

The challenge of contemporary architecture didactics: designing in dialogue with Artificial Intelligence

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Abstract. The change of technological conditions in the field of architecture is a rapid and constant phenomenon that forces architects of all ages to always be alert and updated. The inability to understand the phenomena surrounding us translates into the inability to control them and the risk of quickly becoming obsolete and losing contact with reality. Contemporary architects must be aware: they must possess a strong knowledge of history and tradition but at the same time they cannot ignore contemporaneity, technology and all those new tools that are inevitably altering their profession. For this reason, it is important to develop a new teaching method, in which students are provided with theoretical and practical notions that help them design by combining the most common skills with the use of innovative means, first of all generative artificial intelligence – which represents the greatest technological revolution since the advent of the internet. Students must learn to dialogue with AI, control it and rework its outputs within a new multidisciplinary and stratified process, developing a critical awareness that makes them "augmented" architects ready to face the challenges of contemporary architecture. As research group we accepted the challenge and the responsibility of developing a new teaching system: during the architectural design laboratory of the Polytechnic of Bari we used it to help students develop their year's projects.

Keywords. Architectural Design, Didactics, Design, Artificial Intelligence, AI.

Résumé. L'évolution des conditions technologiques dans le domaine de l'architecture est un phénomène rapide et constant qui oblige les architectes de tous âges à toujours être vigilants et à jour. L'incapacité à comprendre les phénomènes qui nous entourent se traduit par l'incapacité à les contrôler et le risque de devenir rapidement obsolète et de perdre contact avec la réalité. Les architectes contemporains doivent en être conscients: ils doivent posséder une solide connaissance de l'histoire et de la tradition mais en

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même temps ils ne peuvent ignorer la contemporanéité, la technologie et tous ces nouveaux outils qui modifient inévitablement leur métier. C'est pourquoi il est important de développer une nouvelle méthode d'enseignement, dans laquelle les étudiants acquièrent des notions théoriques et pratiques qui les aident à concevoir en combinant les compétences les plus courantes avec l'utilisation de moyens innovants, en premier lieu l'intelligence artificielle générative – qui représente la plus grande révolution technologique depuis l'avènement d'Internet. Les étudiants doivent apprendre à dialoguer avec l'IA, à la contrôler et à retravailler ses résultats dans le cadre d'un nouveau processus multidisciplinaire et stratifié, en développant une conscience critique qui fait d'eux des architectes « augmentés » prêts à relever les défis de l'architecture contemporaine. En tant que groupe de recherche, nous avons accepté le défi et la responsabilité de développer un nouveau système d'enseignement : pendant le laboratoire de conception architecturale de l'École Polytechnique de Bari, nous l'avons utilisé pour aider les étudiants à développer leurs projets d'année.

Mots clés. Conception Architecturale, Design, Intelligence Artificielle, IA, Didactique.

1 Introduction

Architects have always expressed themselves essentially through drawing – formerly analogue and now digital. Today they have the possibility of giving shape to their ideas in a new, simple and fast way through Generative Artificial Intelligence. This tool simplifies the visualization of draft ideas, eliminating the necessary mediation between imagination, requests and the hand of the designer.

For this reason, it is important not only to understand how to “speak” with AI but also to train young architects immediately, so that they can develop a strong critical awareness of the architectural discipline. This way they can control contemporary tools adequately, without ever letting themselves be overwhelmed by technology, losing their central role in the creative process.

Architectural education is bound to both knowledge of tradition and control of innovation. Therefore, a profound awareness of the past must be associated with the necessary understanding of a rapidly evolving reality, in which the advent of Artificial Intelligence, despite its revolutionary value, is only the last step of a long journey that has already seen architects deal with multiple important innovations, such as the advent of Computer Aided Design (CAD) tools and parametric modelling, which have radically changed the discipline. Now that tools and techniques such as photo editing, extended reality, simulators and real-time rendering have been widely integrated, it is time to also deal with AI, which arouses a sense of novelty and uncertainty that may perhaps be frightening [1]. However, it certainly allows experiments of different types and in various fields, including Architectural Design teaching.

This paper describes the experiments conducted within the Architectural Design Laboratory of the fourth year held by prof. Giuseppe Fallacara at the Polytechnic of Bari in the academic years 2022-2023 and 2023-2024 [2, 3], during which an attempt was made to mix the traditional university teaching process with the use of Generative Artificial

Intelligence. While the most common trend is to use powerful tools such as Midjourney or Stable Diffusion to generate aesthetically impactful images without constructive and scientific value, in this case we tried to overcome this condition, to stratify the results and give them a strong educational value. Therefore, the images provided by AI were never considered the result of a purely aesthetic process, but a starting point for the development of multidisciplinary reasoning processes that could allow students to achieve a solid architectural awareness based on the combination of creativity and technique.

A preliminary training phase was carried out by proposing challenges to be faced through different uses of Artificial Intelligence, associated from time to time with other tools and application methods. At the end of this section, the actual design phase started. In 2022-2023 the course was focused on the project of a cultural center in the city of Andria, while in 2023-2024 the theme was the redesign of some critical areas in the city of Molfetta. Both Andria and Molfetta are located in the south of Italy.

2 Practical exercises

2.1 Phase 1: from AI to 3D model

Tackling an innovative topic such as the use of Artificial Intelligence for architecture presupposes a strong maturity on the part of the students, who must be able to critically evaluate the suggestions from AI and develop those technical skills that could give them the possibility to effectively shape the suggested spaces, that are often very suggestive but also very complex.

For this reason, the first exercise was set up to allow students to refine their spatial interpretation and 3D modelling skills.

Images of external or internal environments previously generated by the teacher using Midjourney were provided, asking students to try to process the visualized space three-dimensionally and, in some cases, to 3D print the model obtained.

According to Giorgio Vasari, Michelangelo Buonarroti talked about architecture in these terms:

[...] Bisognava avere le seste negli occhi e non in mano, perché le mani operano e l'occhio giudica[†] [4].

This means that architects must be able to understand the conformation and the proportions of a built space by observing it. In this case, the task consisted in interpreting imaginary spaces, linked only to bidimensional representation. Therefore students have to move from a subjective space – so defined because each individual can interpret it in a personal way – to an objective one, “fixed” by the 3D model.

Two considerations can be made regarding this exercise.

The first is that this type of activity allowed the students to sharpen their eyes, training in their understanding of architectural forms.

[†] [...] Compasses were needed in the eyes and not in the hands, because hands work and eyes judge.

The second consideration is that software knowledge is essential to use AI correctly. As a matter of fact, a limitation that has often been observed among students concerns the need to make simplifications due to the lack of knowledge on 3D modelling that would allow a more precise reproduction. It was, in fact, necessary to follow them constantly so that the gap between what they wanted and what they could do was reduced to a minimum [fig. 1].



Fig. 1. Some of the results of the first exercise. The AI images are on the left, while the corresponding 3D-printed models are on the right.

2.2 Phase 2: from AI to photo editing

For the second exercise, students had to interact directly with AI. Therefore, once they had been provided with the practical and theoretical notions to use it, they were asked to produce architectural visions using Midjourney. In 2023 they focused on producing pavilions to be placed in an Apulian square, while in 2024 they worked on architectures that could fit in a context similar to Molfetta.

It was necessary to stay generic because this AI is not capable of reproducing a specific context, but at most an environment that resembles it. Therefore, once an acceptable result was obtained, it was necessary to work in Photoshop to modify the surroundings of the structures with photos.



Fig. 2. Some of the results of the second exercise.

It has been a complex exercise because it has required both ability with post-production software and awareness and control.

AI is a tool with immense aesthetic-compositional potential but, at the same time, it does not require specific skills: often a few sentences or even a few words are enough to achieve extremely suggestive results.

Architectural projects always aim at achieving beauty (*venustas*) but, unlike other artistic fields, architects do not limit themselves to using their knowledge for the sole purpose of creating works of art, but also seek functionality (*utilitas*) and stability (*firmitas*). Therefore architecture places itself in an intermediate position between art and science.

Consequently, when approaching a tool such as artificial intelligence, it is interesting to produce credible suggestions and architectural references that present a series of qualities and construction characteristics that only the trained mind of an expert can identify and develop. Moreover, artificial neural networks are not bound to natural laws and, therefore, cannot develop structures that respect physical and static criteria: it is not a given that a building or a pavilion developed by an AI tool can be built. It is up to the architect – literally head (*archi*) builder (*tékton*) to control the creative process, to understand from time to time what works and what should be discarded from the output obtained, to intervene critically and, finally, to transform the suggestion into a project.

Only through full awareness of the designer's role according to the potential of technological tools it is possible to avoid subjection to the *novum* [5] and control the design process. A deep knowledge of the architectural lexicon is fundamental because without a

proper vocabulary it is impossible to unlock the full potential of AI: human creative capacity runs out when people are not able to name or define in words what they want to view.

This mechanism is based on the principle of the definition of reality through the use of words: lexicon can be considered the key tool for the definition of reality itself within a complex cultural process for which giving a name to things means generating a mental image of them, so that it is possible to deal with them critically. On the contrary, what cannot be communicated, described and named cannot take on any type of form and, consequently, cannot exist.

«L'atto di denominare non è un dato tecnico, ma descrive un processo culturale e intellettuale di primaria importanza. È nel nome che la lingua manifesta il suo carattere ontologico: nel nome il mondo viene alla presenza, nel nome l'uomo si apre alla verità del mondo»^{*} [6].

In the initial phases of the exercise, facing this condition was perhaps the most difficult challenge for the students, who seemed unable to easily communicate with the artificial mind, getting stuck on results that were aesthetically very similar to each other. However, as the confrontation evolved the situation changed and the amount of possibilities – given by the richness and variety of the usable vocabulary – gave them the ability to range between forms and materials in a new and more effective way. The subsequent need to carry out a photomontage represented a technical step for an attempt to filter the AI outputs, personalize them and place them in the chosen locations, carrying out an aesthetic and compositional exercise aimed at training design awareness. Placing a pavilion generated by artificial intelligence in an existing context forces one to deal with factors such as functions and proportions of the architecture and also materials, lights and the global atmosphere of the chosen place. Therefore it is necessary to wonder how to make the image credible and one is forced to pay attention to reality. Details cannot be neglected, since they are an important component of the context in which architecture exists.

The results of this exercise represent the outcome of a process of maturation of young people who, after having faced the inevitable technical difficulties of the software, managed to eliminate the gap between the ephemeral and decontextualized suggestion of AI and its possible form, translating everything into architecturally credible works, even if interpretable and not considered objective spaces or real projects.

2.3 Phase 3: from AI to rendering

After the training with Midjourney, students had to face a further step in their training to master visualization software. Some of the architectural visions already produced were selected and assigned to groups of two or three people, who had to interpret them and obtain a credible 3D model. Models had to be rendered in a photorealistic way and inserted in the urban context of Andria or Molfetta.

This step was necessary in order to push students to face practical matters of the project, paying attention to details such as the materials to use and their constructive system, the

^{*} The act of naming is not a technical fact, but it describes a cultural and intellectual process of primary importance. It is in the name that the language manifests its ontological character: in the name the world comes into presence, in the name a man opens up to the truth of the world.

dimension of architectural components (e. g. glass panels or metal sheets), the correct proportions of the entire structure, its function, a possible lighting system, etc. As a matter of fact, this is the only way to keep these visionary projects credible.

In some cases, parts of the projects had to be modified or adapted according to constructability and aesthetic criteria. Moreover, an ulterior effort had to be made to imagine how to complete the project by designing all those parts that were not visible in the AI image [Fig. 3].



Fig. 3. Some of the results of the third exercise.

3 The final project

After the three exercises described in the previous sections, we proceeded by asking the students to use all the skills acquired for the year's project.

In 2022-2023, a cultural hub was designed for the city of Andria. After a phase of study and comprehension of the context of intervention, suggestions were produced via Midjourney, asking the software for a building or an aggregation of buildings with a central plan – a choice inspired by the layout of Castel del Monte, a reference monument for this urban center [Fig. 4].



Fig. 4. Some of the suggestions obtained using Midjourney.

From these suggestions, we moved on to the actual project, consisting of a group of buildings, each one with a different function (a theater, a restaurant, a museum of music, etc.). [Figg. 5-10]



Fig. 5. Aerial view of the cultural center designed for the city of Andria (students: Miriana De Gregorio, Maria Lanciano, Margherita Palumbo, Alessia Saulle).



Fig. 6. Rendering of the external façade of the central building (students: Stefania Laterza, Maria Rita Maggi, Alessia Nanocchio, Marco Pastore).



Fig. 7. Rendering of restaurant (students: Adriano Marra, Emanuele Masnata, Natale Monopoli, Blerta Qosja).

In 2023-2024 we left students free to autonomously choose which technologies and techniques to use to complete the project. In this case they did not work on different parts of the same project, but they were divided into three macro-groups, each one focusing on a different area of the waterfront of Molfetta. For each area three project themes were established, therefore at the end of the year, nine projects were developed, choosing functions that could be useful for the community of Molfetta (e. g. a sports centre, a restaurant, a cultural centre, a market, etc.) [Fig. 8-10].



Fig. 8. Rendering of the theatre designed for the city of Molfetta (students: Giacinto Consiglio, Rossana De Ruvo, Pierangelo Urso.)

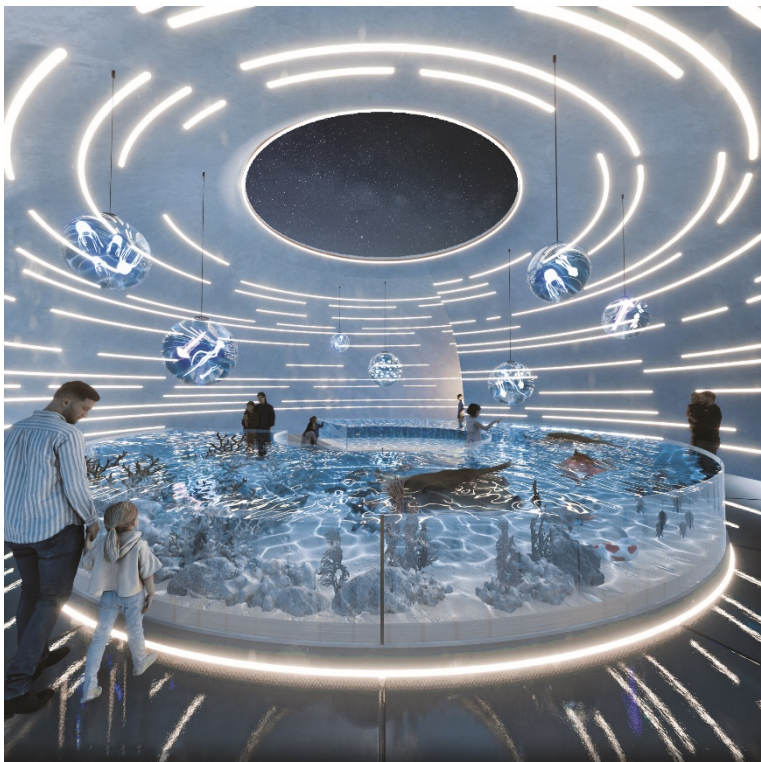


Fig. 9. Rendering of the aquarium designed for the city of Molfetta (students: Giacinto Consiglio, Rossana De Ruvo, Pierangelo Urso.)



Fig. 10. Rendering of the new waterfront designed for the city of Molfetta (students: Mariarosaria Mazzarella, Elena Nuzzi, Andrea Petruzzella).

In both cases students managed to complete the project in a significantly reduced time compared to other years, since they mastered all aspects of the contemporary design process at a high level. Therefore, starting from some ideas generated thanks to artificial intelligence, the young future architects had sufficient critical capacity and maturity in the use of technological tools to be able to proceed quickly and complete the project in about eight meetings spread over two months, demonstrating the effectiveness of the innovative configuration of the laboratory.

4 Discussion and conclusions

We are in a transition phase in which AI does not have a defined identity yet, especially in the architecture sector. This is, paradoxically, a good thing on a practical level, because its use is characterized by wide margins of freedom that stimulate users and, at the same time, generates extremely satisfying results that encourage exploring the potential of the medium. This situation is advantageous in educational terms, because, if exploited adequately, it can incorporate the characteristics of the so-called gamification – for educational purposes – and increase the involvement of students [7]. The speed in achieving positive results has been the outcome of the enthusiasm shown by the students who, stimulated by the novelty of the proposed tools and by the sense of challenge, were able to quickly and effectively acquire knowledge, were able to increase their critical spirit and were able to deal with the project also with the help of a kind of software that will soon be an integral part of the set of tools available to the architect.

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