexed, troubled or confused situation – that lays the basis for action – and is followed by a clarified, unified, resolved situation – which concludes the process (Dewey, 1933). Completing this kind of cognitive process is meant to develop the individual's theoretical background and the abilities that make them think critically when necessary.

In addition to inclinations and abilities, critical thinking requires precise knowledge of the concepts and principles of critical thinking and of the phenomenon of reflective thinking. A short list of concepts whose understanding contributes to deeper assimilation of the methodology of critical thinking can be generated by means of a taxonomical procedure. *Observation abilities* require understanding the difference between observation and inference. *Question formulation abilities* require understanding the concepts of ambiguity and vagueness. *Inferential abilities* require understanding the difference between conclusive and cancellable difference (in traditional logic, between deduction and induction) as well as the difference between necessary and sufficient conditions. *Experimentation abilities* require understanding the concepts of hypothesis (including the null hypothesis concept), presupposition and prediction as well as the concept of statistical significance. They also require understanding the difference between an experiment and an observational study and especially the difference

between a randomised study, a prospective correlational study and a retrospective (case-control) study. *Argument analysis abilities* require understanding the concepts of argument, premise, presupposition, conclusion and counterargument.

Testing methods

Over the course of time, standardised tests have been designed to assess the degree to which a person possesses such inclinations and abilities. It has been demonstrated via experiments that school or university students can consolidate and train the faculty of reflective thinking through education, especially when the latter includes dialogue, concrete instructions and appropriate guidance, but controversies have arisen regarding the generalised use of the method in different fields and the validity of critical thinking as a universal problem-solving method.

The testing of professional competences is a fact currently confirmed, inter alia, by the use of different types of tests in recruitment or admission to the most prestigious higher learning environments (North American, Canadian, English, French, etc.). The following are among the most popular tests today in selecting applicants to higher education:

1. Tests of critical thinking or with a high percentage of critical thinking components (Watson-Glaser Critical Thinking Appraisal, MENO Thinking Skills Service, ACT – American College Testing, SAT – Scholastic Aptitude Test, GRE – Graduate Record Examinations, LSAT – Law School Admission Test);

2. Language tests (TOEIC, TOEFL and GRE – for English, TEF – for French, Daad – for German, etc.);

3. Computer tests (PCIE, CISCO CCNA certificate, MCSE Microsoft certificate);

4. Management/finance exams (CFA, CPA, CGPG certificate);

5. Admission tests to engineering, commerce and MBA schools (TAGE 2, TAGE-MAGE, GMAT).

Since these tests are often summarised in standardised fashion to assess the training of critical thinking and academic success respectively, admission to universities and colleges or access to programmes and scholarships is based on using special kinds of instruments: teachers' letters of recommendation, candidates' prior involvement in extracurricular activities or essay-building abilities.

In employing these instruments, critical thinking becomes focused on practical problems. Critical thinking teaches us to read, to deconstruct, to understand and to define arguments for the practical purposes of daily life, for a better discourse in public debates or for the organisation and structuring of scientific communication in certain disciplines (Hoaglund, 1999). Here are a few examples:

1. Critical thinking and orientation, guided towards debate. Learning how to debate a problem presupposes not only knowing how to build up arguments but also being able to "read" the opponent's arguments, to understand them quickly and be able to respond to them.

2. Critical thinking and the theory of argumentation, geared towards specific disciplines: e.g. legal argumentation in law schools (whose graduates must know how to plead in front of a jury).

3. "Research logic" – connected to specific disciplines.

4. Critical thinking and the introduction to logic, oriented towards the construction of arguments in philosophy and the critical examination of philosophical arguments.

The oldest and most famous critical thinking test is the Watson-Glaser Critical Thinking Appraisal (WGCTA), developed over a period of 85 years. The assessment performed with its help is considered a good predictor of productivity at work and is an effective instrument in identifying candidates with a fair potential of becoming managers or of occupying managerial positions.

Developed by Goodwin Watson and Edward Glaser, the Watson-Glaser test is preferred by law firms, eager to measure the individuals' ability to reason, to reach conclusions and to know when logical leaps are made. The questions in each of the five sections are aimed at evaluating the candidate's capacity to:

1. Draw correct inferences.

2. Identify the moment when a hypothesis was formulated.

3. Use deductive reasoning.

4. Draw logical conclusions.

5. Evaluate the effectiveness of the arguments.

This critical thinking test assesses critical thinking abilities from the five key areas by starting from a brief paragraph made up of a few short sentences or of a longer sentence. To perform at maximum capacity when taking the Watson-Glaser test, the following specifications must be borne in mind:

_*no prior knowledge is required* – The key point is that critical thinking tests measure reasoning capacity or the method used to reach a conclusion. Thus, no prior knowledge is required to answer the questions, which are formulated so as not to depend on subject expertise. For example, the assessed individual is not expected to know mathematical formulae or laws of nature and to answer questions using this type of information. If they are given the formula and its description in words, they must use this information to obtain the answer.

_*following instructions* – There are five sections in all versions of the test administered to candidates, but each version assesses a slightly different ability. It is recommended that the instructions should be read and that one should understand what is expected in order to answer the questions of a particular section. There is a fairly large difference between the "Hypotheses" and the "Deductions" sections, for example. Applying the rules of one section to another would lead to merely guessing the answers and thus to the appearance of additional errors.

_*observing the allocated time* – These tests are complex and a situation may arise where the examinee becomes stuck on an answer, allotting it more time than necessary. An analysis of the complexity of the test and a uniform distribution of time between all the questions are thus required. The time management aspect is relevant to all tests but is especially important in critical thinking tests since many people think they have ample time to solve all the test items and thus underestimate the number of questions they need to answer.

_*logical errors* – Identifying logical errors holds the key to many aspects of these tests and researching the difference between healthy and erroneous thinking will prove useful in a critical thinking test. An error is an error of reasoning due to a wrong concept or presumption and an argument which uses a sophistic or linguistically deceptive error or an inductive or deductive logic error in its reasoning becomes invalid. Research into the different types of errors can be helpful in finding or recognising them in the test, leading to correct answers to the questions.

Industrial society expressed itself through standardisation of production, consumption and work as well as of the human being as such; in this context, education was mostly confined to acquiring abilities for physical work and for the manipulation of various machines or assembly lines, this being a period when the field of logical reasoning, of critical thinking, was not a central concern for the majority of educational institutions.

The importance of critical thinking in the field of architecture

In the post-industrial information society, where physical work is transferred to machines and robots, human work is, to an ever-increasing extent, made valuable by critical thinking, analysis, creativity and problem-solving. Following the research conducted by the *World Economic Forum* (2020) on the Linkedin and Coursera platforms, *problem-solving* emerged as the most important of the key abilities required by employers. It encompasses five of the top ten competences in the ranking: analytical thinking and innovation; solving complex problems; critical thinking and analysis; creativity, originality and

initiative; reasoning, problem-solving and ideation (*World Economic Forum*, 2020).

If the XVIIIth, XIXth and XXth centuries were marked by the Cartesian dualism between mind and body, physics and metaphysics, which laid the foundations of an ontology and epistemology of a materialist character, the current moment of the maturing of the information society towards a knowledge society compels us, via patterns like the one described above, towards the recovery of an integrated vision of the human being, the scientifically based restoration of the balance between body and mind. Yet three centuries of support, debate, development and implementation of patterns specific to materialist and mechanistic thinking represent a heritage that is difficult to overcome, which is why, in addition to the evolution of educational theories and practices, models of thinking and practice were sought, whose study would lay the foundation for new models meant to lead to the development of the abilities required by XXIst-century industries. The domain of architectural practice has become perhaps the most interesting example:

> Sciences are more and more interested in the ability of architects to connect and to integrate, by designing and building, different disciplines, diverse scales and various points of view ... The operation method of architects, in the planning of a building, should be to connect the countless information of the different disciplines without losing sight of the whole. (Ganshirt & Stapenhorst, 2016, p. 55)

Architectural practice is, exceptionally, an interdisciplinary field, where critical thinking has always been at the centre of the concerns of the great practicing architects and/or theoreticians. Already in the first architectural treatise, written in 50 BCE, Vitruvius asserts: "The architect should be equipped with knowledge of many branches of study and varied kinds of learning, for it is by his judgement that all work done by the other arts is put to test" (Vitruvius, 1914, p. 5). Vitruvius thus emphasizes two components of architectural practice, which he considers vital: knowledge from a very wide range of fields, both architectural and non-architectural, and judgement, critical thinking, both necessary for the architect "so as to leave a more lasting remembrance in his treatises" (Vitruvius, 1914, p. 6). Perception psychologist Rudolf Arnheim, referring to the fields of art and architecture, defined this form of transdisciplinary practice typical of architecture as "productive thinking" (Arnheim, 1969). For Christian Norberg-Schultz (1966), *the ability to judge* is essential to the architectural design process since it influences any decision taken in the conceptual and design process.

Architectural practice is obviously at the intersection of artistic and scientific fields, to which it pays epistemological tribute while retaining its individuality. "I tell them (the universe of authorities) that an architect is a specialist in non-specialisation, but they cannot take that not even as a joke", Alvaro Siza asserted (cited by Keneth Frampton in Lizondo Sevilla, 2012). Likewise, Christian Norberg-Schultz observed

that "the real task of the architect consists in the unification of several factors taken from different fields" (1966, p. 203). This positioning as an integrative and coordinating factor has naturally favoured the architects' adoption of critical thinking patterns. Even here, the influence of mechanistic standardisation was a levelling and oppressive factor, yet at present and concurrently with the development of complexity sciences and the emergence of transdisciplinary research and fields of study, the field of architecture and in particular that of architectural education are being ontologically reinvented through the conscious integration of processes specific to critical, analytical and logical thinking into architectural production processes. "Taste, judgment and criticism are therefore immovable components of the aesthetic understanding", philosopher Roger Scruton stated in his book *Architectural Principles in an Age of Nihilism* (1997, p. 205). Thus, the architect becomes a "reflective practitioner" (Schon, 1992), and architecture a reflective practice.

"Critical reflection", "critical thinking", "critical engagement", "critical views", "critical reflection", "critical activity", "critical eye", "critical debate", "critical activity", "critical reactions", "critical analysis", "critical analysis skills", "self-evaluation" are the frequently repeated phrases in the *Changing Architectural Education* book (Nicol & Pilling, 2000), published more than 20 years ago, which highlights the importance that editors and authors attribute to the capacity of logical reasoning, both during the period of academic studies and of professional practice.

Similar approaches can also be discerned in the preoccupations of university teachers of architecture, in connection to the work methodologies employed in the design studios, which seek to use and develop the students' abilities of logical reasoning, i.e. critical thinking, logical thinking and comprehensive thinking, via specific exercises. *Laboratoire de la production d'architecture* – LAPA, represents such an example of an interdisciplinary approach to architectural projects, implemented by the architect and professor Harry Gugger at the École polytechnique fédérale de Lausanne (EPFL). The working method is exploratory, pursuing the development and diversification of design processes which are based on a very intense research period and a two-stage critical approach, first of the context and subsequently of the architectural project, with the primary aim of developing the students' integrative thinking ability (Ganshirt & Stapenhorst, 2016).

The importance of developing critical thinking in architectural education and practice is perhaps best expressed by Rudolf Arnheim, who describes any artistic practice, implicitly also the architectural, as a form of reasoning: "All perceiving is also thinking, all reasoning is also intuition, all observation is also invention" (Arnheim, 1974, p. 5). Arnheim argues for this by indicating the relationship between visual perception and cognitive operations: "Visual perception is visual thinking" because "the cognitive operations called thinking are not the privilege of mental processes above and beyond perception but the essential ingredients of perception itself" (1974, p. 13). He expands upon this assertion by providing a list of processes specific to cognition as well as perception: "active

exploration, selection, grasping of essentials, simplification, abstraction, analysis and synthesis, completion, correction, comparison, problem-solving, as well as combining, separating, putting in context" (1974, p. 13), all of these being also found in the above-noted list of abilities specific to critical thinking. It is important to note and remember the fact that all these processes are simultaneously characteristic of the patterns of critical thinking and of the design and architectural design processes.

Conclusions

While the importance of critical thinking has been recognised as essential to architectural work since antiquity, it was long considered to be more of an innate ability and less of a trained, learned one. Yet at present, a switch of focus is noticeable in architectural education, from the final product, i.e. the architectural object, to the design process, taking into account the fact that a well-grounded and well-argued design process automatically leads to valuable results.

The ever-increasing complexity of the problems tackled by architecture has led to the development of new methods in architectural education, whereby training in the above-presented processes specific to critical thinking becomes an integral, indispensable component of high-quality architectural education. Increasingly, the development of critical thinking abilities is becoming a major criterion in assessing the quality of architectural education (Spiridonidis, 2010).

As previously discussed, critical thinking abilities can be trained by means of specific exercises, whether or not they are part of the architectural problems the students are required to solve, and they can be measured by tests with architecture-specific content, thereby contributing to the continual updating of the educational model through adapting methodologies, updating content and measuring the quality of the educational process.

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