ULUSLARARASI HAKEMLİ TASARIM VE MİMARLIK DERGİSİ
INTERNATIONAL REFEREED JOURNAL OF DESIGN AND ARCHITECTURE
Doi: 10.17365/TMD.2023.TURKEY.29.09 / ss. 187-207 - pp.187-207

THE NECESSITY OF TEAMWORK APPROACH IN ARCHITECTURAL DESIGN EDUCATION: AN ANALYTICAL STUDY[1-2]

MİMARİ TASARIM EĞİTİMİNDE TAKIM ÇALIŞMASI YAKLAŞIMININ GEREKLİLİĞİ: ANALİTİK BİR ARAŞTIRMA

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Abstract: Aim: This study intends to identify the processes of group design with students, the weak and strong areas of their activity in different phases, and to assess the implications of education in executing this activity by focusing on the principles of group design thinking in architecture.

Method: A test was conducted among students from Tehran and Konya Technical Universities to investigate the influence of education on improving group design quality. This experiment was conducted by having three-hour drawing sessions and dividing the students into 8 groups. The single-variable test method was utilized because of the independence of the groups and the equality of their variances. Two preliminary exams were used to measure students' lack of understanding and familiarity with group work, followed by an extra examination for the students involved in the issue.

Results: The findings revealed that in group architectural design, group members focus largely on the design's content, with team communication centred on two essential aspects: content analysis and process review.

Conclusion: Teamwork in designing can be superior to solo effort, and proper training can increase this. It is felt that paying attention to the concept of group design and teaching it in architecture schools is useful.

Keywords: Content Analysis, Design Process, Design Thinking, Group Architecture, Group Design

Öz: Amaç: Bu çalışma, öğrencilerle grup tasarımı süreçlerini, farklı aşamalardaki faaliyetlerinin zayıf ve güçlü noktalarını belirlemeyi ve mimarlıkta grup tasarımı düşüncesinin ilkelerine odaklanarak bu faaliyetin yürütülmesinde eğitimin etkilerini değerlendirmeyi amaçlamaktadır.

Yöntem: Tahran ve Konya Teknik Üniversitelerinden öğrenciler arasında, eğitimin grup tasarım kalitesini artırma üzerindeki etkisini araştırmak için bir test yapılmıştır. Bu deney, 8 öğrenci grubu arasında üç saatlik eskiz çalışması yapılarak gerçekleştirilmiştir. Grupların bağımsızlığı ve varyanslarının eşitliği nedeniyle tek değişkenli test yöntemi kullanılmıştır. Öğrencilerin grup çalışması konusundaki anlayış eksikliğini ölçmek için iki ön sınav kullanılmış, ardından konuya dahil olan öğrenciler için ekstra bir sınav yapılmıştır.

Bulgular: Bulgular, grup mimari tasarımında grup üyelerinin büyük ölçüde tasarımın içeriğine ve ekip iletişiminin iki temel konuya odaklandığını ortaya koymuştur: içerik analizi ve süreç incelemesi.

Sonuç: Tasarımda ekip çalışması tek başına çabadan daha üstün olabilir ve uygun eğitim bunu artırabilir. Grup tasarımı kavramına önem verilmesinin ve bunun mimarlık okullarında öğretilmesinin yararlı olacağı düşünülmektedir.

Anahtar Kelimeler: Ekip Tasarımı, İçerik Analizi, Mimarlık Ekibi, Tasarım Düşüncesi, Tasarım Süreci

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[2] Çalışma, araştırma ve yayın etiğine uygun olarak hazırlanmıştır. Çalışmada herhangi bir intihale rastlanmamış olup dergi kapsamında istenen %20 alıntı oranına uygun olarak hazırlandığı bu yönlerden makalenin tüm sorumluluğu ile bilgilerin doğruluğu ilgili yazar(lar) tarafından kabul edilmiştir. İşbu makalenin her türlü telif ve sair diğer hakları açık erişim olmak üzere yazar(lar) tarafından dergiye devredilmiştir. "The study was prepared in accordance with research and publication ethics. No plagiarism was found in the study and it was prepared in accordance with the 20% citation rate required within the scope of the journal, and in these respects, the full responsibility of the article and the accuracy of the information has been accepted by the relevant author(s). All copyright and other rights of this article have been transferred to the journal by the author(s) as open access."

ISSN Print: 2148-8142 Online: 2148-4880

INTRODUCTION

The need to create leads the human mind to new concepts and attitudes. In such an activity, the mind is involved in various conceptions about the surroundings and the process of creation. In this respect, architectural design is considered an important discipline that is continually concerned with innovation and is one of the main steps in the building construction process. Individual skill and innovation, as well as collective engagement and support for shared ideas, are clearly required for design. It is critical to strike a balance between individual and collective thought. The leader's intervention in the design group's activities is quite delicate. Real participation is deliberate social involvement that is accompanied by the participants' awareness of the activity. Designers must be aware of how their thinking influences group behavior, as well as how their thinking influences the thinking of other members of the groups with which they work. During the group design process, Kvan (2000) emphasized the importance of collaboration, with each individual contributing their expertise in different areas at moments that resonate with their knowledge. Participants are driven by their unique attitudes toward collaboration, which collectively enrich the solution process. This approach ensures that each member brings their specific skills to the table, fostering a dynamic and effective problem-solving environment. In stating the theme of collaborative design, Lloyd and Oak (2018) proposed the theoretical framework of research around linking past experiences and relationships that exist in the design process and suggested this as a key value and function in the collaborative design process. With a careful theoretical and empirical look at the most basic elements, Nisha (2019) expressed design thinking with the four basic cognitive functions of thinking, exploring, comparing, and choosing, and presented a general model of design team activity that design teams should be able to evaluate the given conditions of group design in the design workshops and adjust the situation quickly and flexibly according to the conditions, and this process requires training and practice. Meanwhile, educating architectural design through cooperation has a major impact on job quality (Holubchak, 2020). The importance and sensitivity of architectural education in comparison to other specializations are that knowledge and practical experiences cannot be transferred as easily as in disciplines such as natural sciences or technical engineering (Couchez & Heynickx, 2021). Architectural education has always clashed with architectural practice. Architectural design is both a problem-solving exercise and a philosophical inquiry. What about figuring out what the issues are? (Ozkar, 2018). Therefore, it is obvious that the process of architecture and its education is considered one of the most important issues in the field, and the importance and sensitivity of architectural education should be made known as a necessary and specialized matter; because the heritage of the past is the knowledge of architecture and civilization that should be remembered for future generations, and this fundamental principle is considered one of the examples of

ISSN Print: 2148-8142 Online: 2148-4880

the transmission of science and art from one generation to another (Han et al., 2022). Thus, nowadays, architectural design must be taught in such a way that architecture students are pushed to a serious level of competence, even if they do not know what they are supposed to learn. This means that students start without knowing what they are supposed to do, leading to a completely person-centred approach to architectural design. So, unlike students in other disciplines, architecture students have to do something before they know what to do, which is a special way of thinking. Also, the traditional teaching method, trial and error, and the mere ability to create a good design are not enough to teach architectural design (Soliman, 2017).

Although the person-centred design approach improves the way students learn technical and design skills, helps them to shape their individual ideas in the form of an architectural project and solve problems creatively, students have difficulty making final decisions because they work individually and do not draw on the experiences of others (Labib et al., 2019). Therefore, collaboration is considered one of the most important success factors in architectural design, coordination and successful cooperation between the participants in the process. Indeed, teamwork in architectural design is effective in generating new and innovative ideas, sharing knowledge and experience, improving design quality, and streamlining the architectural design process (Emam et al., 2019). Due to the high complexity of the process, teamwork in architectural design also increases the possibility of identifying and solving problems. Multiple different perspectives can help identify more problems and find better and more efficient solutions (Chiocchio et al., 2011). Therefore, it is necessary that the architectural design is created in a group platform, and to learn design, it is not enough to make the design. In design workshops, students are often asked to make a design without considering the complexity of the design, but this complexity is facilitated by the group; in the sense that the decision-making process in design requires gradual training to be able to consider the many possibilities that exist. Therefore, we can answer questions such as whether students should be given the opportunity to experience some kind of self-learning in design education. How can we achieve more effective architecture teaching with group architecture in educational spaces? And how can we put friendship and attraction instead of competition and exclusion? (Morales et al., 2022). In this regard, architecture faculties and the content of architectural design education programs make an important contribution in this regard by teaching students the different styles of architectural design, explaining appropriate communication skills for teamwork, providing opportunities such as workshops or design competitions, and giving students successful experiences with teamwork in architectural design. To achieve these goals, students should be given the opportunity to practice teamwork in architectural education. The current study hypothesizes that the introduction of teamwork in architectural education can lead

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to more effective techniques in teaching architecture. Accordingly, it attempts to explain the necessity of teamwork in the architectural design process by examining collaborative and collective architecture, and it proposes ideas for implementing participation in architectural design workshops.

AIM

Collective participation in architectural design is considered a strategic method in the field of architectural education, and group collaboration has led to synergistic effects, although the result of the work naturally exceeds the overall capacity of the individual. In this type of design, participation in all components of a design and a product is a valuable and constructive communication of people who have participated in some way in the design process. On this basis, collective participation is assessed as something positive and valuable, because in the stages of scientific and cultural development of societies, the participation of all parts of society will be influential and play a role. This study attempts to investigate collaborative architectural and design workshops using the descriptive-analytical research method, and with reference to the necessity and importance of teamwork, the related dimensions of participation in architectural design workshops are presented. In this respect, the main concern and aim of the present study is to investigate the different ways of performing teamwork in architectural education and to propose solutions to improve students' performance in design groups, as well as to suggest how to achieve the desired outcome in university architectural design courses. In this regard, the current study seeks to determine the right approach to the design program for architecture students, to make the right decision for students to select and use specific and appropriate tools at each stage of the design process, and to develop students' ability to interpret and compare different options and solutions to produce an effective design.

CONTENT

Following the aforementioned cases and considering the research objectives, the content of this study is designed in accordance with the basic principles of groupthink. In the first step, the study examines the concept of group, group work (teamwork) and identifies the processes of group design, the characteristics and the requirements of group work in architecture. In the following step, the theories related to teamwork in architectural design process are reviewed, the main factors of group work thinking are identified, and the theoretical framework of the research is introduced to investigate the effects of training in applying teamwork approach, the effects of training in increasing the quality of group work among architecture students and identifying the strengths and weaknesses of architecture students. To validate the theoretical framework, the third step was to conduct a test with students from Tehran Azad University and Konya Technical University. For this test, three-hour sketch sessions were held, groups of five were formed, and the research method of one-variable test

ISSN Print: 2148-8142 Online: 2148-4880

(Student-t) was applied, considering independence of groups and equality of variances. These tests included two pre-tests under conditions of lack of student knowledge and lack of familiarity with group work. Subsequently, an additional test was conducted with the students and the results of these tests were discussed in this article.

RESEARCH METHOD

The statistical population of this study includes 40 architecture students at Azad University of Tehran in Iran (24 men & 16 women; M=20.65) and 40 architecture students from Konya Technical University in Turkey (14 men & 26 women; M=21.35). A total of 80 students (20 freshman from the Basic Design II course, 20 sophomores from Design Studio III course, 20 juniors from Design Studio V course, and 20 seniors from Design Studio VII course) volunteered to participate in this study. This test was administered by eight groups of ten students in four different levels of education and each group was divided into two groups of five students [*Iranian students*: Group 1, 10 freshman students from Basic Design II course (Seed A: 5 students & Seed B: 5 students), Group 2, 10 sophomore students from Design Studio II course (Seed C: 5 students & Seed D: 5 students), Group 3, 10 junior students from Design Studio V course (Seed E: 5 students & Seed F: 5 students), Group 4, 10 senior students from Design Studio VII course (Seed G: 5 students & Seed H: 5 students); *Turkish students:* Group 5, 10 freshman students from Basic Design II course (Seed A: 5 students & Seed B: 5 students), Group 6, 10 sophomore students from Design Studio II course (Seed C: 5 students & Seed D: 5 students), Group 7, 10 junior students from Design Studio V course (Seed E: 5 students & Seed F: 5 students), and Group 8, 10 senior students from Design Studio VII course (Seed G: 5 students & Seed H: 5 students)].

Table 1. Frequency Distribution of Participants

Year	Number	Gender		Group							
		Men	Women	1	2	3	4	5	6	7	8
Freshman	20	9	11	10				10			
Sophomore	20	10	11		10				10		
Junior	20	9	10			10				10	
Senior	20	10	10				10				10
Total	**80**	**38**	**42**				**80**				

The corresponding test was conducted by the author in both Iran and Turkey in two phases, the pre-test and the post-test. The group members who had no training and intellectual background in teamwork and imaginative strategies in group work participated in the pre-test. The post-test was conducted with an explanation of the concept of group work and training in creativity methods in group work. Results were obtained by allocating time to each performance and measuring the percentage

ISSN Print: 2148-8142 Online: 2148-4880

of each performance in relation to the total test time. Students were asked to bring their own sketching equipment and draw throughout the test. Student-approved equipment was disclosed to create a level playing field across groups and to formalize public information. The free choice of drawing equipment allowed them to compete based on their skills in using the equipment. In the architecture department of each university, a design studio with eight drawing tables (two for each group) with identical spatial conditions in terms of light, sound and visibility was studied before the start of the sketching test. For each table, a 50×70 piece of cardboard, a 70×100 piece of parchment paper and five sheets of A3 paper were provided. Members of each group sat down at their own table and were given a questionnaire to familiarize themselves with the people in each group's history and their function in the group. An attempt was made to use the organizing principles of the questionnaire to formalize the work (items such as stating a full objective, short questions and instructions on how to complete the questionnaire in the form of five choices on the Likert scale). Participants in each group were assigned a number and asked to take an A3 sheet of paper, write down their number, and draw their personal analyses on it so that the role of each person in the group could be evaluated separately. During the design period, the researcher observed and recorded all the conversations and processes in the group using the contents of Table 2. In fact, using a stopwatch and the activity table (see Table 2), the researcher documented each group action and the duration associated with that activity in the target box. For example, when a student asked a question or made a suggestion, the time for each action was noted. Following the test, the time it took to bring up the concept in the solution generation step and the time it took to ask questions in the analysis step were noted. An average was calculated between these two records, and if there was a significant discrepancy between the two figures given, the necessary agreement was obtained by talking and listening to the arguments of the two people. Finally, the percentages of activities performed in relation to the time variable were calculated using the recorded numbers.

The typical pattern was that at some point after the test began, someone in the group inadvertently assumed the role of leader. This allowed the researcher to collect papers, regulate the recorded items, and schedule, and determine the participation of individuals in the outcome of the work. After the test, the students were given another version of the same questionnaire to answer the previous questions with the experience gained from the test. Then, by analyzing the information obtained, the aim was to determine the percentage of group activity in the different phases of a draft and a role play, as well as the group members' positive or negative view of group activity. Following the pretest, the final test was administered. Before the final test, students were introduced to different approaches to group thinking and creativity in a meeting where the aim of the test was stated and the main objective (group activity) was explained, and

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the final test was conducted with a new perspective on this topic. After the test was completed, all documents (50×70 paper, parchment paper and A3 paper) were collected for analysis and assessment. The questionnaire data were analyzed with SPSS software, using Pearson correlation tests and one-sample t-tests. The Cronbach's alpha coefficient was used to test the validity of the questions.

RESEARCH RESTRICTIONS

The study was done during a set period of time, such as a semester, which may limit the long-term impact of incorporating cooperation into architecture education. Longer-term research would offer a more complete picture of the influence of cooperation on teaching strategies. Also, the research may be criticized since it is impacted by the educational institution's specific circumstances, such as its curriculum, resources, or organizational structure. These environmental considerations may restrict the findings' application to different educational environments. The desire and motivation of individuals to participate in collaboration may also impact the research results. If participants are not completely dedicated or do not value collaboration, the efficacy of the instructional strategies under consideration may suffer.

RESEARCH PROBLEM

Teamwork must achieve widespread acceptance as a successful instructional strategy in a variety of educational fields, and its potential advantages in architectural education are gaining traction. Teamwork in architecture education is seen to show potential for improving teaching methodologies and promoting more effective learning experiences. This introduction seeks to investigate and resolve several research issues concerning the incorporation of cooperation in architectural education. The study challenge is concerned with discovering collaborative tactics and approaches that may be effectively introduced into architecture education to improve teaching procedures. Educators can get insights into the most relevant and impactful techniques for introducing cooperation within architectural curriculum by studying various approaches. Indeed, in architectural education, comparing the outcomes of collaboration-based approaches to traditional teaching techniques would give insight on the potential benefits and usefulness of teamwork in increasing student learning experiences. Educators can get significant insights into the cognitive and social components of learning enabled by cooperation by researching how teamwork helps the development of architectural skills and competencies. In this regard, knowing how collaboration improves students' collaborative abilities and prepares them for real-world architectural practice is critical for guaranteeing architectural education's relevance and applicability.

RESEARCH HYPOTHESES

The importance of a teamwork approach to architectural design education has become a topic of great interest. The changing complexity of today's architectural difficulties has led to the need to rethink previous

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teaching methods. This study seeks to illuminate how collaborative learning experiences can better prepare aspiring architects for the complex demands of the modern built environment by examining the multiple benefits that result, from increased creativity and diverse perspectives to improved problem-solving and communication skills. The study produces hypotheses that may be used to guide further research and examination into the possible benefits and results of adding collaboration into architecture education. In this context, as the first one, it is hypothesized that incorporating cooperation into architecture education promotes student involvement and participation, resulting in improved learning results. As a result, it is possible to argue that collaborative learning through cooperation increases creativity and inventive thinking in architecture students. As the second one, it is hypothesized that incorporating cooperation into architectural education improves problem-solving abilities, encourages holistic design thinking, and allows for a more thorough knowledge and application of architectural ideas and concepts.

THEORETICAL FRAME

Architecture provides humans with the knowledge and instruments to collaborate and develop together. The architect may provide room for the person to become a sensible being. By perceiving space, the person comes to terms with his own existence. When architectural education is based on societal requirements, knowledge about the environment must be gathered in order to identify and solve an architectural design challenge. Communication and electronic technology must be integrated in architecture education to improve its efficacy in academic and professional domains. Teamwork fosters innovation in terms of intellectual approach as well as specialist assistance, and it boosts the bravery to launch a firm (Akin, 2018). In general, one of the most significant aspects to consider when improving interaction and collaboration in workgroups and group projects is teamwork architectural design. Therefore, promoting access and communication among team members is an important goal that can be achieved by establishing an appropriate place for information sharing, conversation, and coordination (Delport-Voulgarelis & Perold, 2016). Important goals in the architectural design of group work are to create a suitable atmosphere for coordinating work, sharing ideas, improving communication, and creating a good dynamic in the work group (Zhang et al., 2008). Teamwork has indeed become a significant tool in architectural education, with the ability to transform teaching approaches and enhance student learning experiences. By collaborating with other faculty and pooling their different experiences, viewpoints, and creative ideas, teachers can design unique and engaging courses. Each team member brings a unique set of talents and experiences to the table. The result is a comprehensive approach to teaching that meets diverse learning styles and individual needs (Tucker & Abbasi, 2014). In addition, the teamwork approach in architectural design provides a supportive and collaborative environment in educational settings where teachers feel respected,

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motivated, and inspired. This positive atmosphere can have a direct impact on the quality of teaching, as teachers who feel valued and encouraged are more likely to invest time and effort in improving their teaching methods. As a result, students are more likely to feel included and encouraged to actively participate in the learning process, leading to a dynamic and conducive environment for acquiring and retaining information (Vasquez et al., 2020). The potential of teamwork to improve teaching practices and create more successful learning experiences is obvious. Educators can harness the power of collective thinking and shared experience to develop new courses, promote continued professional growth, and create a good learning environment through collaboration. By fostering collaboration, educational institutions can open new avenues for development and advancement that ultimately help both faculty and students in their pursuit of knowledge and academic success (Keramati & Gillies, 2022).

This study tries to find out how a group architecture is created. What are the different roles played by the individual members of the group or the whole group in the run-up to an individual architecture during an architectural process? A peek at the great architectural firms shows that the group functions not only as a collection of individuals, but that it somehow transcends the capabilities of the people as a whole. This idea is like the Gestalt psychologists' concept that "the whole is something different or something other than the sum of its parts" Bryan Lawson (2006) connects teamwork in architecture to the Gestalt phenomena of collections. In teamwork, just as in Gestalt, the effect of the members in the group is greater than the sum of the effects of the individual members. This is because in this process we are dealing with creative minds that, in mutual agreement, take the weak points of each other's thinking and present them in a positive form (Liu et al., 2022). As a result, it may be argued that design is frequently a collaborative process in which group members' knowledge may be more significant than their ideas, since concepts can become one's own mental realm. Critical ability becomes impersonal in group work (Hu et al., 2018). In this regard, it seems necessary to explain the important points and features of group design:

- Group design norms: Group architecture reflects design as a collective process and a set of design activities that go beyond design. To achieve the desired outcome, group members must perform their tasks correctly so that the roles of group members are integrated into the design process (Schipor et al., 2019). In this context, factors such as the combination of intellectual abilities, group motivation, mental and practical processing, cultural habits, individual behaviors, and shared concepts among group members in a work group are addressed, which makes group members more harmonious (Hassan et al., 2023). Flexibility in group architecture is also important in advancing the goals of the group. In the process of building teamwork, creating a model is one of the most important elements that contribute to the success of the group. By defining a model for teamwork, the

ISSN Print: 2148-8142 Online: 2148-4880

group moves forward faster, and the steps are more specific (Luck & McDonnell, 2006).

- The necessity of group work: Design workshop courses are the foundation of architecture and other design sectors. The goal of the design workshops is to uncover creativity, improve the capacity of the mind, sight, and hand to collaborate, and produce solutions. Being able to generate alternative solutions for uniqueness, creativity, and design should be regarded group effort in this process. As a result, design workshops are an atmosphere in which coordinators and students connect with one another, generate ideas and designs, and discuss (Abbasoglu Ermiyagil, 2019). In a group activity, people actively and responsibly work together to achieve a common goal, and each individual is not only responsible for his or her own behavior, but also feels responsible for the behavior of others. Therefore, coordination and organization are essential in cooperative teamwork (Hill, 2016). Architectural group design involves group members setting specific goals, examining problems, implementing solutions, taking responsibility for results, and a high level of communication (Hammar Chiriac, 2014). In this way, more creativity, higher motivation, more attention to creativity, fewer team members, more communication, better use of resources, better decision making, and a better work environment result (Ghonim & Eweda, 2019).

- Basic elements of design thinking: Problem-solving is a process in which a person can take actions to address an issue or problem based on his or her practical experiences and mental skills. This skill allows a person to solve the hardest difficulties in life. Because problem-solving skills are education-oriented interventions, numerous psychologists and theorists have emphasized the learner's participation in various learning activities, particularly problem-solving activities, in discovering and developing knowledge. In this sense, issue solving is equivalent to cognitive processing to turn an assumed condition into a desired state, even if the individual addressing the problem lacks a clear strategy for doing so (Aein, 2018). To assess the effectiveness of teamwork and to cope with any kind of problem in design processes and problem solving, a cognitive basis for statistical measurement of information is needed (Tymkiewicz & Bielak-Zasadzka, 2016). In this regard, the factors of generation and exploration in creative thinking provide diversity and expansion of the subject. On the other hand, there are two factors of comparison and selection that make these two options more convergent. These factors are necessary to communicate with any topic or problem. The first two factors are expansive and aim to expand the problem space. The second two constrain the problem. Therefore, it has been proposed as a fundamental step for thinking and problem solving in design (Stempfle & Badke-Schaub, 2002).

- Applying elements of design thinking to group design process: When analyzing the thought and design process of designers, many problems become apparent. This is because there are no direct criteria for understanding the process in the mind of the

ISSN Print: 2148-8142 Online: 2148-4880

designer (Marful et al., 2022). In using the four factors of generation, exploration, comparison, and selection, a special emphasis on two specific elements like content and process is very necessary. This type of emphasis and differentiation leads groups to not only successfully communicate with the design theme, but also to direct some of their activities toward structuring the group process. In this regard, content element includes steps such as goal clarification, solution finding, analysis, evaluation, decision, and control. Goal clarification is about the communicative actions related to the design goals (Khaled, 2010; Stempfle & Badke-Schaub, 2002). Solution finding is about suggestions and ideas for solving problems in the design process (Smorzhenkov & Ignatova, 2021). The analysis step is associated with design questions and finding solution. In the evaluation step, positive and negative aspects of the solution are evaluated. In the decision step, decisions for or against a solution are evaluated, and the last step is related to controlling the implementation of a solution idea (Stempfle & Badke-Schaub, 2002). In general, the first step of goal clarification seeks to provide the goal, the next four steps relate to the solution process, and the last step of control relates to the goal and the solution (Table 2). In relation to the process, five steps can be defined that are comparable to the content, such as planning, which includes proposals related to the group process, like the nature of the process, description of tasks, etc.; analysis, which includes questions and answers related to the group process; evaluation, which is associated with positive and negative assessments of the group process; decision, which refers to the decisions of group members; and control, which is associated with the summary or control of the work of group members (Stempfle & Badke-Schaub, 2002). From the results of the discussion, a model can be presented that makes it possible to break down the complex operations of the design team into smaller components and give an accurate impression of what design teams do. Compared to design theories, the proposed research model does not suggest a fixed order in which certain steps should be followed but shows a cycle in which the same actions are repeatedly applied at different levels of the design process, such as the concept phase and the detailed design phase (Graph 1.). In the relevant diagram, the basic elements of thinking in the two basic stages of process and content are specified. The steps related to each of these two parts are drawn in order of occurrence and the connecting lines define these steps in terms of being a subset with the basic points of thinking. For example, in the part of the design process, the analysis step is associated with the part of the basic elements of thinking as a subset of exploration and is related to this category.

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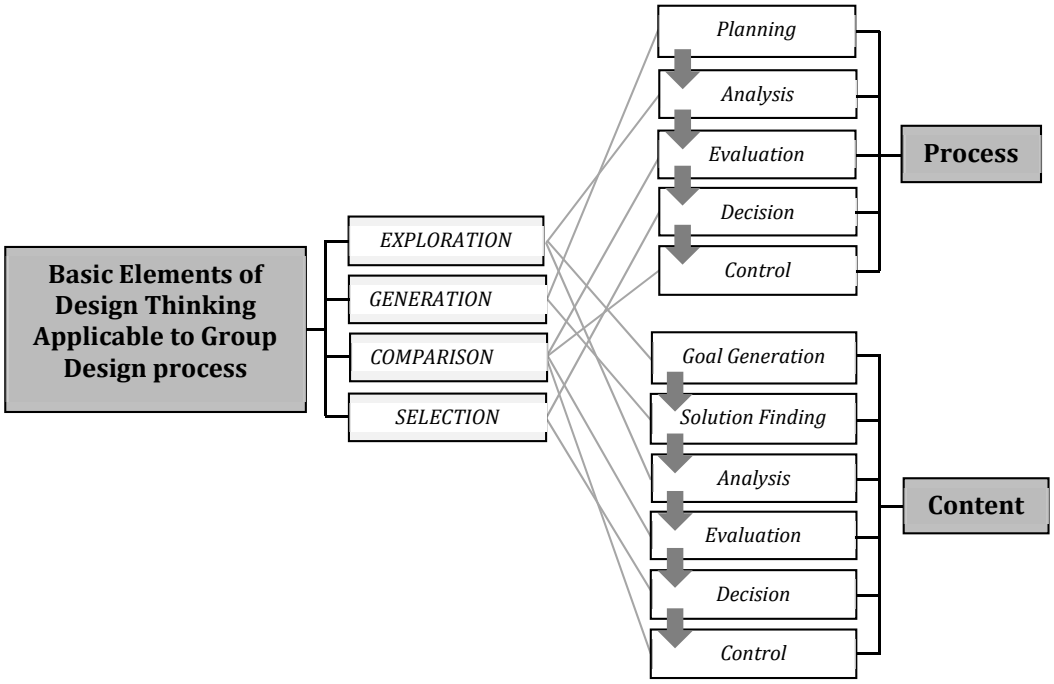

Graph 1. Step Model of Teamwork Design

Table 2. Activities Properties

Activity	Step	Action
Process	Planning	Collective planning and decision-making about work evolution
		Referring duties to group members (task division)
	Analysis	Question, Answer, Hypothesis, Concept (implication)
	Evaluation	Assessment of comment or work development
		Positive evaluation / Plural agreement
		Negative evaluation / Lack of plural agreement
		Uncertainly
	Decision	Decision, agreement
	Control	Control of group members
		General satisfaction and agreement
Content	Goal Clarification	Goal-related question
		Need-related question
	Solution	Solution idea
	Generation	Question, Answer, Hypothesis, Concept
	Analysis	Assessment of comment or work development
	Evaluation	Positive evaluation / Plural agreement
		Negative evaluation / Lack of plural agreement
		Uncertainly
	Decision	Decision, agreement
	Control	Control of facts and reflections

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RESULTS

The following diagram illustrates the occurrence of communicative acts within the content and process factors across the eight groups. It is evident that there is a consistent distribution of communicative actions among these crucial categories across all eight groups. For the content activity, the reliability coefficient of the goal clarification, solution generation, analysis, evaluation, decision, and control steps were rated as 0.773, 0.713, 0.742, 0.717, 0.879, and 0.801. As seen in the table 3, the correlation coefficient between content variable and communicative acts is r=0.771 and p<0.001; That is, there is a direct relationship between students' concentration to design content and design actions. Higher scores for content factors mean that the evaluation score of the students' design product is higher. In this regard, six of the eight communication design groups are primarily concerned with content, while the remaining two groups are concerned with the structure and dynamics of group activities. Similar trends have been reported in non-design and problem-solving groups.

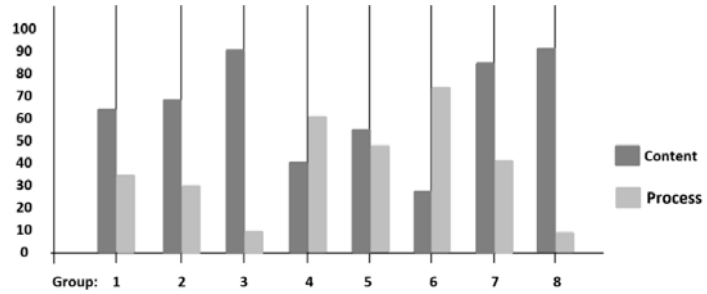

Figure 1. Frequencies of Activities by Assessing Content and Process Factors

Table 3. The Correlation Coefficient Among Activities and Communicative Acts

Activity	Step	r	p
Process	*Planning*	0.671	0.001
	Analysis	0.610	0.001
Groups	*Evaluation*	0.674	0.001
1,2,3,5,7,8	*Decision*	0.608	0.001
	Control	0.713	0.001
		0.655	
Content	*Goal Clarification*	0.773	0.001
	Solution Generation	0.713	0.001
	Analysis	0.742	0.001
Groups	*Evaluation*	0.717	0.001
4 and 6	*Decision*	0.879	0.001
	Control	0.801	0.001
		0.771	

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When it comes to the stages of the design process, the allocation of communicative acts within the different stages shows remarkable similarities across all eight groups, exhibiting a correlation of 0.655. The reliability coefficient of the planning, analysis, evaluation, decision, and control steps were rated as 0.671, 0.610, 0.674, 0.608, and 0.713 respectively. for the process activity. In the analyzed teams (groups combined for this study), team communication primarily revolves around two key aspects: content analysis, which accounts for 51% of the discussions, and process evaluation, which constitutes 23%. Content evaluation ranks as the second most prevalent category at 16%, whereas goal clarification and process evaluation follow closely behind, representing 11% and 8% respectively.

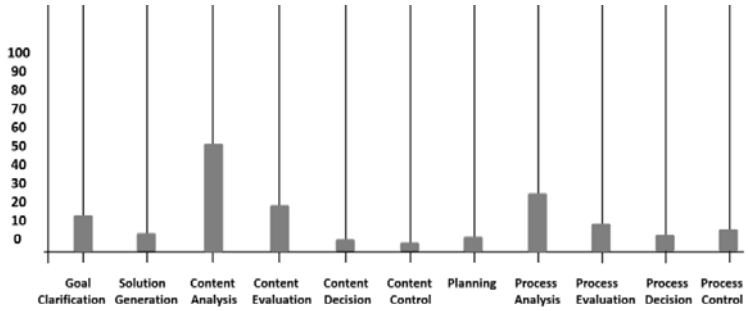

Figure 2. An Average of the Eight Groups' Frequencies of Steps

In general, the goal area accounts for around 13% of team communication, 59% is about the solution area, and 28% is about the group process. In terms of the solution space, the observed teams rely mostly on two important operators: analysis and assessment, which have the largest quantitative significance. Despite the large diversity in the overall number of recorded communication actions among the eight groups, as discussed previously, the distribution of communication activities among these groups is notable for its constancy. In terms of the absolute frequency of communication types, the studied design groups' thought processes varied just little. However, it is worth emphasizing that there are observable disparities in the groups' approaches and activities, which cannot be entirely explained by the aforementioned findings. By analyzing design steps from a micro perspective, two-step sequences of these steps were investigated. The goal was to see if team communication follows a 'chaotic' pattern in which any sequence of design processes is likely to occur, or if there are consistent patterns in which one step systematically follows another specified one. To answer this question, the transition probabilities between all steps were computed and compared to the baselines of the stages. For instance, if content analysis occurs in 35% of all team communications, and in 65% of those cases, another content analysis follows, it indicates a high likelihood of content analysis sequences in team communication. A Chi-

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square test (see Figure 3) was used to determine the significance of the observed transition probability in comparison to the baseline categories.

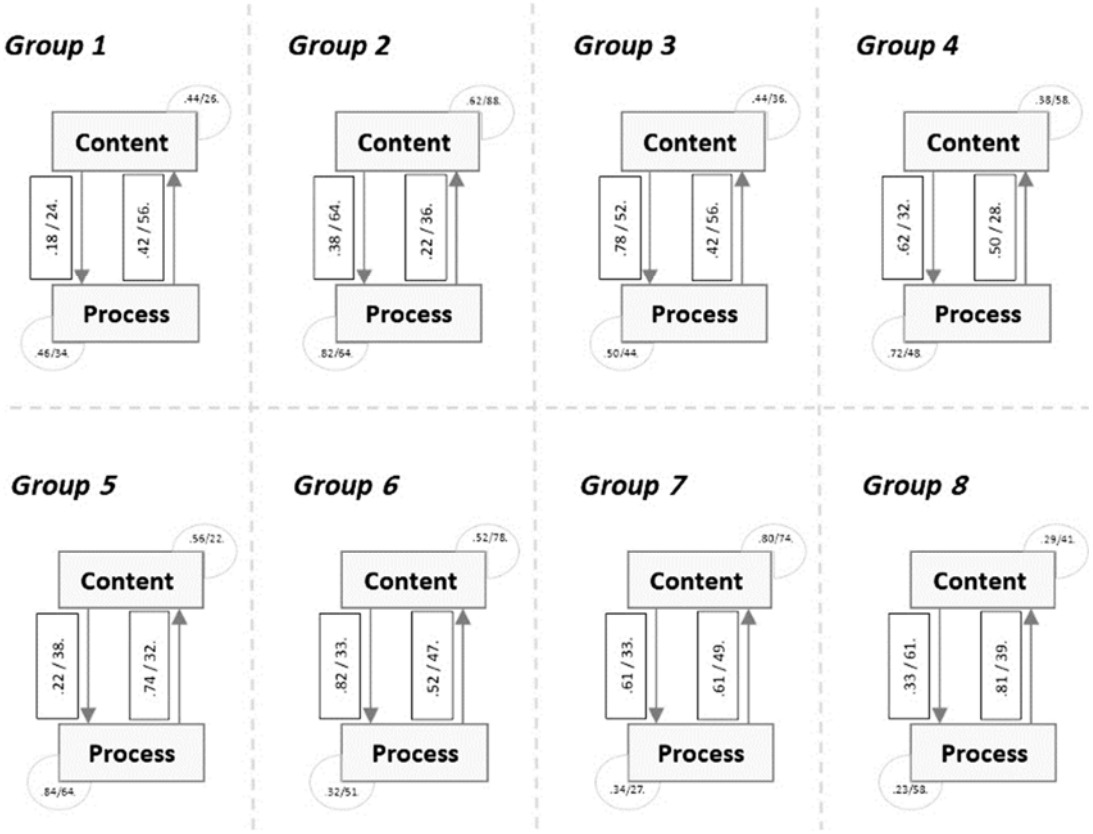

Figure 3. Alterations From One Activity Focus to Another

The graph above displays the transition probabilities in the eight groups between the two communication foci, content, and process. In this graph, an arrow at the end of a link represents a transition that, according to a Chi-square test, is more likely to occur than the base rate. A straight line near the end of a connection, on the other hand, indicates a less likely changeover than the base rate. The transition probability is represented by the first number connected with each link, whereas the base rate probability is represented by the second number. There is a high likelihood of a transition within the same focus of activity in all eight categories, but a shift to the complementary focus of action is exceedingly unlikely. With a $p<0.5$ level of significance, these findings hold true for all eight teams analyzed. When teams are working on either content or process, they tend to keep their communication concentration for a long time before shifting to the complementary focus. On average, the eight teams spend 10.41 communicative actions on content-related communication before transitioning to process-related communication. Process-related communication sequences, on the other hand,

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last an average of 6.61 communicative activities. These findings show that the team's design process is defined by a continual intermixing of content-directed and process-directed sequences, each of which lasts a certain amount of time.

The alterations between distinct design phases were examined at the design step level by the eight teams. By emphasizing the design process, the study focuses entirely on content-directed communication in the subsequent analysis. A noteworthy discovery is that, with the exception of the 'decision' step, all design phases have a high possibility of shifting inside the same step. This implies that the proposed design processes do actually serve as discrete stages, as teams often engage in many communication actions within each step before moving on to the next. Moreover, there exists a noteworthy feedback loop involving analysis and evaluation. This iterative loop of analysis and evaluation appears to form the essence of the collective thinking process within the observed teams. As mentioned previously, analysis allows the teams to expand the solution space, while evaluation helps to refine and narrow it down once again. The continuous interplay between analysis and evaluation potentially enables design groups to maintain the solution space's size within a permissible range.

DISCUSSION

The findings of this study revealed, via observations and examination of the two initial and final tests, that the objective of design is to find the answer to the issue rather than to create a solution. Instead of personal thinking, it is feasible to arrive at a logical response that is accepted by all group members by participating in the group and discussing the group members. Furthermore, the results revealed that in group work, the time spent on goal clarification, solution creation, analysis, and evaluation may increase, while the time spent on decision-making remains nearly constant and the time spent on control is reduced. Based on these findings, it is possible to conclude that the amount of time spent on group activities and the interplay of thoughts, idea generation, and other procedures that need group collaboration rather than division of labor will rise. Instead, in the process of group work, the portions of group work that were merely in the form of division of task and performing it independently are diminished. In several cases, the groups were unable to obtain a consensus solution in the preliminary test, which was considered invalid according to the test guidelines.

The process of creating in group work was compared between first- and fourth-year students, according to this paper. The author's observations and evaluations show that the role of the leader in the group, pushing the goals, and organizing the members in the work schedule has a significant impact. Final year students coordinated substantially better in group projects than first year students. Students in their last year demonstrated a higher quality design approach. The first-year students were involved in one-on-one brainstorming and were busy expressing their thoughts to others; nonetheless, the ideas were integrated by the final-year students. The

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important element to note is that first-year students who had a common geography, or a history of friendship were more successful in transferring mental notions. When compared to the final year students, the disparity in the findings of the groups from shared and non-shared climates was more colorful among the second-year students. In other words, geographical factors became less important in the final year students because they were all together for a certain period of time in the same course, and previous group work also helped to establish communication in the groups, especially in the case of a specific group. It was evident among the students who had completed the group design experiment as part of an educational assignment. Finally, considering that after the architectural training period and beginning professional work, the need for teamwork and cooperation with other engineers and others is felt; thus, expert training in this field is useful and as we witnessed in the present article; first, it is possible to do group design and the result of this design can be superior to the result of individual work, and second, effective training can improve this. As a result, paying attention to the subject of group design and teaching it at an architectural school is deemed worthwhile.

CONCLUSION

Looking at architecture as an isolated item causes us to overlook its greater characteristic as a response to human needs. Given that design is based on individual taste and innovation as well as group effort and support for shared ideas, striking a balance between individual thought and cooperation is critical. In group work, each member should endeavor to make the movement of the entire group accomplish a positive outcome rather than looking for monotony and strengthening his words. In this sense, design thinking research, although having particular impacts on training and design training, gives a general view on human thinking as well as a deeper experimental view on the activity of design groups. The main objective of the present research was to investigate how design teams tackle design challenges, specifically focusing on the cognitive processes employed by these teams throughout the process of design. Building upon the notion of four fundamental cognitive operations, namely generation, exploration, comparison, and selection, a comprehensive framework for team-based design activities was proposed. This framework aimed to capture the essence of both problem-oriented tasks and the organization of group dynamics within the design process. To evaluate the efficacy of the model, it was applied to the design endeavors of eight groups comprising architectural students, utilizing a theory-based coding system. Subsequently, an analysis of team interaction was conducted, drawing upon the foundations of the generic model. During the observation of all eight teams, it was observed that approximately 75% of their interaction time was dedicated to addressing the content of the design problem, while the remaining 25% was allocated to managing the group process. These findings highlight the significance of not only focusing on the design problem but also ensuring effective group dynamics within design teams. Consequently, it can be

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concluded that the collective design process is characterized by a continuous intertwining of content-oriented and process-oriented sequences, each with a considerable duration.

An examination of the design teams' activities throughout the design process has revealed that approximately 17% of their content-oriented efforts are directed towards the goal space, while the remaining 83% primarily revolves around the solution space. When engaging with the solution space, teams frequently employ the operators of analysis and evaluation. It appears that an iterative loop of analysis and evaluation constitutes the foundation of the collaborative design process. By continuously alternating between analysis and evaluation, teams effectively manage the complexity inherent in the solution space, thus ensuring a manageable design process. The findings presented in this study hold significant implications for design education and practice. It is evident that a shift towards a more scientific perspective is imperative to advance traditional design methodologies. While conventional approaches predominantly emphasize the final outcome or solution concept, critical aspects of the design process, including the temporal aspects and cognitive efforts invested in concept development, have been overlooked. As a consequence, design methodologies have not been embraced to the extent anticipated by design professionals. In our view, a change in mindset is indispensable for both design methodology and design education to bridge this gap and foster innovation and effectiveness in the field.

The findings of this study provide a solid foundation for the creation of a design process that prioritizes practitioners' requirements and views. In terms of education, it is critical to examine team dynamics as well as the many obstacles that designers face in real-world professional contexts. A more holistic approach is advised rather than focusing simply on teaching designers' specific methodologies, strategies, or tools for structuring the design process. Designers should have a thorough awareness of the different aspects that impact the design journey, as well as the capacity to adapt and think critically to efficiently manage the intricacies of their professional surroundings. Finally, considering that after the architectural training period and the start of professional work, the need for teamwork and cooperation with other engineers and others is felt; thus, the training of experts in this field is useful, and as we saw in the present article; first, it is possible to do group design, and the result of this design can be superior to the result of individual work, and second, effective training can improve this. As a result, paying attention to the subject of group design and teaching it at architecture schools is thought to be worthwhile.

RECOMMENDATIONS

Teamwork activities and projects that might be included into architecture education include collaborative design projects, group presentations, and team-based problem-solving exercises. By giving students opportunities to collaborate, they may build important abilities for teamwork and communication, both of which are required in

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the architectural industry. Educators should be given training and chances for professional development aimed at efficiently supporting cooperation in the classroom. They should be prepared to foster cooperation, manage group dynamics, and offer positive feedback to students who work in groups. This would assist to guarantee that collaboration is introduced and encouraged properly in the school context. As a result, fostering an inclusive and supportive team atmosphere in which all students feel valued and respected fosters varied viewpoints and provides opportunity for kids to express their ideas and contribute to the team's success. This can improve architectural projects' creativity, problem-solving, and critical thinking.

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