Neural networks in the initial stage of the architectural design process

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Abstract. This study shows the use of artificial intelligence in the architectural design process as an initial source of inspiration in the conceptual design methodology and how it has evolved over time.

The purpose of the study is to know the results of the incorporation into the architectural design methodology of neural networks as an instrument in the project cycle applied to 1st year architecture students. The results show the usefulness of the instrument in the initial stage of the design, giving importance to the creation of their ideas as a graphic element of the first-born expression. The participants highlight the importance of visual communication in the interpretation of their ideas as well as the development of their skills in a short time, concluding the possibility of incorporating new techniques in the design process of the conceptual space, being a field very broad in which to continue investigating.

Keywords: methodology, space and architecture.

1   Introduction

In the digital age, in which the world unfolds, teacher preparation requires immediate actions that lead to improving digital skills and competencies in order to achieve progress in the educational process (Cervera et al., 2016).

Already in the first decade of the 21st century, technology applied to design and the definition of space was oriented towards the exact sciences and the applications of computer-aided design. It has migrated towards the artificial systematic reproduction of the cognitive behavior of man, therefore, we went from a process of analogical and abstract emulation of the design process by means of computational tools towards an adaptation towards new forms of adaptation and assimilation of new methods available.

The search for teaching-learning strategies finds artificial intelligence as a fundamental tool in the 21st century, whose actions are positioned in many areas

of the process, such as the personalization of learning experiences, immediate and realtime feedback, and process automation. development and administrative type (Ch Hadjichambis et al., 2023)

Rhodes Hileman (1998) in the based classification developed by John Chris Jones proposes four stages of the design methods, he calls the first as artisanal evolution prior to the renaissance in charge of guidelines determined by the artisan himself; The second, until the fifties of the last century, was the graphic expression in the design, where the designer was given a document with information to generate a product based fundamentally on experience and intuition.

The third phase arises as a result of the Second World War due to the search for teamwork where drawing is taken as a tool to help develop problems, at this stage, for example, the list of ideas and synectics.

The fourth is currently being developed, called technological change or sociotechnological innovation, which also includes the creation of multidisciplinary teams where autonomous learning is fundamental, as Simon (1996, p. 1) establishes, referring to design, says that it is the science of artificial systems, that is, that which interacts with the natural environment.

Currently learning at the different educational levels is in charge of students considered "digital natives", that is, technology is essential in their daily lives (TIGSE PARREÑO, 2019).

The ideas that we approach in a generative design through deep learning, is one where the basic components do not maintain an order of priority, (As et al., 2018) however they arrive by themselves motivated by the visual investigation that we obtained with previously (Ferruzca-Navarro, 2015).

The difference between other specialties and architecture is that it offers us different answers to a single problem, in addition to measuring which of these answers is best suited to the process or user, satisfying the needs in the same way in all cases.

However, giving this assignment to a first-year architecture student, who is dabbling in the graphic expression of his preliminary design ideas and what he wants from it, is an ambitious process. The use of digital tools plays an important role in the initial stage of the design methodology, combining shapes and spaces.

The design is based on abductive reasoning, (Design Thinking. Trends In Design Theory and Methodology, nd), where students from the initial stage to the use of the tool for its graphing go through a gap extensive in the project cycle. Material that neural networks offer us in this first stage of design.

2   Method

The methodology is developed in the application of the use of the Artificial Intelligence (AI) tool in students of the first year of architecture, determining the utility, consistency and time of results in the project cycle with neural networks as an idea. generator of the project.

For the commissioned work, FIREFLY's generative AI software was used and it was developed in two simultaneous stages: (1) Development of the generating idea through brainstorming developed by the students and (2) help through AI through FIREFLY in order to obtain the graphing of the conceptual ideas.

For the data collection, the survey was applied to 40 students between men and women who were studying the subject of Design Workshop I of the School of Architecture of the Jorge Basadre Grohmann National University of Tacna - Peru

3   Results

Regarding the use of the artificial intelligence tool in the creation of conceptual design images, the students mentioned being 98% satisfied with the usefulness of the digital tool in the design process.

In relation to the time of the graphing of the generating idea in the initial stage of the project cycle, 86% of the students achieved the competencies of the subject in a shorter time.

Regarding the evaluation of the results of the design proposals, 90% achieved an optimal development in view of the satisfaction of the needs, taking into account all the quality parameters in the design.

4   Discussion

The utility of digital tools in the design process, such as CAD, are used in the final stage of project development, taking into account that decision-making regarding space requirements has already been solved theoretically.

However, the usefulness of neural networks at the beginning of the project even accompanying the design are of vital importance to strengthen their skills.

5   Conclusions

The strategies applied in the students in the inclusion of deep neural networks were evaluated as a positive impact to achieve the competences of the subject

in an integral way in all its design processes, consistently and in a shorter average time than the traditional methodology.

It is necessary to implement new tools in the discipline in a relevant, pertinent and systematic way in the teaching-learning of architecture.

6   Limitation and Future Research

The tools used were free to use, taking into account that they have limited access.

It is necessary to expand the research, to address all stages of the design with the use of AI even in higher years of the degree and others to evaluate the acceptance of the students.

References

As, I., Pal, S., & Basu, P. (2018). Artificial intelligence in architecture: Generating conceptual design via deep learning. *International Journal of ArchitecturalComputing*,*16*(4),306–327.
https://doi.org/10.1177/1478077118800982/ASSET/IMAGES/LARGE/10.1177_1478077118800982-FIG17.JPEG

Cervera, M. G., Martínez, J. G., & Mon, F. M. E. (2016). Digital competence and teacher digital competence: an overview on the state of the matter. RiiTER Interuniversity Journal of Educational Technology Research 2529– 9638. https://doi.org/10.6018/RIITE2016/257631

Ch Hadjichambis, A., Kamalov, F., Santandreu Calonge, D., & Gurrib, I. (2023). New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution. *Sustainability 2023, Vol. 15, Page 12451*, *15*(16), 12451. https://doi.org/10.3390/SU151612451

Design thinking. Tendencias en la teoría y la metodología del diseño. (n.d.). Retrieved August 26, 2023, from https://cv.uoc.edu/annotation/6cf1722b45d28eefcf1db9d2a3e06efe/573143/PID_00206746/index.html

Ferruzca-Navarro, M. V. (2015). Artifact design: a design methodology proposal based on the idea of cognition as distributed. Explorations, Exchanges, and Relations Between Design and Technology, 57–79. https://doi.org/10.16/CSS/JQUERY.DATATABLES.MIN.CSS

Hileman R. (2004). Design Methods: Seeds of human futures en www. smsys.com/pub/dsgnmeth.pdf

Simón S., G. (2010).). The plot of Design, why we need methods to design. Mexico, Design

TIGSE PARREÑO, C. M. (2019). Andean Magazine of Education. Andean Journal of Education, 2(1), 25–28. http://revistas.uasb.edu.ec/ index.php/ree