



Analysis of Design Knowledge from Perspective of Constructivism: A Framework for Design Studio Teaching

Roya Sadeghi Fereshteh ¹, Omid Dezhdar ^{*2}, Sara Jalalian ³, Hossein Ardalani⁴

1.2.3.4. Department of Architecture, Hamedan Branch, Islamic Azad University, Hamedan, Iran

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ABSTRACT

Design studios, as a place of conformity of design knowledge and practice, have undoubtedly faced problems. In the meantime, understanding the nature of design knowledge can be effective in how to learn and teach. This article has a constructivist view of the nature of design knowledge and with an emphasis on constructivist learning, examines education in architecture studios and seeks to provide a framework for teaching in architecture studios. Therefore, an attempt was made to study the nature of design knowledge from a constructivist perspective with a qualitative approach and a grounded theory. The question of this research is, how can a framework for better workshop training be explained by analyzing the nature of design knowledge? The knowledge used by designers seems to be compatible with the knowledge production conformity from a constructivist perspective, so it tries to examine the nature of design knowledge from a constructivist learning perspective. The information obtained from the outstanding documents and interviews with professors of architecture were entered into Maxqda software, while initial, axial and selective coding led to the extraction of components. In the meantime, the role of the teacher is not the transfer of knowledge, but as a guide and facilitator in the workshop, which is a large part of solving design problems for the student. One of the important factors in building the knowledge of group design and interaction between group members is the lack of effective working group in design workshops is one of its shortcomings.

Keywords: *Design Knowledge, design studio, Constructive Learning*

1. INTRODUCTION

The main basis of architectural education is rooted in workshops, and in Iran it is inspired by the University of Fine Arts in Paris and the University of Tehran. The importance of knowledge and awareness related to the design situation and the need to use it in the stage of

forming the idea and beginning the design are key points of designing. Based on this premise, in educational environments and design professions, designers often gather a wealth of information about factors such as design context, social factors, type of building, technology, cost, etc. before starting the design.

*Corresponding Author:
odezhdar@iauh.ac.ir

But what is observed in practice is that despite the emphasis on conducting preliminary studies at the beginning of design and gaining a lot of knowledge and awareness of the design situation, an effective and appropriate understanding of it is not formed and with such a classification of studies, effective guidance on how to design is not obtained. The expansion of the world economy and the importance of knowledge and information have led to changes in educational and skills requirements at all levels of organization, industry and services [1]. With a little reflection on architecture and architectural education in the last few decades, it can be seen that the conventional method of teaching in architecture schools has faced failure in its ideals, from the past till now. Architectural education is a complex category that may, like architecture itself, always remain controversial [2].

Workshop training requires changes in knowledge acquisition levels. Pre-determined knowledge and the teacher as the transferor of this knowledge are not acceptable [3]. Perhaps it can be said that the reason for the lack of motivation and stagnation of students is the same issue. It seems that by understanding the nature of design knowledge, a framework for the pathology of workshop education can be developed. Therefore, this article examines the construction of design knowledge from a pathological point of view with a constructivist approach.

2. Literature Review

In the field of architectural education, great researchers such as Nigel Cross, Lawson, Dorst and Donald Sean have offered theories. About design workshops some studies are conducted, including Schaefer (2003) who describes an architectural workshop in an ethnographic research [4]. In another study, Reime and Douglas (2003) conducted a research on architectural design workshops at the University of Aragon [5]. In the most recent research on the workshop process, Oh, et al. (2012) suggested that criticism in design workshops must be treated as a rhetorical situation.

A study by Quan and Yunian (2005) examined the performance of architecture students in design workshops and concluded that if the type of exercises given to students is consistent with their learning style in the field of practical

workshops, more effective evaluation and efficiency are achieved [6].

3. Research Method

This article has employed the Grounded Theory method. The reason for choosing this method is to achieve a deep understanding of "pathology of education in a design workshop with a constructive approach to the nature of design knowledge." To achieve this goal, qualitative research is needed to examine the factors influencing the construction of design knowledge in a constructive approach in a design workshop. In this article, to validate the research, a combination of three methods of written sources, interviews with professors of architecture and field-based observation of the architectural design workshops have been used. Data collection includes library studies and reviewing outstanding documentations in the field of architecture education and design studies (from 1960 to 2016), including articles and books by great authors in this field as well as articles by Iranian researchers. After reviewing the documents and sources, they were entered into MAXQDA software and the initial coding was done by analysis and then the subsets of each code were identified. In the interview method, the interviewees were selected from 12 professors who were rich in the desired information and had experience in the subject. In-depth interviews gave interviewees the opportunity to express their views in an informal and open manner. The interview continued until the data were saturated. After the interviews were written, they were entered separately into MAXQDA and the initial coding was started for each one. Field-based study of the architectural design workshop was conducted by attending the architectural workshop for two and a half years, recording the process of architectural education as a purposeful observation and collecting the required information. The collection process was performed using the participant observation technique, being present in the workshop as a marginal member to perceive the behaviors, activities and interactions of the teacher and the student. The statistical population studied in the observation method was 22 students of the first and second semesters of 2018-2019, attending the course of Architectural Design (III), in Hamadan University of Science and Culture. Given that Design (III) is a subject that emphasizes

mostly the students' ideas and concepts, to find suitable ideas in architecture, design knowledge is required.

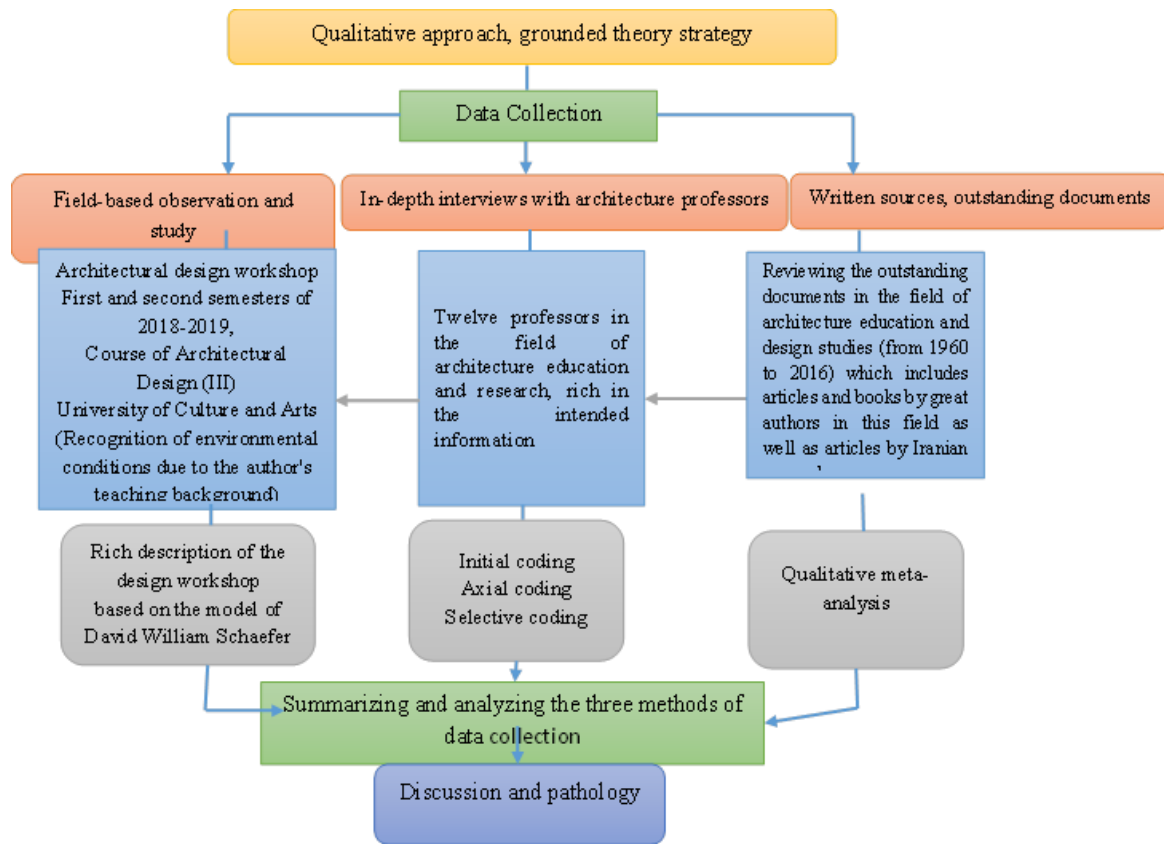


Figure 1. Structure of Research Method (Source: Authors)

4. Design Workshop Training

The design workshop is in the center of architecture education. Students spend a great deal of their time and energy in these learning environments. The teaching methods in the architectural design workshops are rooted in the common historical tradition of the Paris School of Fine Arts (Beaux Arts) and the Atelier model in that school [7]. The learning process of design courses includes the stages of analytical understanding, critical thinking, and creator's decision making [8]. According to the evidences and the beliefs of many experts, despite many efforts to change the process of the training system in the country, this training system has long been unable to fully meet the needs of the job market in terms of providing skilled labor and training to fit the technologies of the present century [9]. The learning process in design courses includes the stages of analytical understanding, critical thinking, and creator's decision making [10]. Such abilities

have always passed their developmental path under the influence of human scientific and technical findings, and have been influenced by cultural, social, political and economic developments throughout history, leading to the multiplicity and variety of educational methods. The most important goal of architecture education is to create an idea that provides the ability to enter the process of architectural design for architecture learners. The system of architecture education in our country, Iran, before the Islamic Revolution was influenced by a number of Western educational systems [11]. With the gradual formation of the first school of architecture in Iran in the late 1940s, the traditional methods of teaching architecture were forgotten and "academic architect" replaced "traditional architect" [12]. The design workshop is a place where all the knowledge is executed together and different relationships are developed [13]. Group work in the workshop environment ensures knowledge construction [14]. How to look at theoretical

topics and prepare an architecture student for a professional design is regulated by human relations [15].

In design workshops "Learning through presence and doing" [16] takes place. Face-to-face interaction can provide feedback from the learner's perception. Simultaneous interaction also includes multiple gestures, including body language, facial movements, and tone of voice, which convey knowledge beyond the spoken message. So what is very important here is to pay attention to the content and type of teaching in design workshops [17]. For many architects, workshops are just the right place to learn design as an artistic and creative skill [18].

Architectural thinking is based on non-verbal thought, whereas our everyday thinking is often verbal. For this reason, the transfer of ideas by non-verbal means alone is usually impossible and difficult [19]. "You have to know what is in the designer's mind to understand his drawing" [2]. Learning in design is the result of the interaction between abstract representations and tangible and material representations. The variety of representations and the effort to bridge between them advance the understanding of design [20]. Designers' desire to use a variety of representations of thought in the design process, such as hand drawing, modeling, narrative, and descriptive expression, is the evidence of the above claim. The most important part of training in workshops is that ideas are produced and transferred within the group work.

5. Constructivist Training in Design Workshops

The teaching method is a function of the learning system and the success of the educational system will depend on the existence of teachers who have the necessary qualifications as well as the required teaching skills [22]. One of the approaches in modern education is the use of new theories of learning in teaching. Learning theories are a framework of structure and principles that describe how people learn [23]. Learning theorists have proposed a variety of theories. One of the newest is constructivist theory, which is considered a paradigm shift in epistemology and learning theories. According to this philosophical-psychological view, reality and meaning are actively constructed by individuals themselves and in their minds, and individuals

make most of what they learn. The basic tenets of constructivism go back to the learning theories of John Dewey, Jean Piaget, Jerome Bruner, and Vygotsky [24]. This theory focuses on making knowledge, not reproducing or copying it. In fact, the learner is not the storehouse of knowledge, but he is the producer of thought and makes knowledge for himself [25]. Learning should be intertwined with real tasks, not a separate activity. Accordingly, complex issues must be embedded in valid assignments of the learner to be used in real-world situations in the future [26]. Learning is an active and social process, and learners acquire knowledge jointly through social discussions, rather than competing for it [25]. This theory emphasizes the learner's ability to understand things. Because the nature of each person's knowledge is derived from their previous experiences, it is not completely transferable to another. Knowledge in this theory is not absolute, but can be produced and is relative. The ability to design is an aspect of the general human ability that each individual enjoys to some extent [27]. The effective components in constructivism and knowledge construction in this style of learning are somewhat close to the nature of the knowledge that designers use in their designs. New information can be successfully linked to the learner's previous knowledge and experience [28]. According to the followers of constructivism, the process of acquiring knowledge involves using scattered information as the cornerstone of knowledge and extracting new knowledge from among them [3].

6. Design Knowledge

Knowledge, which is usually described as a collection of texts written with mathematical formulas, is only one type of knowledge, called explicit knowledge, while we have some kind of unformulated knowledge, called personal knowledge, gained through "experience" and doing and preceded by explicit knowledge, which is the basis of scientific, artistic, sports and technical genius [29].

Tacit knowledge is the opposite of explicit knowledge and expresses a situation in which man has a set of knowledge hidden within him, without being able to express it. Sadram (1396), in his article, considers tacit knowledge to be attainable only through practical experience and intuition and states

that it is synonymous with "practical knowledge" [30]. The ability to design is an aspect of the general human ability that each individual enjoys to some extent [31]. Design includes drawings related to the designer's personal knowledge [32].

Donald Schon (1983) puts forward a solid view of design as a contemplative practice. In such a view, reflection may be considered as a kind of dialogue with situation, often guided by drawing. Cross (1996) has shown the importance of the relationship between drawing and professionalism in design groups. In fact, Cross's article is full of examples of how drawing and talking go hand in hand with the design process. Schon (1988) showed that experienced designers, throughout their design process, often use design archetypes in the form of highly motivating words. Motivation of words is one of our long-term memory functions, which is conceptual and schema-oriented [33]. We store and remember information about theories and rules differently from information about events and situations. This point is very important in understanding the nature of design knowledge [34].

7. Data Analysis

Initially, the analyses were performed separately for each method of data collection, as described below.

7.1 Results of Interviews and Conducted Studies

Three coding steps, including open, axial and selective coding, were taken for the interviews. The following graphic shape, taken from MAXQDA, shows the number of common codes for the interviews. The data were segregated and the initial concepts were attached to the raw data, which is of an analytical nature. At this stage, extensive sampling has been done to be able to discover the concepts in the open position. Codes were extracted from the text of the interviews. The data were reviewed regularly and final codes were identified. Given that this article is based on the four main categories, education, design workshops, constructive approach to learning and knowledge and design knowledge, the initial codes were extracted separately for each of the main categories. Examples of initial codes are given in the tables below. In the table below, based on the categories of research, interviews were written and carefully reviewed, and then the initial coding was done in MAXQDA software. In Table 1, an example of the initial coding is given.

Table 1. Sample Codes Obtained from Interviews

Analyzing the reasons	Code description	Row
Training and transferring the architectural skills	Drawing	1
Challenging what the student has drawn	Criticism	2
Listening without prejudice	Effective support	3
Beneficial criticism in a supportive environment during teacher-student interaction	Increasing the learning	4
Student correction sessions with the professor	Transfer of thought	5
Attending the classes and looking at the teacher's hand	Acquisition of visual knowledge	6
Face-to-face conversation between professor and student	Reflection	7
Doing practical exercises	Drawing	8

(Source: Authors)

To begin the initial coding, the written interviews were entered one by one into the MAXQDA software, and then after studying them in depth and accurately, the code of each category was identified and entered into the software. In this stage of open coding, the concepts were registered without any limitation in terms of the number of codes. Similar concepts were identified and then grouped together. In fact, with the completion of data conceptualization, similar concepts were grouped into a specific category. Axial coding is the process of linking categories to

subcategories. Thus, in this stage of data analysis, using analytical notes, categories are categorized into main categories and subcategories. Subcategories give more power of explanation to categories or phenomena. In the selective coding stage, after repeated studies and reviewing data, concepts, categories and codes, one category appeared more than others in the data and interviews. This category, which is the central category or core of the present study, was placed at the heart of other categories as a pivotal phenomenon in the architectural workshops as a *constructivist approach*.

In a workshop environment, learners must play an effective role in the whole learning process and increase their learning by increasing their skills and experiences through the required assignments. Because design knowledge itself is a different knowledge from other sciences, the way knowledge is acquired is by changing action during activities. Thus, the nature of design knowledge is dependent on work and tasks and focuses on individual capabilities which can specify the knowledge to themselves and become an unlimited knowledge based on experience, situation and conditions and in accordance with the stages of its acquisition. Teaching methods are based on the common approach of objectivism and constructivism. In the objectivist approach, the goals of education, teaching method and teaching content are predetermined and are taken from the perspective of modernity and based on the view

of rationalism. The teacher has the role of implementing the method and transmitting knowledge to the learners. The second approach is constructivist, which emphasizes knowledge construction, active learner participation, paying attention to individual abilities, produced during the learning process, real assignments, as well as group knowledge and participatory activities. The task of design, based on the characteristics of constructivism, must be real and original to fulfill the demands, such as the demands of the employer from professional designers, and at the same time the individual abilities of the student must be taken into account. In the meantime, the role of the teacher is not the transfer of knowledge, but as a guide and facilitator in the workshop, which is a big part of solving design problems for the student.

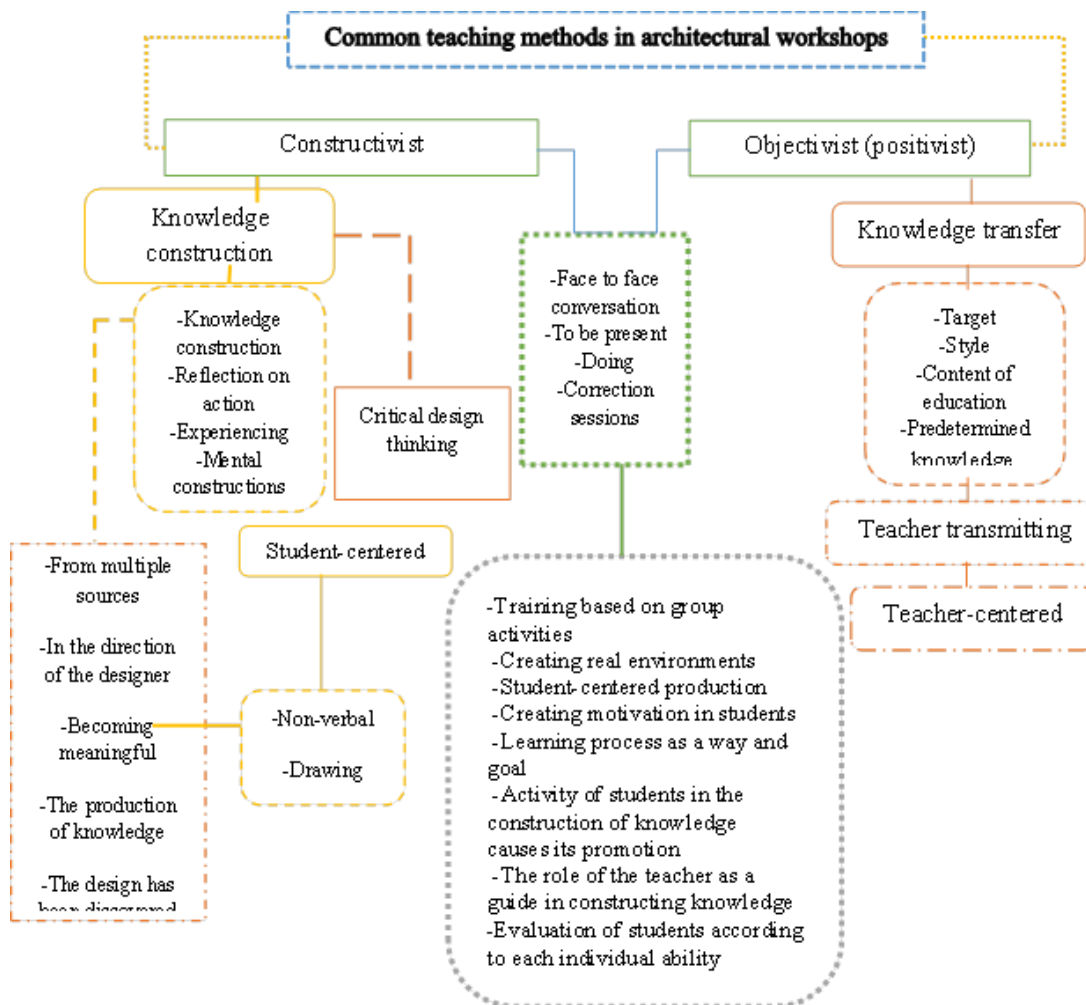


Figure 2. Structure of Interviews Analysis (Selective Coding) (Source: Authors)

7.2 Findings Obtained from the Field-based Observation of a Design Workshop based on the Schaefer's Model (Protocol Analysis)

An important part of architectural education takes place in workshops. David William Schaefer (2003) has a rich description of design workshops. Schaefer conducts field studies in a design workshop at MIT University. Schaefer deems that the main task of workshops is the students' assignments on the projects, in full, in a consecutive time interval, done in an open environment [4]. He tries to gain a deep understanding of the phenomena through a rich description by observing in the workshop. This article, with the Schaefer model, has a rich description of a design workshop in Architecture Design (III) course.

In the workshop, the activities were group-based, and each member of the group was actively motivated and interested in obtaining

information, because the selected assignments were real design assignments according to the real demands of the employer, real rules and standards, and students were active in finding their solutions. The groups were active in exploring and constructing knowledge and looking for different solutions. They did not rely on the teacher; they only took instructions from their teacher in necessary situations. The tasks were completely different; the students fully understood the subject and answered the teacher's questions correctly. Their self-confidence and motivation were high; they expressed their ideas with great mastery and enthusiasm. There was a lot of interaction between the groups, and by the verbal communication that was in the groups, each member got more information. Learning was completely internal and sustainable because it came with practice.

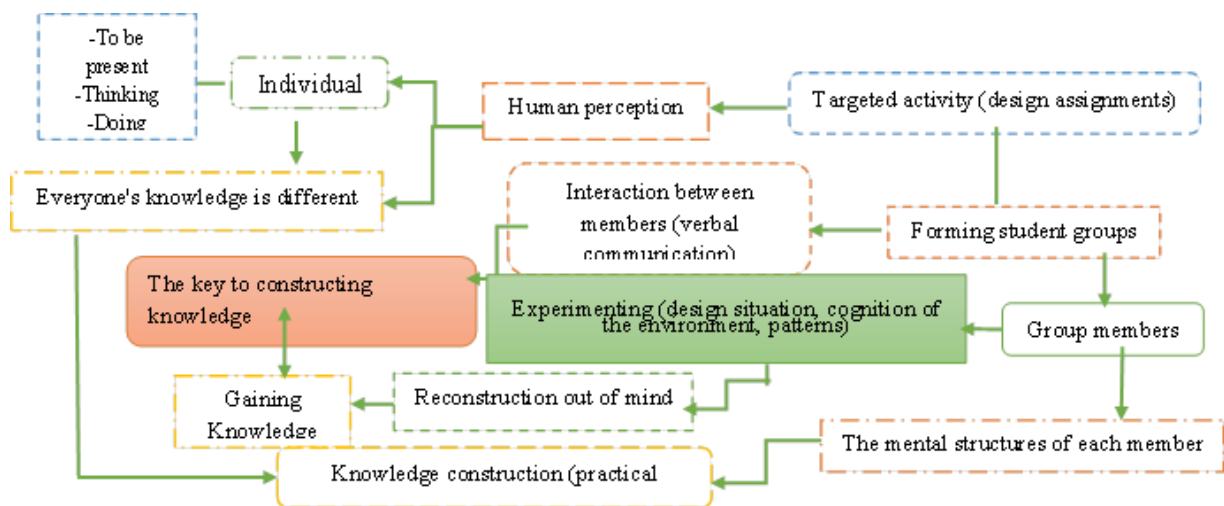


Figure 3. Knowledge Construction Process in the Design Workshop (Source: Authors)

During his interactions with the students, the professor challenged their ideas, forcing the students to think and search for answers. When the student was explaining, the professor paid full attention to the conversations and in addition to challenging, he supported the students, which made them more active and enthusiastic about new topics. In this workshop, there was not much emphasis on the final work and the most emphasis was on the design process and the process of reaching the idea. As a result, the student was more focused on working in the classroom and finding new knowledge, and with full confidence and communication with the subject of their assignments, they sought solutions and

presented ideas derived from thoughts, experiences, and new knowledge gained during the class, through the conversation and interaction of the student with the teacher and all his group members. By attending the class enthusiastically and actively, doing the required tasks and thinking, the learner appropriately learns how to construct design knowledge that is specific to the person and related to the same task. Students built their knowledge through conversation, relationships, and past experiences, so knowledge is endless and uncertain because dialogue is always there.

8. Research Findings

According to the analyses performed in the three methods used to collect information about design knowledge, regarding the design knowledge, the process of constructing the design knowledge is based on a set of knowledge formed when solving a design problem, without being expressible, based on drawings. The components of design knowledge construction are based on various factors, which are derived from the specific nature of design knowledge. Each person's individual factors derived from personal perceptions, experiences, type of thinking, beliefs and backgrounds have a direct impact on the construction of design knowledge. According to studies, design knowledge is unique to each individual. Active communication of the learner in the workshop by attending the workshop and performing exercises, experiencing the design situation, encouraging and motivating by the teacher and making the student think, lead to a precise

understanding of the subject, which results in the discovery and construction of design knowledge. The learner acquires new and specific knowledge for each design situation. Design, unlike mere problem solving, requires the use of knowledge that is unclear or not even necessarily referred to in the outline. Given that in constructivist learning, knowledge is formed during the teacher-student interaction, in design education also, each student, according to his beliefs, attitudes, etc., can use his personal knowledge to interact with the teacher to somehow construct design knowledge. In constructivist learning, more emphasis is placed on the learning process and the thinking behind the product than on the product or learning outcome, and in design, issues are dealt with in process-oriented manner. The main purpose of training in architectural workshops is that students find the ability to acquire design skills to be able to enter professional works in the future.

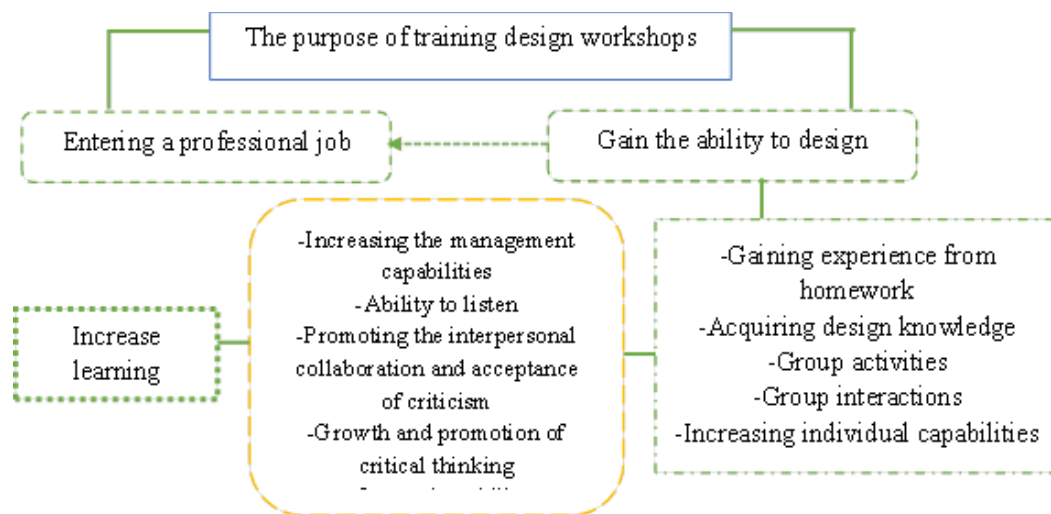


Figure 4. Purpose of Training in Architecture Workshops (Source: Authors)

Group activities and group interactions become one of the ways to increase new knowledge and production. Therefore, one of the training methods in the workshops is to do group homework. In group activity, competition for superiority over others is eliminated. By defining the duties of each member, the group work increases the managerial capabilities, the ability to listen and promote interpersonal cooperation and accept criticism, and positively affects the growth and promotion of students' critical thinking.

In teaching the design process in the stage of explaining and interpreting the design, the teacher can put the student in a position to become aware of the concepts of his design by talking to the student and asking him questions and encouraging him to reflect on his design. In this way, what the student has deemed as unconscious is explained in a conscious way, and it is the student who explains the plan instead of the teacher.

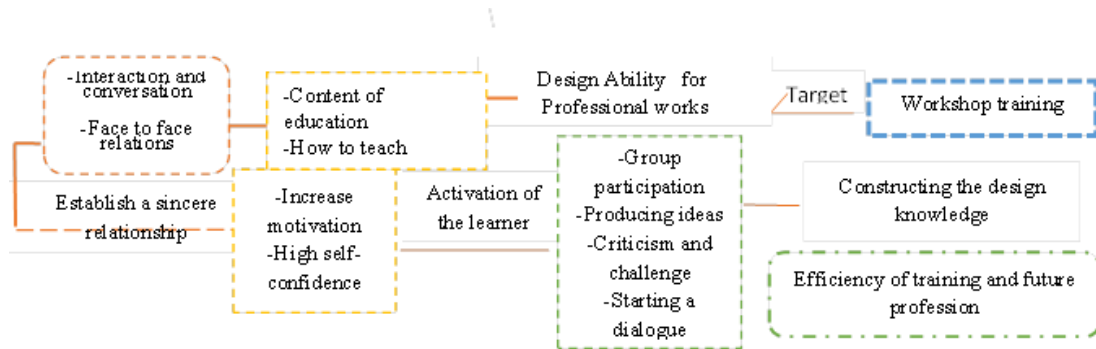


Figure 5. Training in Architectural Workshops in a Constructive Way (Source: Authors)

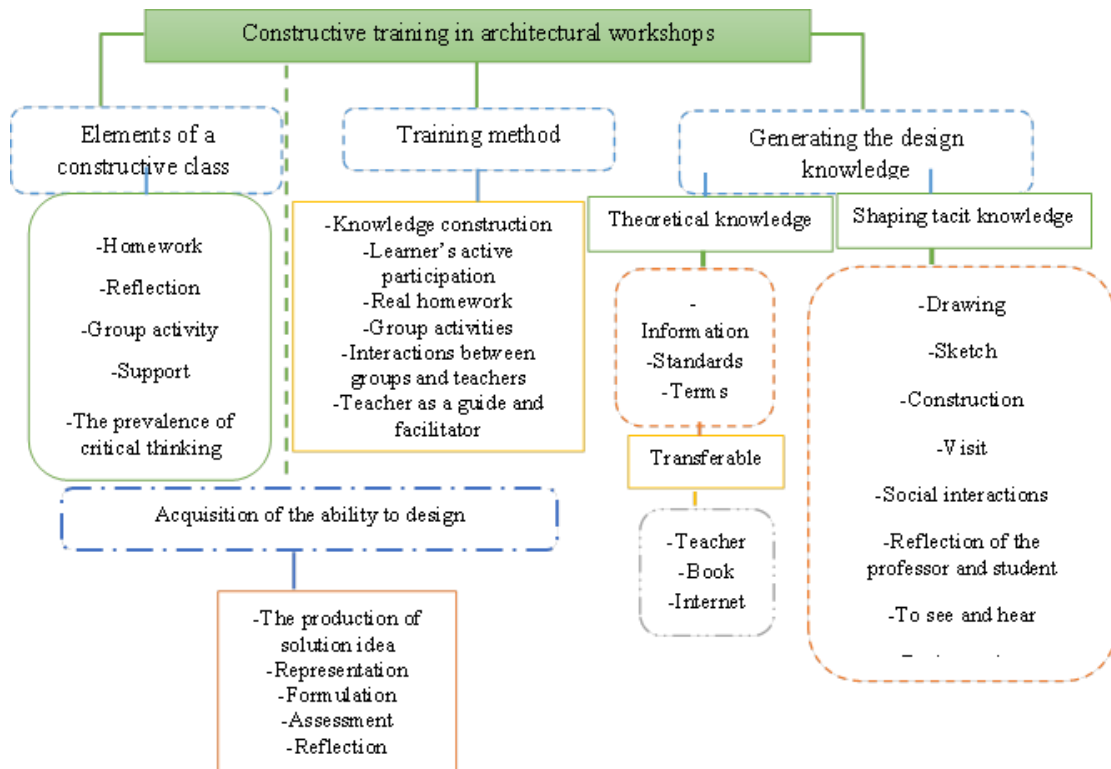


Figure 6. Analysis of Training in Architectural Workshops in a Constructive Way and the Shortcomings of the Conventional Style (Source: Authors)

9. Pathology of Learning Process in Iranian Architectural Workshops

Based on the research, shortcomings can be identified in architectural workshops in Iran. Some of these shortcomings are related to the lack of understanding of the nature of design knowledge. According to studies, in conventional design workshops in Iran, the professor is the ruling power and the student, relies on the professor and reflects on the teacher's action, and is only the recipient. This method destroys the interactions between the teacher and the student, and the student cannot express his opinion and loses the power to defend his idea; as a result only the knowledge of the teacher and his experience is transferred

and no new knowledge is created. One of the major challenges and disadvantages of the education system is the students' expectation of the teacher in the transfer of knowledge. Students usually consider the teacher as the main source of information and expect the teacher to provide the student with all the information and concepts for design. This is one of the most important disadvantages of the current teaching method, in which the student relies on the teacher and does not take action to acquire new knowledge. Lack of recognition of students' individual abilities by professors is also one of the harms of education. Professors in the workshops assign a certain type of homework to all students and expect all students

to have the same level, and in assessments, comparisons are usually made between students, and individual abilities are ignored.

9.1 The Position of Design Knowledge in the Process of Training

One of the fundamental problems identified in the design workshops is perceiving the workshop knowledge as a separate topic from the training process. As stated in this study, design knowledge is generated while doing homework and in design workshops, but in any case, for students, these concepts are introduced and displayed as pre-determined and fixed specifications. Here it can be seen that the definition of these presuppositions and the

most teaching methods, the teacher as the presenter and transmitter of fixed and predetermined ideas is the basis of work. Since there is no interaction about the nature of these concepts and ideas and activities, the student is not able to understand how and by whom these concepts were constructed and for what purpose. The student cannot understand whether the professor has made them or these topics are given as something obligatory by him.

expectation of the student to adapt to these main presuppositions have led to the separation of the educational structure and the structure of the students.

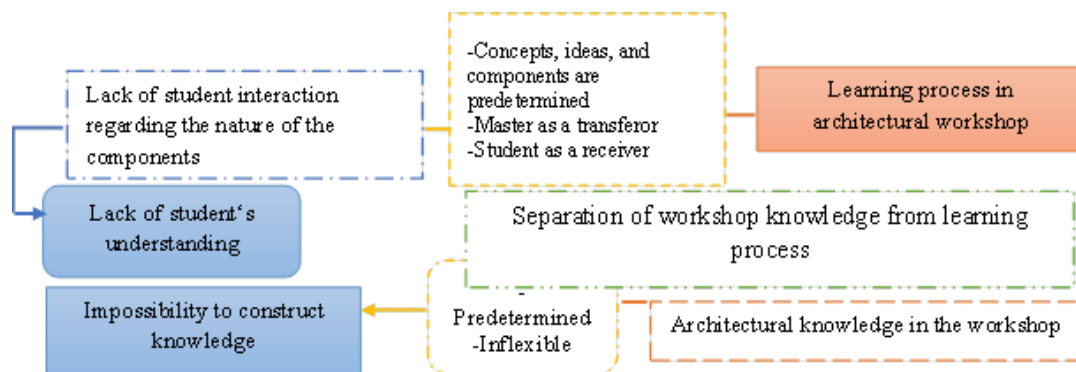


Figure 7. Separation of Workshop Knowledge from the Learning Process in Workshops (Source: Authors)

Another issue worthy of consideration is that the architectural knowledge not only seems predetermined, but also inflexible. In fact, it can be said that the possibility of multiple representations and the production of architectural knowledge in design and training situations is denied, and it should be considered as one of the disadvantages of the learning process. To conclude this section, it can be said that in the design workshop, the teacher's

relationship with structure and knowledge construction is a non-contemplative relationship. Consequently, this reduces the student's ability to reflect on epistemological hypotheses. The student can only accept and follow the given ideas and concepts. He is never invited to participate in the design process through the interactive and reflective production of knowledge.

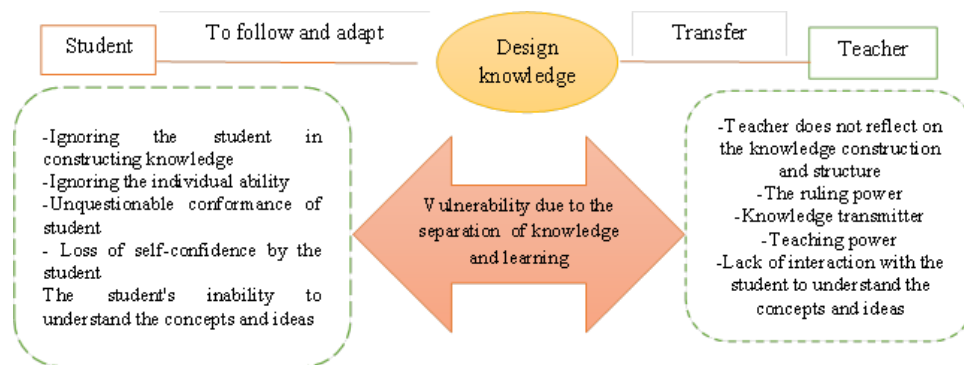


Figure 8. Different Roles of The Teacher and Student with Regards to the Architectural Knowledge in Workshops (Source: Authors)

In the design knowledge section, it was stated that this knowledge is created through interactions and conversations between the teacher and the student. The power structure in the design workshop should be such that there is room for such a free dialogue.

9.2. Teacher-Oriented Approach to the Knowledge Construction

As a conclusion about the construction of knowledge in design workshops, it can be said that the category of reflection in different educational situations can be examined from two perspectives: A: The role of the student. B: The learning process.

Since atelier learning is based on the "learning by doing" model, students seem to be actively involved in the learning-teaching process. However, the findings show that the functional presence, which the author calls the presence of power, causes that in such a workshop environment, reflection on critical and active action be diminished or absent. It has been said that one of the key issues about the nature of knowledge is that knowledge does not have an external body that can be used for professional purposes; rather, knowledge is the process of knowing. The externalization of knowledge and its construction and production and keeping it out of the student's reach is one of the disadvantages identified in the workshop learning process, so that the knowledge that the student uses in his design is not "knowledge in practice". The teaching approach in design workshops is teacher-centered. Two

characteristics create an asymmetric hierarchy in the workshop: A) Patterns in the teacher's mental background are kind of uniaxial and deprive the student of any comment, B) The student's homework derives its meaning from the teacher's performance, not from the student's own activity.

9.3 Training Methods in Architectural Workshops

The conventional method of teaching in most architectural workshops is not such that the student can actively design his own design. Based on what was stated in the previous sections, in an architectural workshop with a constructive approach, the student should seek to produce design knowledge because the nature of design knowledge is such that it is non-transferable and is created while doing so. In the workshops, the teacher as an all-knowing gives the concepts and information that he has in his mental background, as a specific model to the student and the student is in the role of the receiver of concepts. In this way, the student cannot use the ideas and concepts that he/she makes while designing according to his / her individual characteristics (previous experiences, values, beliefs and thoughts), and he/she tries to present his/her ideas in line with the patterns introduced by the teacher. The student does not have the ability to talk freely and face to face, which is one of the main factors of constructive education, resulting in the harm to the student and lack of self-confidence in the student.

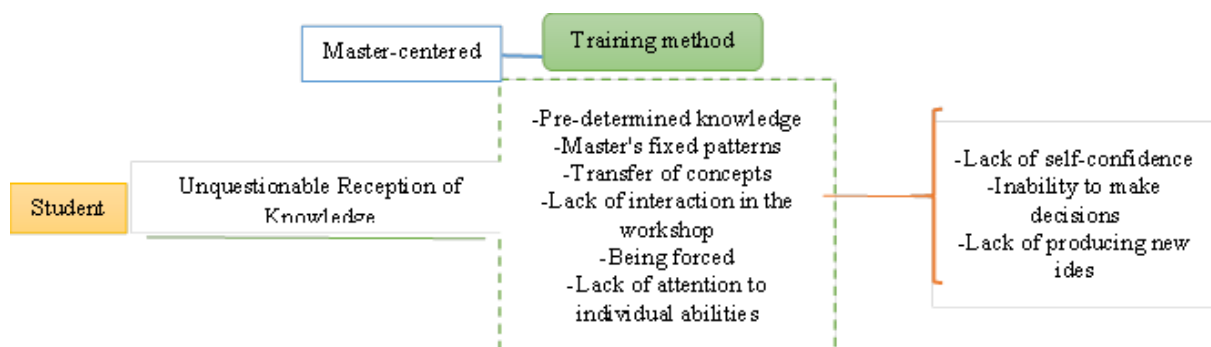


Figure 9. Pathology of Training Methods in Workshops (Source: Authors)

10. Discussion and Conclusion

To conclude the pathology discussion, it can be said in general that for design, there is no pre-determined knowledge, but design knowledge is created during the design process based on

various factors that exist simultaneously with the design. Therefore, in design workshops, students should seek to construct knowledge during the design process. In a workshop environment, learners must play an effective

role in the whole learning process and increase their learning by increasing the skills and experiences required for the assignments. Design knowledge is a different knowledge from other sciences because the way of acquiring knowledge also differs in practice. Knowledge is achieved during works and activities. Thus, the nature of design knowledge is dependent on work and tasks and focuses on individual capabilities which can specify the knowledge to themselves and become an unlimited knowledge based on experience, situation and conditions and in accordance with the stages of its acquisition. In conventional workshops, the student has very little motivation to express the ideas, to have a

conversation, to be active in the workshops and considers himself only a recipient of knowledge and does not make an effort to construct it. Due to his role in the workshops, the learner does not have the necessary ability to make the right decision and cannot defend his plan.

As a new framework, it can be said that the workshop instructor must tend to be involved in constructing knowledge. He calls this a two-way construction as the reference point for his assessment of student work. The student's reflection when designing leads to this point of reference. Since the student is involved in building this relationship, this point seems to be more accessible and understandable for the student.

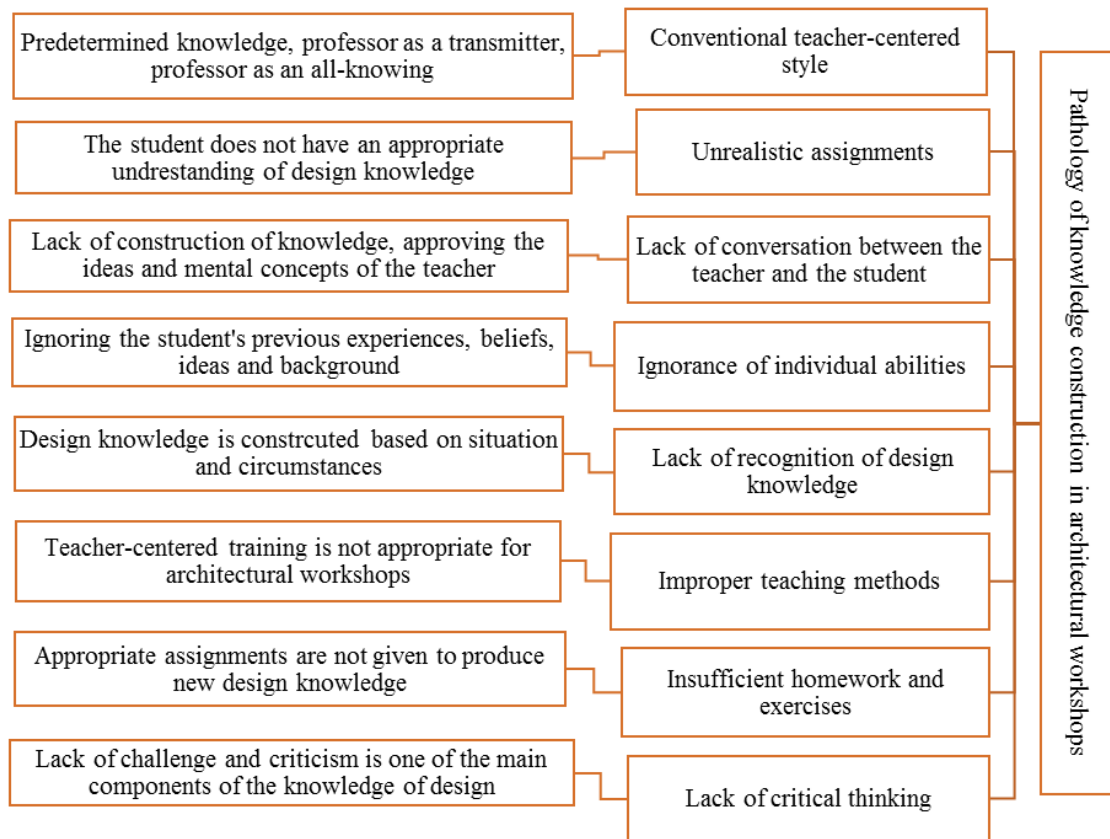


Figure 10. Pathology of Knowledge Construction in Architectural Workshops (Source: Authors)

One of the important features in constructive education is the prevalence of critical thinking among students; in the common practices in the workshops, the dominant power of the teacher in the classroom takes critical thinking from the learner. As stated in the research, the important factors in constructing knowledge are teamwork and interactions between group members, and lack of effective team works in

design workshops is one of their shortcomings. In the final evaluation, not paying attention to individual abilities and the final comparison of each student with the other students in the workshop are of the disadvantages of these environments.

This article has a pathological look at the nature of design knowledge in architectural workshops. As for future studies, it is suggested

to find solutions to the identified harms in order to construct the design knowledge.

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