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# The Multidimensional Exploration Methodology for Architectural Design Studio Education: An Innovative Teaching Methodology Proposal

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## Abstract

In this paper, we discuss the next phase of architectural design, and concerning the requirements of this point of view, we propose a new learning approach that includes digital-design thinking (by the approach) and design-driven innovation (as outcomes).

The paper aims to reflect an architectural understanding shaped by current global facts and developing technologies. Moreover, we discuss this understanding from the academic perspective, which is compatible with the globally evolving socio-cultural, environmental, and economic norms. Therefore, under the title, The Multidimensional Exploration Methodology, we present a new education scheme and a learning methodology that transfers this aligned view to the architectural design studio education model and trains new designers accordingly.

The learning method is developed by taking references from existing methods and blending them into each other in a way compatible with architectural design. While addressing the student as a professional, this method challenges them via real problems through challenge-based learning and adopts the new architectural understanding through the cognitive learning method. Furthermore, it aims to develop designers' perceptions and approaches that align with the digital world through design-science research methodology within the framework of a new understanding. Consequently, it develops practical skills with the learning-by-doing model.

This new architectural concept has emerged, backed up by the power of data and shaped by users' roles and responsibilities in the digital age. This understanding, which is not only limited to Form and Function but also consists of 'Form + Function + Interaction', should be covered by design schools as a progression for the human-centred design approach.

**Keywords:** architectural design studio education, challenge-based learning, design-driven innovation, digital design-thinking, human-centred design, learning theories

## 1. Introduction

As the generation constantly evolves, the spatial necessities have been transformed correlatively. As a matter of fact, throughout history, various movements have been dominant in architectural

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design history. Today's world probably requires the most sophisticated form of architectural design by being the simplest while having the maximum functionality. Generation Alpha (or Generation Z), also known as the children of Millennials), was born into the 'Information Age' (Castells, 1996) that has transformed the industrial society into an informational society. Lately, by the 'Fourth Industrial Revolution' (Schwab, 2017), the industry has become inseparable from technology and digitalism. Even though 'Digitalism' was a term coined in 1995 (Negroponte, 1995), recently, in the 2020s, the fruits of the digital revolution are being collected by the new generation. Consequently, the current era is the time of the Wired Society (Martin, 1978) or the Network Society (Van Dijk, 1999; Van Dijk, 2012; Castells, 2009). Generation Alpha consists of the members of the upcoming generation of the Network Society, and they must receive an aligned, multidimensional, open, and self-sufficient education with a prescient vision.

Concerning the emergence of a new understanding of architecture that offers a new complexity layer and even a new resolution detail of understanding architecture, the new architects need to be trained with a new methodology that defines and can cope with this new understanding of architecture. The professional training and knowledge collection of architects comprises the architectural design studio in the academy, yet even though society has evolved to a more intelligent and connected level, still on a global scale, the academy has not fully transformed to align with the contemporary world requirements.

Over the years, design movements and design education have always aligned and overlapped, yet today, regarding the diversity of the art and design standpoints, the academy does not take straight alignment. Since there is no correct or absolute way to design in today's world, it is also not possible to clearly define approaches in education.

Most importantly, apart from the style or artistic movements, in the current architectural design, the 'digital design thinking' approach (Oxman R., 1999) is essential due to its advantages for the designer. Not only designing with digital mediums but designing the project as a digital artefact might be considered the current movement in design and the architectural design industry.

Relatively, as the synthesis of the current development of technology and the progression of the industry, the requirements and necessities of contemporary society have also evolved. Over and above, the new concept and the proposal of 'Advanced Architecture' (Gausa, Guallart, Müller, & Cros, 2003) topics go beyond the classic 'Form and Function', adding an extra layer of complexity regarding new matters, adding interaction with users and raising conscience regarding environmental concerns. Architecture is not only a spatial description anymore but also an integral and responsive part of human life. "Architecture must do more than just look like a living organism: it should perform as a living system" (Ratti & Claudel, 2016). Along with the digitalisation movement in every industry, the possibilities of creation have also been extended to their limits. Currently, architecture is not a 'tree' (Alexander, 1965), a 'space' or a 'machine' (Le Corbusier, 1986). It is a system that augments and promotes the living experience. As the term 'Interactive Architecture' indicates, those models "include contributions from the worlds of architecture, industrial design, computer programming, engineering, and physical computing" (Birgonul, 2020). With the new definition of architecture, the interdisciplinary approach became an exigency through fulfilling the expectations of society. Furthermore, it became a compilation of computation and digitalism, structure, and, importantly, user interaction, which has become essential in architectural education.

The evidence of a spectacular change in the definition of our spaces goes way further than 'architecture as a machine'. The interaction and sociability of our own habitats pointed out that we have faced the progressive infrastructural and informational dimension of evolving territory, which is defined by layers of information and networks of interchange (Gausa, 2015). Eventually, today's architectural design education relies on the complexity of systems, and a 'new' and 'advanced' architecture needs to align with this synergy. The interrelation between disciplines and concepts is vital in design and application.

Moreover, lately, on top of the functional and formal interventions in architecture, the discussion of further humanistic contexts has arisen. The links between buildings and users' well-being within the importance of beauty in architecture have been discussed (De Botton, 2006). Architecture

was no longer just a structure, not a machine to live in. The user became the focal point of the design, which resulted in 'human-centred design'. Architecture creates the place where life happens, and this is the reason why it is evolving through the transformation of contemporary society and its lifestyle, so the contemporary training of architectural design students must give high importance to focus on all the facts that are mentioned above as well as other sensitive human-factors.

## 2. Requirements of the New Generation Design Studio

The architectural design studio is a milestone for the design students to construct their knowledge and build an individual standpoint through projects. "The design studio is concerned with the definition of design education, its' problems, relations and contents at a sociological level and its relation to other disciplines at epistemological level" (Demirbas & Demirkan, 2003). The gained vision as an outcome of studio education must correspond to practical problem-solving skills and the capacities each student must develop individually to be respectful and responsible for society and the built environment.

Design studios now face different questions that need answers, and teaching 'how to design' has implications that didn't exist ten or even five years ago. Contemporary and future designs need to deal with the changing conditions of both society and nature. The world that will face this new generation of architects is going to be a very different place than the one we live in, and moreover, the world where they are trained. This generation of designers and architects would need to solve problems that cannot be predicted in the present time. This new layer of complexity and resolution are concepts that probably even their teachers haven't been trained on how to teach.

Consequently, it is the reason why studios are shifting towards a more design-research practice, where the knowledge on what is good design and what solves the proposed problems is not what the professor knows as in classic academia, but a collective effort where the knowledge is created within the class, where the topics are discovered and learned as they appear during the process (Kolb, Boyatzis, & Mainemelis, 1999). Design and research-driven studios should propose ideas that neither the teacher nor the students should be able to answer, and only research can fulfil. This collaborative design process requires large datasets of related research within different fields to validate the new designs. The new ways of design, and of course, a new set of digital tools for design, are largely led by parametric design (Schumacher, 2008a; Schumacher, 2008b) but are not only limited to them.

To cover the requirements of the new era and to move forward with the development of concepts in the advanced architecture field, a new, accurate, and upgraded learning methodology must be applied to the current education system, and an aligned approach is needed to proceed in architectural design studios. Teaching a new understanding in most disciplines, including architecture, requires cognitive activities. On the other hand, learning the same concept requires experiencing on top of it. Learning by experiencing shapes the cognition of the student so that the syllabus must cover up-to-date concerns and themes while approaching the subject with ethical, effective, and responsible manners. This paper manifests the unity of those three learning theories by overlapping and blending the phases of the methodologies for re-phrasing the architectural design studio education, which results in a novel teaching/learning methodology. Moving forward and aligning with the contemporary understanding of the new architecture and the necessities of today's society, the education of design thinking in architectural design studios must be transformed into an interdisciplinary, holistic and compelling style.

## 3. Multidimensional Exploration Methodology

Our proposal for the learning method for architectural design studio education is based on various learning methods such as Cognitive Learning Theory (Greenwald, 1968; Bloom & Krathwohl, 1984), Kolb's' Experiential Learning Methodology (Kolb D., 1984; Kolb, Boyatzis, & Mainemelis, 1999) and Design Science Research Methodology (Van Aken, 2005; Henver, March, Park, & Ram, 2004; Peffers et al., 2006). Our learning methodology is developed based on the aforementioned learning techniques and finally adapted contextually to the Challenge-Based Learning theory.

'Challenge-based learning (CBL) is a collaborative learning experience in which teachers and students work together to learn about compelling issues, propose solutions to real problems, and take action. The approach asks students to reflect on their learning and the impact of their actions and publish their solutions to a worldwide audience' (Apple Inc., 2010).

The Multidimensional Exploration Methodology is a holistic learning and design-thinking approach that aims to deconstruct a classical approach and regenerate knowledge while shaping the learner's cognition to align with contemporary requirements (Birgonul & Carrasco, 2021). Developing the link between the cognitive learning approach and experience-driven learning proves that the stages of learning overlap. This method perceives the cognition reshaped, aligning with contemporary understanding, as well as the regeneration of knowledge as a result (Figure 1).

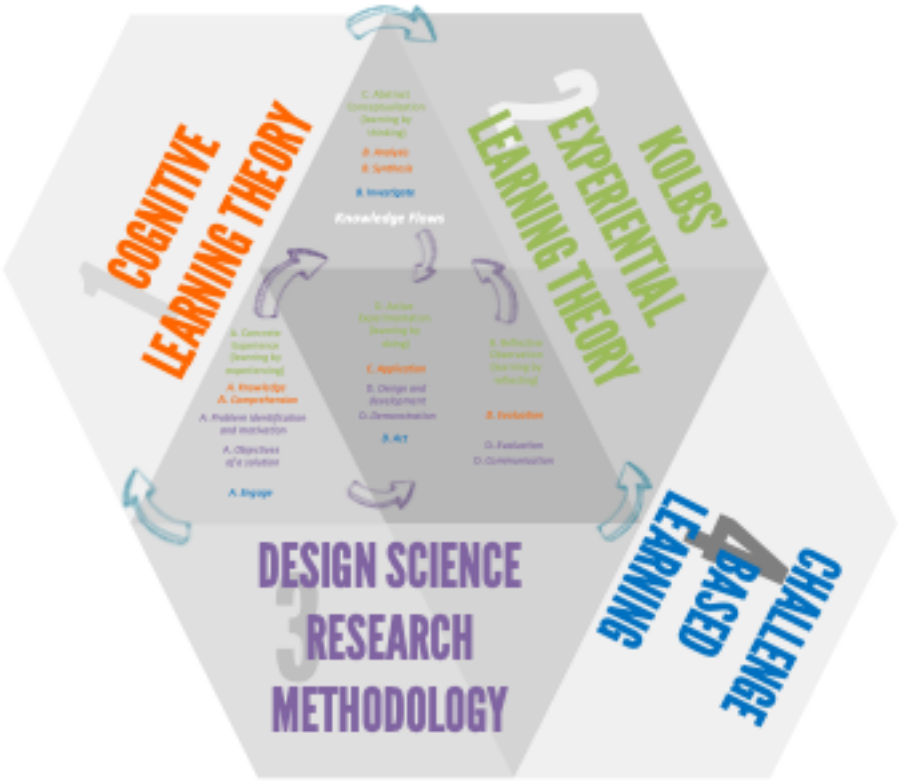


Figure 1. Multidimensional Exploration Methodology Phases – Overlapping with existing methods. (Visualisation by Authors)

New design tools have emerged in the last decade to enable designers to communicate in their creative endeavours. Regarding the applied digital-design thinking to this method, the active use of technology is essential. As new design tools appear and become rapidly available, the representation methods are evolving and getting richer and more complex, as the actual transition in representation techniques is evolving from digital and multi-media representation to virtual environments, representing an even more significant disruption. Regarding the computational design approach in education (Mitchell, Ligget, & Kvan, 1987), "The concept of computational design thinking is related to algorithmic thinking that architects use in their design process rather than the tools they use" (Colakoglu & Yazar, 2007). They conclude their research by stating that computational thinking will be a fundamental skill to be used in the near future. Within ten years, computational design became an essential skill and an added value both in academics and private industries. Consequently, the encouragement of further use of digital tools and learning new software technologies (Taslı-Pektas & Erkip, 2006) is another challenge in this method; to be able to dominate digital mediums affect the students' capabilities on both increasing the design processes, quality of representations and enhancing the final artefacts values.

Computation in architectural research and practice is often transdisciplinary and well-integrated with technologically enhanced design and production processes. Not only designing with digital

mediums but also designing the project as a digital artefact became essential; therefore, digital-design thinking (Oxman R., 1999); (Oxman R., 2006a) emerged. These consolidated designs embody the responsiveness of objects and spaces, production optimisation, crafting, and augmented physical experience. Relatively, thanks to digital mediums, simulations allow us to see beyond reality and to experiment with imaginary structures and processes (Terzidis, 2015). They are used to virtually test the under-construction reality and learn about its unpredictable behaviour. The contemporary architectural design understanding involves all those tenets with the digital-design thinking approach for proposing innovative solutions.

Moreover, as other important references, Design-Driven Innovation (Verganti, 2009) and Holistic Design-Thinking (Birgonul, 2020) are two concepts that have an inclusive theory that takes its' reference from digital-design thinking essentials, advanced architecture contexts, socio-cultural and environmental concerns, and leads the designer to design-driven innovation. This approach aims to bring together effective, sustainable, prudent and aesthetic ideas to create a sustainable and innovative design & production process.

The phases of Multidimensional Exploration Methodology are experienced by following the following phases (Figure 2):

1. Identification of the Problem
2. Introspection (Cognition & Thinking)
3. Design: Representation + Simulation
4. Prototyping (Application)
5. Testing and Interaction (Evaluation)
6. Discussion
7. Knowledge Generation
8. Loop: Repeat the process until the required goal is fulfilled.

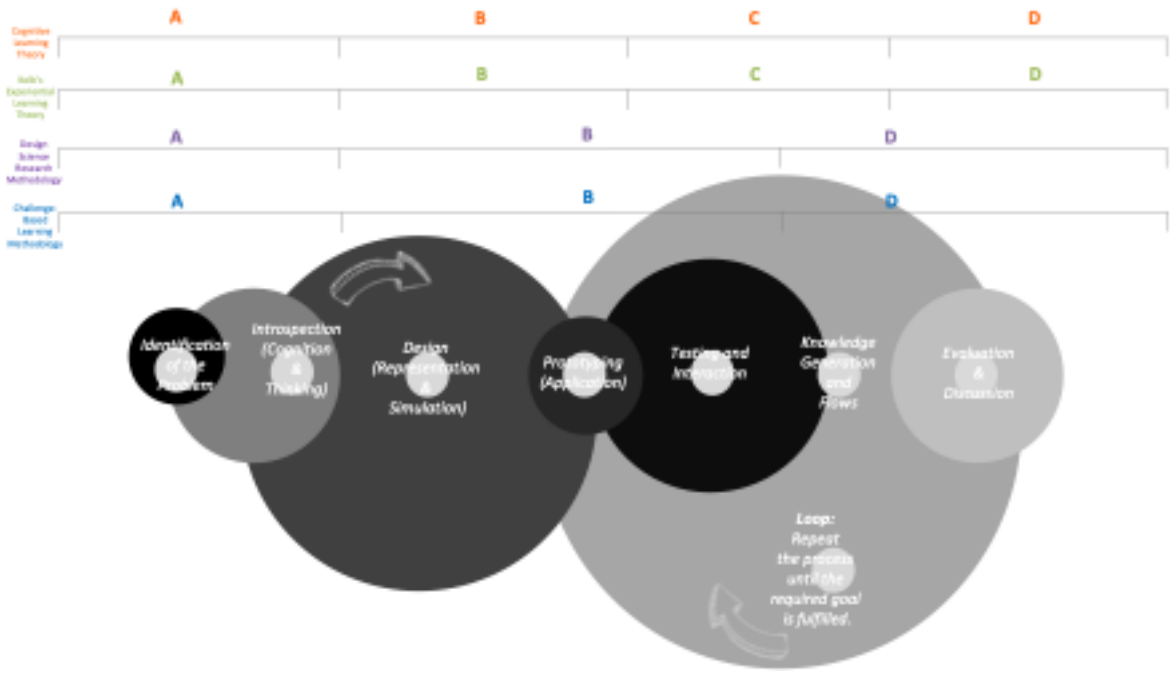


Figure 2. Multidimensional Exploration Methodology Phases – Overlapping with existing methods. (Visualisation by Authors)

When the MDEMs' spiral approach is applied to design research, its multiple check-in points and gate moments allow novel designers in the advanced architecture field to keep validating their proposals and intuitions as cognitive elements. This is mainly because most of them are out of the scope of classical architecture; they work interdisciplinary and their work involves several fields in an actual multiple intelligence process by Dewey (Dewey, 1938a; Dewey, 1938b) (such as

electronics, energy concepts, biology or rapid manufacturing to name a few). The wide range of application, visualisation, modelling, creation and experimentation techniques serves the purpose of experiential learning theory by Kolb (Kolb D., 1984; Kolb & Kolb, 2017), boosting the development of the projects in both knowledge and time-wise.

The validation of these artefacts happens in the reflection phase, which allows converting this new knowledge into an experience that will be used during the next iteration of the design research cycle. The evaluation of all discoveries and critical concepts of design can also be done by the researchers themselves, thanks to the set of skills gained during the development phase. This method upgrades the research to multidisciplinary content so that the students are capable of assisting the interdisciplinary study with their knowledge, which is generated during the same learning process. Moreover, the methodology allows them to understand and use that knowledge for further stages of design, select and filter all knowledge gained, and, importantly, visualise the parts of the design in an objective and ethical manner, within global standards and responsible common sense.

By this method, the information is processed and converted to knowledge rather than being just data inputs. The application of the gained knowledge to the problems allows the learner to be creative and unique in problem-solving, as well as reflecting the information on other subjects. The same knowledge could be applied to further problems. The brain of the learner creates connections between various tasks through a cognitive learning approach by converting knowledge into skills. Furthermore, training architects to be more responsible for current and future global concerns is essential. Training the students to become open-minded designers lets them deal with infinite possibilities. Furthermore, this new understanding of architecture does not imply disregarding all previous knowledge, as it uses it as experience (as in Kolb's Theory) for developing ideas and artefacts that can respond to contemporary social inquiries.

In relation to the blended methodologies, the new design studio is over and above very much related to prototyping, experimentation and evolution, moving away from the classical concepts and catalogue solutions used in architecture, not disregarding them, but amplifying and adding extra layers of complexity. The new architecture defines a paradigm where the process of creation is as important as the outcome. Problem-solving involves verbal discussion in the early phases; mathematical, engineering and science forms during the decision-making; and lastly, in the last phases of the method, using subjective judgment and the objective results of the analysis is the precursor to making decisions (Eder, 2005).

The resulting projects have a much more comprehensive holistic approach to the physical and built environment by taking into consideration social interactions between themselves and the environment in a more profound way than just green-washing buildings (Beder, 2002). Also, it tends to include as add-ons a high degree of technology in itself, such as IoT or other smart systems or embedded by the use of smart materials and elements and techniques from the Fourth Industrial Revolution (Gershenfeld, 2012).

The teaching process and learning action interact intensely with each other as a collective operation. This operation creates hybrid moments where knowledge is exchanged in the classroom by digesting the necessities of the brief via experiencing the ample resources of the projects in their different representational aspects. As a matter of fact, we firmly believe that knowledge is not thought; it is generated by collective actions. Additionally, developing strong cognition bonds between the researcher and the research topic generates a more consolidated knowledge, thanks to the experiential method. The acquisition of the student is usually more significant in terms of knowledge acquired (Gould, 1995). It produces a new way of learning style in the first position, as well as a new way of dealing with problems and making design decisions.

## 4. Discussions

The dimensions of learning and exploration are symbolised within the axes, 'time', 'self' and 'knowledge', symbolising the particular development and discovery within the contexts. As a result of overlapping the 2D spiral graph with the steps of the methodology, the outcomes evolve through every axis/dimension as the generated knowledge expands in correlation. Each of

the coloured strings symbolises the seven steps of the proposed methodology. Those strings' position, width and length show the students' evolution through time and by themselves. Each exploration 3D spiral is different from the others. When the proposed methodology is applied, the outcomes are multidimensional and various, as shown in the diagram (See Figure 3).

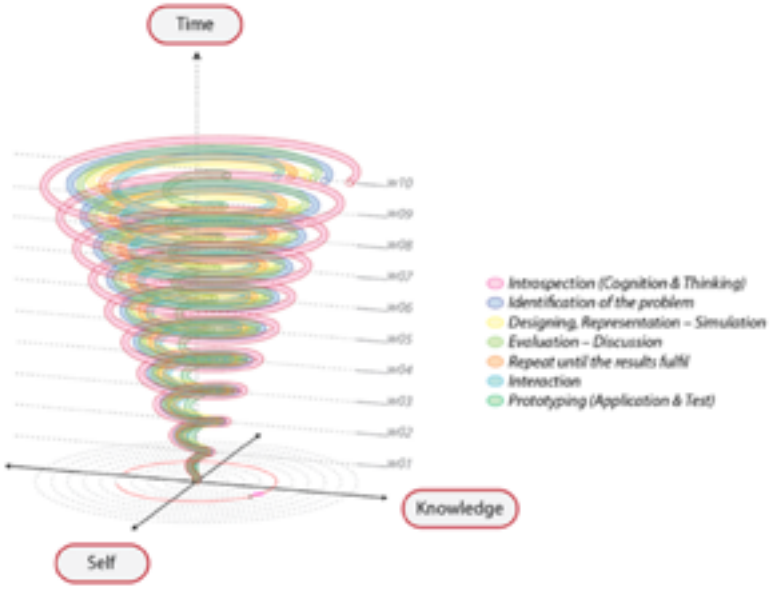


Figure 3. Multidimensional Exploration Methodology, Example visualisation of learning by stages in 3D. (Visualisation by Authors)

While experientially learning the theme, the student actively participates in the content for further design decisions. Experiencing and 'learning by doing' provides the conscience on continuously experimented artefacts and may also result in 'interactive' artefacts. Lastly, combining those learning methods with the application method of Design Science Research elicits the productivity of the process. The new method provides the opportunity to build interdisciplinary knowledge during problem-solving and creation. The experiential Method, combined with the Cognitive Method, enhances design thinking creativity and catalyses learning efficiency. When the experiential method is put one step further by "Prototyping", it challenges the learner with the hands-on requirements, as well as, during the learning process, more "Aha! Response or the Sudden Mental Insights" (Akin, 2008) are observed. When the spiral graph of the method is expanded in 3D, a similar form of the shell is observed. In the methodology, the three-dimensional criteria are defined as Time, Self (Cognition) and Knowledge. Moreover, multidimensionality is not limited to the three main dimensions, and it can be varied by the learners' input, creativity, and horizon.

Regarding the learning space and experiential environment, Shaffer has compared a studio to traditional learning in labs to explain the process of the collaborative learning process of students (Shaffer, 2007). The research shows that the modern studios of hands-on workspaces enable the students to collaborate, learn from each other, and have a continuous working period since they are open, inter-relational, and interactive, opposite to the traditional classes and labs. "The physical space as well as the digital space must be sharable and visible to the others in the studio" (Arvola & Artman, 2008). The well-associated places and well-designed learning events create the possibility of exchanging information between students, as well as creating opportunities for developing better results. The 'new design studio' is not only a concept of teaching but also requires the form of a new physical space where students can interact, create and evaluate projects and concepts with each other without physical or time limitations. Moreover, it is a collective space that boosts creativity and reformulates the classic concept of making, where learning by doing is done through The Multidimensional Exploration Methodology, also outside of the class during daily life, thanks to technology.

Taking reference from the previously classified teacher roles, which are 'A source of expertise or

authority', 'A coach or facilitator' and 'A Buddy' (Dinham, 1987; Quayle, 1985; Goldschmidt, 2002) in this methodology, the teacher in the process is positioned only as a mentor, rather than being a source or authority, nor knowledge facilitator. This method rejects rigid roles. So, apart from being participants in the same learning pathway, teachers and learners share the same exploration from other perspectives, which can also be interpreted as a multidimensional exploration. Teachers are also participants in the Multidimensional Exploration Methodology as they are also experiencing the learning by themselves and the learners' perspectives simultaneously.

On the other hand, the evaluation and grading of the student by the mentor are flexible and not primarily preferential. It is believed by this new methodology that exploration through the learning process is the main contribution; therefore, measuring students by traditional means is not relevant. Within this methodology, there is no right or wrong since there is no indication to follow or no strict rules to apply. Students are free to express themselves through their creativity and exploration process. There is no specific method to approach the project and no limit on creativity unless they can convince themselves and each other that the proposal has added value.

It is important to note that within the new design studio, neither students nor teachers have the answers to the questions proposed by the course syllabus, but the latter has a higher intuition on how the results should be. This blurriness of the outcome allows design evolution to be the predominant tool for refining, evolving projects and finding a design solution to complex topics. The role of the tutor in this context is to moderate the process. Also, it is important to evaluate the work done and build upon it, then guide students through the next iteration of the process. This method can also be categorised as a pseudo-bottom-up, where artefact design is based on experimentation, data and fitness. The fitness criteria are a construct between the syllabus, the teacher's intuitions and the students' naivety. Upon constant discussion and moments of self-evaluation of the learner for the results proposed, a more profound cognitive process is needed to discern which design solution should be developed further and built on top. These findings from the previous iteration are then catalogued and used as inputs for the next one, where more complexity will be added, creating, thus, a richer artefact.

## 5. Conclusion

Teaching design through the Multidimensional Exploration Methodology transforms design students into change-makers. Defining the new generation designers together with engineers and all other professionals as change-makers point out the differences in common sense in the understanding of architecture until today, with advanced architecture concepts that are currently rising in pioneering design schools. The usage of new fabrication tools, where designers and makers (builders or constructors basically) are in one role, reduces the distance between the design and the fabrication of elements. The control that implies is more significant than before. Those new-generation design schools do have more tools and are more prepared than universities that still teach with the classical approach, as they can think in the long term, in adaptability, and in the future interaction that can appear.

The application of this methodology inevitably changes both the perception of architecture and the ways of designing it. From a superficial standpoint, the differences in digital tools used allow designers to get different results. However, outside that, the method behind the design also produces some important differentiation in the results. Architecture of the current era is much more than matter; architecture has become something much more complex than a 'machine to inhabit' (Le Corbusier, 1986). It has social implications, global concerns and environmental responsibilities. Those issues expand further into the digital world through searching for new and better ways of interaction between people and spaces. The resulting architecture is a hybrid that deals with a wider variety of inputs and offers a more abundant array of solutions to classical problems. Architects of the new age should be concerned about creating added value for the future in a responsible manner and with an interdisciplinary approach.

Designers not only design spaces but also become the designers of the interactions and the systems that appear in that architecture. Designers also need to think in open-ended systems, where the users have the freedom to modify and adapt their built environment. To sum up,

Alison and Peter Smithson believed that they could transform people's lives for the better through architecture (Smithson & Smithson, 1986), and as the world is continuously undergoing a transformation, the adaptation of design thinking behind architecture also needs to be transformed. It requires a new and revised teaching methodology in academia such as it was discussed in this paper under the title of Multidimensional Exploration Methodology.

## Conflict of Interests

The author declares no potential conflict of interest was reported by the author.

## Endnotes

This paper has been presented at the SPACE International Conference 2022 on Architecture and Design Education.

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