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The place of geometric thinking in improving the capabilities of architecture students in basic undergraduate courses (Case example: Introduction to architectural design course 2)

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ABSTRACT

Research Problem:

As a specialized branch of education, architectural education requires the development of innovative abilities. The primary concern of architecture students is to create three-dimensional spaces and forms that align with human functions while preserving and conveying the values of the profession and society within that space. In fact, architectural education necessitates the use of effective methods to demonstrate its efficiency in responding to the quantitative and qualitative needs arising from modern socio-economic development. The teaching of Introduction to Design in architecture is one of the most crucial components of architectural education during students' academic years. The aim of this research is to examine the principles of effective design education in foundational architecture courses to enhance the quality of instruction. Among these principles is the science of geometry, which has historically had a profound impact on architecture. In the past, architects were geometers who designed structures using geometric tools and oversaw their construction. In other words, geometry played a central role in the world of architecture. Over time, the emergence of software and technological advancements has significantly influenced the perspectives and motivations of architectural designers, investors, and users. As a result, the role of geometry and geometric thinking in architectural design has diminished compared to the past. However, in the current era, given the positive outcomes of past designs, the role of geometry and geometric thinking in design has regained critical importance. This research aims to apply geometric thinking as a teaching method in Introduction to Design classes for architecture students. Geometry is a branch of science that enhances individuals' ability to succeed, analyze professional situations, and manage life effectively, which is why it is emphasized at various educational levels even to the extent of having its own dedicated field of study. From this perspective, geometry can be considered an essential necessity. The essence of geometric thinking revolves around order, describing and understanding the order hidden within seemingly complex situations. The fundamental tools of this science are concepts that enable us to describe this order. In reality, geometry is about comprehending and understanding problems to provide logical solutions. Thus, it can be said that geometry is the science of problem-solving, examining numbers, shapes, objects, and proportions required in all sciences, influencing all aspects of social life, including decision-making.

Research Question:
To what extent can the application of geometric thinking in problem-solving ideation enhance the quality of design outcomes in students' projects?

Research Method:
This study employs a mixed-methods approach, combining qualitative and quantitative strategies. The qualitative strategy is based on the Grounded Theory method, while the quantitative strategy involves analyzing data collected from the study population. For the study, 50 architecture students from the 2017 intake were divided into control and experimental groups. Initially, a pre-test titled "My Dream Atelier" was conducted, requiring students to produce sketches on 50x70 sheets to assess homogeneity between the two groups. The sketches were evaluated by university faculty members, confirming the uniformity of students' design and academic levels. Subsequently, students were randomly divided into two groups of 25 each. The control group received traditional instruction in Introduction to Design, involving case studies, ideation, and sketching. In contrast, the experimental group followed a geometric thinking-based approach, where all stages from ideation to concept development were rooted in geometric principles and proportional reasoning.
For the quantitative phase, faculty members were asked to analyze the results and assign grades. The sample consisted of academic staff selected through theoretical sampling, a purposeful sampling method focused on theory development. Interviews continued until theoretical saturation was reached, concluding with nine participants. Interviewees were required to have at least ten years of experience teaching foundational architecture courses at the undergraduate level. Data collection in the qualitative phase involved semi-structured interviews, with thematic analysis conducted through open, axial, and selective coding using MAXQDA software. For structural equation modeling, Smart PLS (variance-based) was utilized.

The Most Important Results and Conclusion:
Geometric thinking and geometry-based education are concepts in architecture that emphasize the appropriate relationship between components and the whole. These concepts are significant due to their role in creating visual beauty, familiar associations (linking geometry with historical architecture), and conveying transcendent human-centered concepts in architecture and livability.
One of the pressing concerns in contemporary architecture is the relationship between structures, geometry, and vitality traditionally achieved through communal and connective spaces. Applying geometric principles from traditional architecture in contemporary designs when executed with proper proportions and contextual relevance can enhance a building's functionality, user comfort, sense of belonging, vitality, balance, and identity. Thus, the influence of geometry in architectural design and its role in connecting users with structures is undeniable, particularly for students in foundational design courses. This study, using a mixed-methods approach, examines the impact of geometric thinking education on architecture students' design processes. A set of criteria and indicators related to geometric concepts and building characteristics were extracted through Grounded Theory interviews with architecture professors and subsequently used for evaluation and analysis. The assessed geometric features include: Building form, Design context, Presentation, Patterns, Creativity.

KEYWORDS
Architectural education, Geometrical thinking, Architectural basics, Geometry, Proportion.