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RESEARCH ARTICLE

Reflections on architectural design education: The return of rationalism in the studio



Fathi Bashier*

Department of Architecture and Urban Planning, EiT-M, Mekelle University, Mekelle, Ethiopia

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The design studio environment has remained the same throughout the past century. As the Studio Culture Task Force of the American Institute of Architecture Students (AIAS) (Koch et al., 2006) noted, the ongoing changes in architecture education are not aligned with today's fast-changing world, especially in the context of architectural practice. The AIAS analyzed the design studio problem and expressed doubts on the effectiveness of current studio practices in providing adequate design-thinking education. The report indicates that studio culture values project appearance instead of the actual design process. In recent years, similar problems have been the topic of debates in Khartoum. Criticisms are mostly centered on the observation that students show no interest in the design process and tend to focus on form making. As a result, efforts to teach design methods and to restore the balance between creativity and rationality in the design process have failed. The reason is related to the difficulties associated with the implicit nature of conventional design methods. These difficulties, which are common in architecture schools, include the lack of a clearly defined design methodology and the misunderstood role of the systematic approach to design in the studio. Nevertheless, signs of change are gradually emerging, as demonstrated by the global call for change in the studio environment. This call for change indicates a general agreement on the need for the reorientation of architectural design education toward an engaging policy that considers the social responsibility of architects. This study proposes that the route for change is through the return of rationalism in the studio. Since the 1960s, many writers have recognized the importance of balancing rationality and creativity, which are mutually interdependent, in the design process. From this perspective, the research question is drawn: how can we bridge the gap between the rational and the creative design activities in the design process? A theory that conceptualizes the idea of knowledge interdependence does not exist. The available design theories, such as rational problem solving and reflective-in-action theory, deal with different aspects of design activity. Both theories fail to describe the integration of the rational

*Mobile: +251 9 368 83917.

E-mail address: fatibashier@yahoo.com

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and the creative aspects of the design process. Therefore, we propose the integration of the two theories into a new theory called the integrated design paradigm. The proposed theory serves as a theoretical base upon which the interdependence of the rational and the creative phases of the design process can be conceptualized. We aim to bridge the gap between the two design phases by considering research knowledge interdependency as a unifying activity. The first phase is a systematic method involving research, the use of positive theory, and the production of basic principles. The creative practice phase also involves research and focuses on understanding the rational knowledge developed in the systematic phase, including the basic principles and design strategy, as well as on the application of these concepts to the design problem.

The Department of Architecture and Urban Planning at the Ethiopian Institute of Technology EiT of Mekelle University (MU) is currently developing a research program in which the development of and reflection on design methods is a key research area. Within this framework, the present study intends to be an introductory effort to guide future empirical research. The present study aims to describe the design process of architects, and introduces theoretical and technical frameworks. The integrated design paradigm as a system of inquiry within the spatial relationship strategy is framed.

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1. Introduction

The growing dissatisfaction with design failures in architectural design studios appears to be the main concern of researchers and academicians around the world (Salama, 1995). In a time when the world is becoming complex, the field of architecture faces the challenges of climate change, globalization, urbanization, and social transformation in an unprecedented scale. The design studio environment has remained the same throughout the past century. As the Studio Culture Task Force of the American Institute of Architecture Students (AIAS) (Koch et al., 2006) noted, the changes in architecture education are not aligned with today's fast-changing world, especially in the context of architectural practice.

The AIAS analyzed the design studio problem and put forward a report that is focused on the design thinking process, which they consider as the most critical aspect of design studio education. The AIAS report casts doubts on the effectiveness of current studio practices in providing adequate design-thinking education. The following questions express these doubts: To what extent do our current studio practices and projects promote process learning as a main objective? Which should be emphasized, the design process or the final product? The report indicates that studios value project appearance instead of the actual design process: "...the current studio culture rewards students with the best looking projects" (Koch et al., 2006).

In recent years, similar problems have become the topic of debates in Khartoum, the city where the author of the present work engaged in design studio teaching for many years. Most criticisms have been directed at the teaching policy, which is often focused on presentation drawings instead of the design process. One of the most commonly cited problems in teaching architectural design is the focus of studio assessment on the end product rather than the process.

Rationalism has been the norm in design studios since the beginning of architecture education in Khartoum 60 years

ago. However, design methodology has become implicit, which may be attributed to the tendency of students to focus on design appearance rather than the process. Many difficulties associated with the conventional design methodology in most architecture schools in Khartoum are related to such implicit nature. These difficulties include the lack of a clearly defined design methodology and the misunderstood role of the systematic approach to design in the studio.

The inadequacy of the implicit design methodology has caused students to lose interest in the design process and to jump to form making while relying only on intuition and artistic skills. According to McAllister (2010), the real danger is the fact that students pay too much attention to the end product that they ignore the development of essential design process skills.

As a result of these trends, several negative outcomes have been observed, including the tendency to adopt the architecture-as-art approach, the focus on form-making as the primary design goal, the reliance on intuition and artistic skills, the disregard for the process and the lack of focus on rational problem solving, the focus on self-satisfaction, and the lack of social consideration.

The disinterest in the design process combined with the tendency to focus on form making hinders the restoration of the rational basis of design in the studio. However, the present study recognizes the inevitable change toward rationalism that is already occurring in practice. As Friedman (2003) noted, the design process "...is necessarily in transition from art and craft to form of technical and social science focused on how to do things to accomplish goals".

The following section reviews the literature to understand how studio environments around the world reach the situation in which the rational design process is replaced with intuition and artistic skill. The implications of these trends on the education of future architects are also examined. We then discuss the relationship between the intuitive approach, the concept of architecture-as-art, and

the reliance on intuition. Meanwhile, the exclusion of rationalism from the studio is analyzed. In response to the global call for change in studio culture, we acknowledge the need to reorient the architectural design education policy toward an engaging policy that considers serving the people as a priority task. We define the route to that goal, which is the return of rationalism in the studio, a concept that human experience eventually leads to.

2. The state of design studio culture

Focusing on form making as the goal of architectural design has caused students to ignore the design process and rely largely on intuition and artistic skills. This approach is not reliable in this age of technological advancement, which has enhanced the knowledge base of design beyond the scope of artistic or intuitive talent. As a result of the great technical progress in the 20th century, the pre-industrial intuitive model is not compatible with the complexity of today's design problems. In the 1960s, the design method movement created the need for design activity to be based on the scientific method. In the words of [Cross \(2007\)](#), "The reasons advanced for developing new methods were often based on the assumption that modern, industrial design had become too complex for intuitive methods".

To explain why design studios around the world have replaced the rational design process with intuition and artistic skill, we examine the historical evolution of design education. Many scholars and historians have documented the history of architecture education. [Fisher \(2000\)](#), as cited in [Koch et al. \(2006\)](#), stated, "Studio culture pedagogy originates, in part, from 18th century and 19th century French rationalism, which held that through the analysis of precedent and the application of reason, we could arrive at a consensus about the truth in a given situation". The design learning approach based on rationalism that originated from the Ecole des Beaux Arts was transferred to the Western schools of architecture and eventually spread around the world.

The rise of the balance between rationality and creativity as the central concept in the design process that characterizes design education is an important development of rationalism as the ordering paradigm. [Brown and Yates \(2001\)](#) recognized that two main concepts remain central to architectural design throughout the different periods of design education from the Beaux Arts to the Bauhaus to the contemporary schools of architecture: "...the ability to engage study and respond to the human condition and the conceptual and physical manipulation of the built environment". They further explain these concepts by quoting [Weaver \(1997\)](#) as saying, "The aim in educating an architect is to develop the conceptual, analytical, imaginative, and practical skills necessary for the student to determine human needs and aspirations and to meet or express these in space and form".

[Brown and Yates \(2001\)](#) analyzed the shift in the philosophy underlying architectural design since Modernism. In their analysis of the prevailing conceptual basis of modern architectural design, [Brown and Yates](#) said, "Following the advent of Modernism, the development of architectural theory has focused primarily on the design and manipulation

of built form. Testimony of this tectonic and (mainly self-referential) conceptual development can be found in an extensive body of work produced by recognized figures in the field, extending from Le Corbusier to today someone such as Peter Eisenman. And while a valuable body of work exists which reflects the other principle goal of architecture education described as the "determination of human needs and aspirations", as seen in the work of [Christian Norberg-Schulz](#) or [Charles Moore](#), such efforts have received far less recognition within the architectural culture."

The lack of balance between rationality and creativity in contemporary architectural design in the studio and in practice has led to considerable public criticism. The public feels that practicing architects have strayed far from the needs and goals of users and society at large and that architects are mainly focused on satisfying their need for personal expression. In the studio, greater emphasis is placed on form making and the end product than on the goal of community service. According to [Brown and Yates \(2001\)](#), "On the educational side, where the stated aim includes responding to human need and aspirations, emphasis continues to be placed on perceptually and representationally based form-making".

In 2002, the Studio Culture Task Force of the AIAA issued a report that offers a studio culture critique of the current practices in design studio education. According to this report, design studios are not doing enough to cope with the changing nature of the world or the changing context of architecture practice. This condition directly affects studio culture and should thus be changed to produce engaging graduate architects. Specifically, architectural practice is undertaking large transformations, new technologies are affecting space design and the construction of built environments, clients are demanding, and architects are delivering expanded services. The report concluded that studio culture must change and that this change must begin now; change must occur to proactively address the changes in the world and in practice, and change is crucial to enable the discipline to increasingly serve communities [Koch et al. \(2006\)](#).

The content of the AIAA report, which describes the state of design studio culture in the United States, can also be applied to design studios in many parts of the world, especially in third world countries. In fact, we are more concerned than others with the conclusions of the report, particularly in relation to the responsibility of architects toward community service as well as the effects of such aspirations on design studio education. Today, societies are confronted with complex problems, and architects must take responsibility and contribute effectively toward solving these problems. This situation has given rise to an urgent need for new vision for architecture education, practicing methods, general professional knowledge, and design studio policies.

3. The need for change: the return of rationalism in the studio

The previous discussion shows that the call for change in studio culture has become a global trend, emerging both in Western countries, as exemplified by the AIAA and other international institutions such as the joint UIA/UNESCO

Charter for Architectural Education (1996), and in third world nations. These countries have one thing in common: they recognize the need for the reorientation of architectural design education toward an engaging policy that considers community service as a priority task. The obvious route to this goal is one that human experience leads to, that is, the return of rationalism in the studio.

With a policy that aims to improve the learning and teaching methods for architectural design, our department (the Department of Architecture and Urban Planning) at the EIT-MU is currently developing a research program, in which design method development and reflection are key research areas. This research program is set to be implemented in the coming months.

In preparing the research program, the present study serves as an introductory effort to guide future empirical research. However, the aim of this study is not to develop a design methodology but to establish a theoretical formulation that describes the design process of architects based on empirical research. The remaining part of this paper introduces the integrated design paradigm as a theoretical base upon which the knowledge structure of the design process is conceptualized. This paradigm acts as a system of inquiry, as Grout and Wang (2002) called it, within which the spatial relationship strategy is framed. The section is also devoted to the formulation of the research question, which is related to the knowledge interdependence of the two aspects of the design process: rationality and creativity.

This study uses data collected from the literature and from observations in studio practices. In addition, the study relies on the studio teaching and design experience of the author. Data analysis is based on the comparison of the knowledge from the literature with the empirical knowledge gained from teaching in the studio, a considerable part of which is practically inspired by ideas generated through discussions with students and instructors.

4. Redesigning the rational design process

4.1. The integrated design paradigm

Design movement theorists have realized the need to balance creativity and rationality in the design process. Jones (1992) aimed to reconceptualize the design process so that intuition and rationality could co-exist instead of having one exclude the other. Since the 1960s, many writers have recognized the importance of the relationship between creativity and rationality in the design process. With innovation requiring both creativity and rationality, these concepts are known to be mutually interdependent and should not be considered as separate (Kroes, 2010; Casakin, 2008; Wankat and Oreovicz, 1993).

Architectural design generally involves studying human needs, organizing space to accommodate activities, and creating forms to shelter people and their activities. As a general rule, the main aim of design is to satisfy human needs, but the enjoyment of architectural aesthetics is also an important goal. Therefore, viewing the design process as largely motivated by positive theory is generally justifiable. However, some designs are centered on appearance, in which case other functions are disregarded. These rare

cases can be deemed motivated by normative theory, as suggested by Groat and Wang.

In general, we could describe the design activity as a process based on positive theory and implemented through rational thinking and creative skill. Cross (2007) defined scientific design as “based on scientific knowledge but utilizing a mix of both intuitive and non-intuitive design methods”. The present study describes design activity using slightly different words but significantly avoids the term “intuitive”. We use the term “creative skill”, which carries a different meaning, as explained in the following paragraphs. The study describes the dual nature of design activity, which constitutes two phases based on scientific knowledge: the first phase generates rational knowledge, whereas the other utilizes rational knowledge and creative skill.

We differentiate two known kinds of design approaches: the rationalist method and the expressionist approach. The rationalist method is a systematic method often adopted by architects who see architectural design from a social viewpoint based on the commitment to provide community service. The expressionist approach relies on intuition and artistic skill and is thus often referred to as the “intuitive method”. Also sometimes called the black box method, the intuitive method is used by architects who consider themselves as artists. They see architecture as a work of art and think of design ideas as expressions of philosophy-based aesthetic values. The expressionist approach has become dominant in the design learning studio, where students tend to skip analysis and theory building and jump to form making without the support of a rational knowledge base.

Although the integrated design paradigm focuses on the rationalist method, the paradigm does not exclude creativity from the design process. We should note that the use of creativity in the integrated design paradigm is different from the pure art creativity in the work of those who use the “intuitive approach” and consider architecture as a work of art. Creativity within the rationalist method is characterized by a rational knowledge base, whereas that within the intuitive method is based on a subjective non-rule-based proposition, as described by Grout and Wang (2002). In the conceptualization of the present study, the creative method is an advanced phase in the design process.

As seen from the perspective of the integrated design paradigm, the relationship between creativity and rationality is characterized by creativity with a rational base and rationality that depends on creative vision. We can further explain the logic of the mutual interdependence of these concepts by considering the kind of knowledge involved in each of them. The nature of their coexistence is easily recognizable following the work of Cross et al. (1981). First, the rational approach is based on the *knowing that* knowledge, whereas the creative approach relies on both the *knowing that* and the *knowing how* knowledge. Second, the *knowing that* knowledge, which Cross et al. (1981) noted to be based on the rational approach, depends on the *knowing how* knowledge or experience.

Despite this comprehensive conceptualization of the knowledge bases of the rational and creative approaches, no design theory reflects the knowledge interdependence of rationality and creativity approaches. The available design theories are rational problem solving and reflective-in-action

theory. However, both theories fail to conceptualize the knowledge interdependence of rationality and creativity.

Theorists distinguish between two fundamentally different paradigms of design methodology that the field is based on. Introduced by Simon in the early 1970s, the first paradigm is a positivistic paradigm that views design as a rational problem-solving process. The other paradigm is a constructionist paradigm that views design as a reflection-in-action; it was proposed by Schon (1983), who also described design as an activity involving reflective practice (Dorst, 1995, 2003). None of the two approaches—the problem-solving approach or the reflective practice—can describe design activity in totality. Each approach deals with a different aspect of design activity. According to Dorst, the ability of these approaches to describe the integration of the rational and creative aspects of the design process is doubtful.

In this work, we posit that only through the integration of the rational and creative methods could a successful design process be realized. In other words, this study proposes a third theory that integrates the two existing ones, namely, rational problem-solving theory and reflection-in-action theory. This integrated design theory unites the activities resulting from the two theories into one holistic design process. According to the integrated design paradigm, the design process can be seen as an activity involving two design phases, with the first one using the rationalist method and the other one using the interpretative or reflective method.

On the basis of this perspective, we draw the research question, which is in fact a product of real-life studio experience: how can we bridge the gap between the rational and the creative design activities in the design process? The best way to answer the research question is to identify the common knowledge base of the two phases.

We argue that the architectural design process can be described as a combination of two design phases, each of which plays a role in the design process hierarchy. The first phase relies heavily on systematic methods and produces rational knowledge. The second phase relies on the rational knowledge produced in the systematic phase and uses skill-based creative practice.

Following the concept of professional knowledge hierarchy proposed by Schon (1983), the knowledge interdependency of the rational and creative phases in the design process can be elaborated as follows. The first phase is a systematic method, involves research, uses positive theory, and produces basic principles such as design theory. The creative practice phase also involves research; focuses on understanding the rational knowledge developed through the systematic phase, including the basic principles and design strategy; and applies this knowledge to the design problem.

In the creative phase, the designer applies basic principles and design strategy to the design problem to develop conceptual design solutions and then uses skills to transform the conceptual design solution into form. Although generating design concepts or solutions is a work of creativity, rationality still plays a fundamental role, as will be elaborated later. This role is evident in the production of the rational knowledge base upon which design solutions are generated. This last part of the practice can be described as interpretive. This part is an individualistic act that is normally performed by a single designer and could lead to

several design options or ideas. By contrast, the rational phase is often carried out by a group of people who can arrive at one rational solution.

The two design phases rely on research, use rational-based knowledge, and utilize rational thinking and creative skill. Conceptualizing the knowledge structure of the design process, including knowledge interdependency, helps in understanding the coexistence of the systematic method and creative practice in the design process. The present study offers the integrated design paradigm as a theoretical base upon which the coexistence of the two phases in the design process can be conceptualized. This paradigm is conceived as a theoretical framework that combines creativity and rationality, a gateway for bringing research into the design process (Grout and Wang, 2002). We propose to bridge the gap between the two design activities by considering research-produced knowledge as a unifying activity.

As Schon (1983) suggested, the knowledge interdependency of the rational and creative phases in the design process leads to the perspective that professional knowledge is a hierarchy, in which general principles occupy the highest level and problem-solving techniques occupy the lowest level. In the following section, we accept the professional knowledge hierarchy concept of Schon as basis to formulate the knowledge structure in the spatial relationship strategy.

4.2. The spatial relationship strategy

As Grout and Wang (2002) suggested, the integrated design paradigm can be understood as a system of inquiry within which a specific design strategy is framed. The strategy used in this study is called the spatial relationship strategy, which is a methodology for structuring the design process. As described previously, the rationalist and the creative phases of design each play a role in the hierarchy of the design process. The distinct knowledge obtained in these phases and the methods through which this knowledge is obtained fall within the framework of the spatial relationship strategy.

Schon (1983) views professional knowledge as a hierarchy, in which general principles occupy the highest level and problem-solving techniques occupy the lowest level. According to Schon (1983), “Researchers are supposed to provide the basic and applied science from which to derive techniques for diagnosing and solving the problems of practice. Practitioners are supposed to furnish researchers with problems for study and with tests of the utility of research results.”

We use the views of Schon as a guide in organizing the professional knowledge within the spatial relationship strategy. According to Schein (1973) as cited by Schon, professional knowledge has three components. (1) The “science of design” is a basic science component upon which the discipline rests or from which the practice develops. “It refers to that body of work which attempts to improve our understanding of design through scientific methods of investigation” (Cross, 2007). This component may include literature reviews, empirical studies, and analyses to determine the needs and values of the users and how these needs are expressed in terms of space and design theory. (2)

Design methodology is an applied science devoted to design methods and their corresponding structure and procedure. (3) The skill component is focused on using basic science and applying methods and techniques to generate design solutions.

The following sections explore the details of the spatial relationship strategy and discuss the corresponding knowledge structure in depth.

4.3. The multiple phases of the spatial relationship strategy

4.3.1. The rational phase

From the perspective of the integrated design paradigm, design activity is based on positive theory and is implemented by rational thinking and creative skill (Section 4.1). The first task of the rational process is the formulation of both the design problem and design theory utilizing two kinds of research.

4.3.1.1. Exploratory research. Exploratory research involves the study of the literature and other sources, such as interviews. Examining the literature aids the designer in arriving at knowledge through reasoning or analysis. This kind of research aims to gain knowledge about space requirements and characteristics and seeks knowledge in two areas: (a) space determinants, including the values and needs of the users and the community at large. This knowledge concerns the functions or services that the proposed design provides, as well as the related space requirements and their characteristics. (b) Space arrangement, circulation flows, and adjacency relationships. In this area, a library research is conducted to explore published designs and identify patterns of space arrangement. Spatial arrangement has a strong relationship with the determination of values, needs, and activities. Space characteristics are controlled by the provision of such determinants.

The aim of the inquiry is to enable the study of knowledge obtained in (a) and (b). This knowledge is then analyzed and condensed into a short but useful form that can lead to the formulation of design criteria, identification of patterns of spatial arrangement, and development of initial design theory. Design theory explains spatial relationships and the reasons for the occurrence of these spatial relationships. This theory describes space characteristics and the determining factors of space characteristics, such as functional needs and human behavior. It also explains the influence of these factors on the organization of space and spatial relationship. However, design theory at this stage is considered preliminary and needs supporting evidence through comparisons with empirical knowledge.

4.3.1.2. Confirmatory research. The rational design phase involves another kind of inquiry called confirmatory research, which is focused on studying precedent examples. The designer starts with the spatial arrangement patterns derived from literature analysis. These patterns are ordered and integrated based on theory. Design theory summarizes and integrates spatial pattern generalizations and then describes and explains the relationship. The theory is then verified through observation and tested against changing constraints, including people, needs, location, time, and resources. This theory must be verified and tested before its application in a design problem to generate conceptual solutions.

4.3.2. The creative phase

In the creative design phase, the designer applies design theory to the design problem to formulate conceptual design proposals. Multiple design concepts are usually generated, and the concept that best suits the design criteria is selected. Although the formulation of conceptual design solutions can be viewed as a work of creativity, rationality also plays an important role in this respect. Rationality plays an important function not only in the selection of the best concept on a rational basis but also in the generation of solutions.

At this point in the creative design phase, the representation of the design solutions obtained relies on graphics and diagrammatic sketching to illustrate the floor plan and abstract formal ideas. The task of the designer is to use knowledge and creative skill to transform the graphical representation of design ideas into a plan and form.

Designers often use conjecture as a source of inspiration. Conjecture imaging may rise in parallel while the rational process is progressing or may even precede rational thinking. The use of intuitive pre-conceived ideas should not be ruled out depending on the expertise of the designers in some cases. Talented or expert designers learn to reflect creatively on rational-based design solutions. With this reflection, these designers may arrive at a new and creative interpretation of old ideas.

5. Conclusions

The design thinking process is a key issue in this study. No disagreement seems to exist among most educators and studio instructors regarding the importance of rational thinking in improving learning and teaching practices in the studio. However, the real problem is the lack of consensus regarding what constitutes as “design”.

While many have recognized that rationality and creativity co-exist in the design process, Grout and Wang (2002) found an inherent divide between the two values in the mind of many designers and researchers. This statement indicates that the use of the word “design” to mean form making or the activity concerned with product appearance is common among designers and writers.

As a result of the influence of the media, architecture today views “architectural design” and “form making” as synonymous concepts. This perspective represents the view of many writers and architects who oppose the idea that design is a scientific activity because they only value the visual appearance of the end product. This viewpoint leads these architects to equate architectural design with artistic creativity. The term “design,” as commonly used by architects and architecture educators, has taken a limited connotation, focusing greatly on the aesthetic dimension of the design process.

Friedman et al. (1982) expressed similar views. They argued, “Design decisions are of two kinds. One kind of design decision is concerned with making things work better. The other kind of design decision is concerned with how things will look...Some people choose to use the word design for only one of the two kinds...”. The first kind clearly involves rational-based decisions about space arrangements. The other kind of design decisions are concerned with form

making. They noted that the word “designer” is used in many different senses in the English language and that all usages consider the designer as the person who chooses the form for something to be made (Friedman et al., 1982).

In another viewpoint, Hill (2006) sees rationality and creativity as two inseparable parts of design activity. He builds his ideas on the principle that “...reasoning and creativity actually employ each other.” He explains this principle, “...good reasoning might have a creative aspect, and on parallel creative work grows out of reasoning as we knowingly deviate from the rules”.

The present study adopts the view that design is a combination of rationality and creativity. We build this position on the logical reasoning of the integrated design paradigm, in which rational-based design decisions and creatively generated ideas as well as reflective interpretations complement each other that none can individually produce complete designs. These ideas regarding integrated design theory have been developed over many years of practicing design and observing other creative designers.

Drawing a generalizable design theory is not possible because of the many definitions of “design”. Therefore, we must conclude that the theory this study is attempting to construct applies to a well-designed design problem. We argue that the integrated design paradigm focuses on well-defined architectural design problems, which represent the bulk of the professional work of architects. Meanwhile, the expressionist approach of many contemporary architecture trends does not concern architects greatly. For example, the design of a villa or a special type of building on a unique site is not related to the professional work in which the scientific method is applied to. Our focus is on mainstream architecture, which has sufficiently uniform design problems, and on the means of solving these problems that qualify as professional.

Professionals apply general principles, standardized knowledge, and systematic methods. Therefore, the message of this study, to students in particular, is that architectural design is not speculation and that the architectural model must be studied and followed. In the renaissance, Alberti stated that the ancients strived to study the laws of nature and transfer these laws to architecture.

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