

Metaphor and Abstraction as Strategies in Architectural Design using Collage Method*

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ABSTRACT

As understanding the visual arts, the visual ability is one of the main features of architecture students, which has been neglected due to the problems in architectural design education. In the first part of the study, after studying the theorists' opinions, the concepts of metaphor and abstraction were explained using the descriptive-analytical method, and different types of metaphor in architecture were classified into three categories. By introducing the steps in the field survey in the second part of the research, the effect and relationship between the collage practices and metaphor and abstract strategies were studied in the spatial-visual ability of the students in two groups of undergraduate students and researchers. Data collection was conducted using a closed questionnaire and Gardner's multiple intelligence questionnaire and attending the architectural design 2 classrooms of the undergraduate architecture in the college of fine arts, Tehran University, and interviews with the professors of the architectural design in the top university of Tehran. SMART_PLS and path analysis method was applied to analyze the data, indicating that according to both groups, collage practices have a direct impact on the three stated factors in the visual-spatial ability and the type of the offered practices is influential on the communication model regarding the type of the built collage, and a more meaningful and desirable relationship occurs between abstract collages in applying the principles of abstraction to enhance visual-spatial ability. The research results could be practical for introducing this method and abstraction and metaphor strategies in architectural design education.

Keywords: Metaphor, Abstraction, Visual-Spatial Ability, Collage, Architectural Design.

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1. INTRODUCTION

The design process is a set of stages that consciously or unconsciously an architect goes through to achieve the design or an idea. Meanwhile, metaphor design or using abstraction principles is one of the strategies of creative design. The collage method is one of the methods that proceeds in architectural design through the visualization process. In the collage method, the sense of the place is expressed visually using the mind's function. Different places create different mental images in individuals, resulting in different perceptions of the space. Human perceptions originate in the meanings and are perceived through interpreting the mental associations. These mental images that display themselves in the collage method using implicit memory are an influential factor in enhancing the visual-spatial ability.

John Lang knows the capacity to innovate potential solutions as the characteristic of innovative designers. Among the studies conducted in this regard is the recognition of design process from various aspects, some of which are as follows: in a paper entitled "Architecture as an Image", in Xerox University, Tang studied the emittance of mages in the architecture beyond their functional role and emphasized the role of the images in representing the architecture to convey the message (Tang, 2019). In this regard, Ralf Weber has conducted effective studies entitled "Teaching Color to Architecture Students". In the exercises performed by him, the search for the initial idea in the architectural space simultaneously occurs with light, color, and texture, and from the very beginning, a desirable space is formed with the help of light and color (Weber & Kanthak, 2017). Then, in a paper entitled "Possibilities in Post-Digital Architecture", it is stated that how an architect uses the architectural images to create the space has a structure beyond a two-dimensional space (Horn, 2017).

Davis, in a paper entitled "Arts-Based Representation in Qualitative Research: Collage as a Contextualizing Analytic Strategy", pointed out the importance of collage in qualitative research, providing proper conditions for an analytic strategy using ambiguity and multidimensionalization (David & Butler-Kisber, 1999).

In another paper entitled "Pictures for Designing Architecture, Architecture for Designing Pictures", it is pointed out that manipulating photos is used as an intermediary for architecture projects. Manipulating photos create various sensory and semantic aspects to meet the artistic and architectural goals (Magagnini & Sardo, 2017).

2. RESEARCH HYPOTHESIS

It seems that collage exercises lead to improving the visual-spatial ability through improving the perception of the space by abstract and mental images.

3. RESEARCH METHOD

The current paper studied the role of metaphor and abstraction and using them in the collage process and its impact on enhancing the visual-spatial ability of the designer. The research method used in this research was descriptive-analytical and based on a comparative approach, and deductive reasoning explained the communication model of collage exercises from theories of different fields of knowledge using metaphor and abstraction strategies.

Collage exercises were used to advance the research, which was conducted in Architectural Design 2 classroom of undergraduate architecture in the college of fine arts, Tehran University, in three consecutive semesters, from October 2017 until February 2018. The current research used direct observation, in-depth interviews, group discussions, and students' manuscripts through consecutive years that were mapped and notes from that exercise at the end of each session. Opinions of the professors of architectural design education were followed up by in-person interviews or sending questions online.

These exercises included reading space from collages through drawing croquis and changing the perspective, extracting the three-dimensional space from two-dimensional collage through making maquette, and processing the spaces by analyzing. At the beginning of the semesters, Gardner's multiple intelligence questionnaire was used to assess the spatial-visual ability of the students. Then, by conducting particular exercises of collage and teaching metaphor and abstraction in design throughout the semester, the effect of these strategies on enhancing the students' visual-spatial ability was investigated. The statistical data of the research were then analyzed using SMART_PLS and SPSS software, and the graphs related to Gardner's questionnaire were extracted.

4. LITERATURE REVIEW

Design is a complicated mechanism of creative and rational practices, resulting in subjective and objective activities of the designer. There is no either proper unique method or a single path in its process. Finding a proper answer to how the architecture is created requires a profound perspective on the broad range of concepts and approaches.

4.1. Collage Method¹

Many studies have been conducted on the role of collage method in education so far. Many of these studies believe that the collage method enables the teachers to use the students' potentials in this method and results in more creativity in students (Hernández-Leo, Villasclaras-Fernández, Asensio-Pérez, Dimitriadis, Jorrín-Abellán, Ruiz-Requies, & Rubia-Avi, 2006). The purpose of the current study was to introduce the metaphor and abstraction strategies in collage method that its different aspects were explained

in the following.

There are two key purposes in the collage method:

- A) Fostering the creativity
- B) Increasing the self-esteem

In this method, an images-based work is achieved

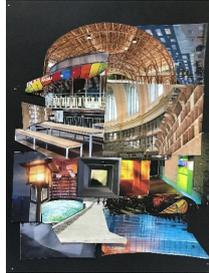


Fig. 1. Collage in Architecture

through the sequence of the subjective creativities, objective perceptions of the abstract and transferable images to others using three-dimensional simulation result of which is a work, which is directly related to the designer's perspective, thought, and power of imagination (Adibi & Karimi, 2008) (Figs. 1 & 2).



Fig. 2. Architectural Collage, Subject: Elementary School
(Sepideh Haji Mahmoudzadeh)

4.1.1. Role of Implicit Memory in the Pursuit of the Collage Approaches

A human being's awareness of his/her environment starts from birth or even before being born. The human interacts with the environment through personal and individual experiences. The information received from the environment is obtained through perpetual processes that are stimulated by mental schema (Hasan Zadeh, Forghanifar, & Ghiasi, 2015). Our implicit memory assesses objectivity and subjectivity, which considers something desirable or undesirable. It can be said that the mental image of the implicit memory is the reflection of the environment in the individual's mind who can extract a part of that by providing a proper condition based on his/her need (Adibi, 2008). A great part of our mind's resources is the visual resources that are in every person's explicit and implicit memories of every person. These images are the repetition or the product of processing the current reality. Our "explicit memory" contains images volume of which depends on our visual experiences. However, the images of "implicit memory" are the innovative aspect of our personality that is not manifested, except for special conditions. When introducing the explicit memory using visual collages, Jetchev states that using collage method performed by cutting and sticking the images, new methods are provided for artists to create collage with the help of the explicit memory algorithm (Jetchev, Bermann, & Yildirim, 2019).

5. METAPHOR AND ABSTRACTION IN DESIGN

The conceptual metaphor was first introduced by George Lakoff and Mark Johnson in a book entitled "Metaphors We Live by". Metaphor is a natural connector between language, thought, and approach for architects to design.

5.1. Metaphor

Metaphor is adopted from Meta in Greek (means after) and Phero (in Greek means conveying). The human nature of architecture can only be perceived by defining its metaphorical, subjective, and expressive nature. In terms, metaphor means to borrow. Metaphor forms a thought, which can complement the reason or bypass it. Two beings are creatively connected to form a new being. This new being is similar to its parents in terms of genetic features (Turner, 2014). The most important role of the metaphor in architecture is to help the process of creativity in architecture as a means to foster the imagination through which improves the unconscious activities of the mind and affects the "production of the theme". The metaphor unites the mental processes by using "imagination" and affects the creative effort put in the designer's mind to organize the design problem and produce the theme (Mahmoudi & Bastani, 2018). Metaphors and analogies determine the relationship between the phenomena. According to McGinty, when the relationship between the design and a phenomenon is abstract, this design method can be considered metaphorical or analogical design. Metaphor and analogy seek to receive an indirect and parallel relationship. In the metaphorical method, when we shift our concentration from one area to another, we consider a subjective or objective matter as if it was another subject or when we try to change the implications from a subjective or objective subject to another subject, we proceed to metaphor. The metaphorical concepts can be tangible, intangible, or combined. The intangible metaphor occurs when its origin is a type of concept, idea, humane state, or particular quality. The tangible metaphor is created when its origin is some of the visual or material features, and the combined metaphor includes both of these origins simultaneously (Fig. 3).

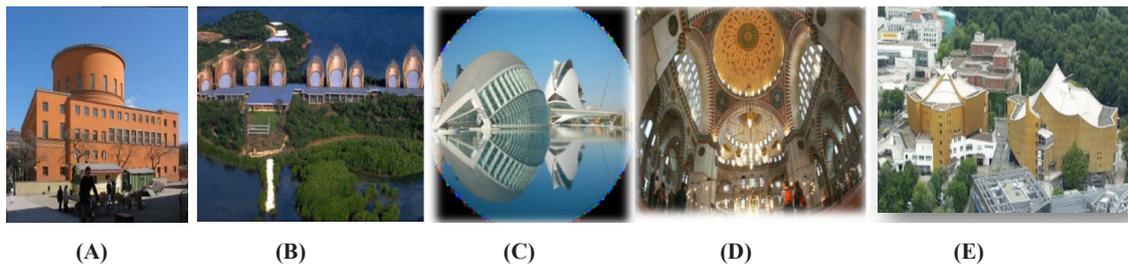


Fig. 3. Different Types of Metaphor. A) Berlin Philharmonic Designed by Hans Scharoun, 1963; B) Hagia Sophia, Byzantine Period, 553; C) City of Arts and Sciences, Valencia, Spain, Designed by Santiago Calatrava, 1996; D) Tjibaou Cultural Centre Designed by Renzo Piano, 1991; E) Stockholm Public Library, Designed by Gunnar Asplund

5.2. Abstraction

In terms, abstraction means removing the extra details and emphasizing the particular attributes of a visual object. Abstraction includes extracting the essence of the numerous visual factors and the required and more general features than what is displayed. Wassily Kandinsky is known as the pioneer of abstract art. Kandinsky considered abstract art the art of the future (Mahmoudi & Bastani, 2018). In an abstract image, unlike the code or symbol, it is not required to have a specific external meaning. If we simplify what we see to some extent that only its initial elements remain, it is called abstracting the images, and its importance is much more important to understand and construct the visual messages. The more the simulation in visual

news, the more specific and limited will be the contents that are perceived from that. Also, the more abstract, the broader and more general is its contents (Usal & Evcil, 2017).

5.2.1. Abstraction in Visual Subjects

Abstract art is a kind of personal experience of the artist in expressing emotion, in which there is less sign of reality. In this method, the relationship between the visual elements includes a set of lines, colors, and forms that maintain their harmonic relationship and achieve a type of visual aesthetics rather than containing a visual message for the viewer. The concept behind the lines and colors is such that every viewer must rely on their personal perceptions to understand it (Fig. 4).

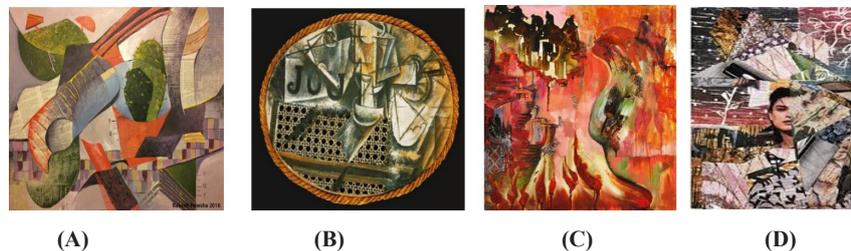


Fig. 4. Modern Art. A) The Art of Painting is an Abstract Interpretation of the Image; B) Modern Art Lou Gallery; C) Collage Art of Pablo Picasso, Abstract Art; D) Modern Art, a Combination of Abstract Images

6. THE IMPORTANCE OF SPATIAL-VISUAL ABILITY IN ARCHITECTURE STUDENTS

Since the ability for understanding the visual subjects, the recognition and perception of the visual patterns, and the proper use of the spatial models are the requirements of education and improvement of the abilities of architecture students and this ability empowers the person to recognize the details, visualize and change the visual objects mentally, the current study tried to introduce an effective method to improve this component.

This field includes manipulating the images, visualizing the different images in mind, recognizing the differences of the very similar objects, interpreting the visual images, and good and excellent sense of direction. In this regard, in a paper entitled

“Connections between Spatial Ability and Visual Imagery Preference”, the importance of visual-spatial ability in architecture education was emphasized. Also, using two types of images, the images of the objects and spatial images, this paper explains that the spatial ability has a stronger correlation with the practices of the spatial images (Csikos & Kárpáti, 2018) (Fig. 5).

In another paper, “The Relationship between Cognitive Style and Visual-Spatial Intelligence of First-Year Architecture Students”, it was stated that creating new designs often requires three-dimensional visualization. The cognitive styles of architecture students play a significant role in design education. Students with local cognitive styles have better spatial-visual ability than other students due to paying attention to the details and drawing the landscapes (Yazici, 2017).



Fig. 5. The Selected Images Based on Implicit Memory

7. STEPS OF COLLAGE METHOD

In education sessions, the different steps are pursued as follows:

1. Communication with the professor, method, and explaining the program; 2. Selecting the pieces; 3. Entering the collage area; 4. Understanding and

recognizing the images and analyzing them; 5. Drawing croquis from the images; 6. Making the maquette and conveying the collage space from the subjectivity to the objectivity; 7. The main foundation of the design and achieving the initial sketches; 8. Complementary step (Fig. 6).

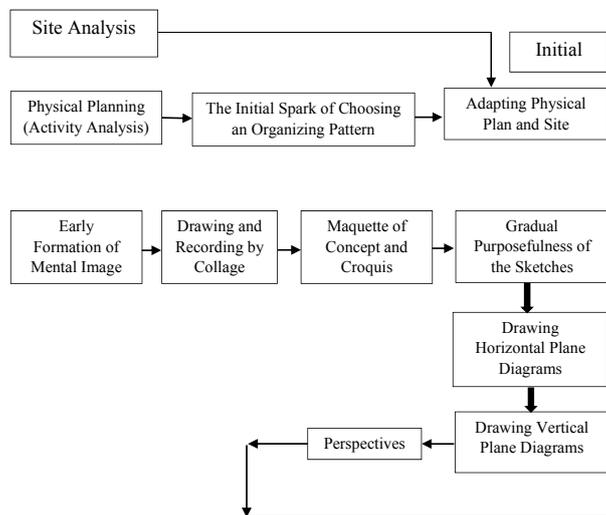


Fig. 6. Design Process Based on Collage Method; Turning the Idea into the Design in Collage Method

7.1. Communication with Professor

In the first step and communication with the professor, his presence is to give confidence about the subject and

eliminate the weakness and give freedom of action and answer the questions in a way not to limit the mind and is only solving (Fig. 7).



Fig. 7. Communication with Professor, Review Session

7.2. Selecting the Pieces

The selected images by the students are originated from the most profound and inner feelings and thought, and being honest with the unconscious is involved in

selecting the images. The images must be expandable to construct the final image. Selecting an artistic image is an existential encounter that changes our sense of being in a moment (Robinson & Pallasmaa, 2015). According to Peter Zumthor, as it seems, we are

programmed by a common image before birth, and our image archive is being formed from the beginning,

like the five-year-old children all over the world who always draw the same image of a house (Figs. 8 & 9).



Fig. 8. Drawing by Erica Lagous: Mozambique

(After Civil War, in 1938, The Spanish Child Welfare Association of America Records Published this Drawing (Mind in Architecture) (Robinson & Pallasmaa, 2015)



Fig. 9. A kid's Drawing in Spain

7.3. Entering the Collage Method

The arrangement of the photos is based on the extension of the lines of each image, proportion, the proximity of the components, color, color harmony or their contrast

to be put together, and textures (Figs. 10 & 11). Embracing everything that comes to the mind reveals a form of attention recognized as open consciousness. The experiments point out that this kind of attention is the origin of our most creative thoughts.



Fig. 10. Forming Collage

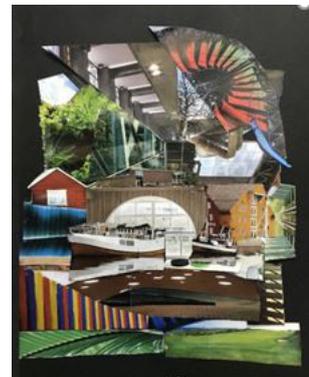


Fig. 11. Forming Collage

(Collages Built by Sepideh Haji Mahmoudzadeh)

7.4. Recognizing and Understanding Images and Analyzing them

Collage is analyzed in terms of texture, color, paper, and perspective, and is a way to start making maquette. At the beginning of the analysis, a distance must be created between the images using software, and then analysis begins. Studying the materials, investigating the prominent colors in collage, using natural light, analyzing the openings, the light shed on the floor

of the spaces indicating that a part of the space in collage does not enjoy ceiling, there are many open and semi-open spaces in the collage. Analyzing the natural components, the concentration points of the green space, analyzing the floors, vertical circulations, form, smooth and sharp edge surfaces, analyzing the prominent element, analyzing the depth of spaces, and using the view and landscape of the surrounding environment and sky are applied in analyzing the collage (Table 1).

Table 1. Analyzing Collage

Abstract Collage		Color Analysis	
Analyzing the Heilight Difference		Skylights	

(Analyzing Collage from Different Aspects, Mohammad Hossein Karimian)

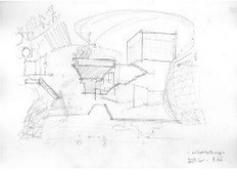
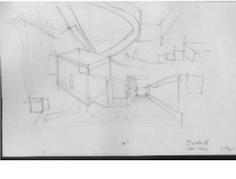
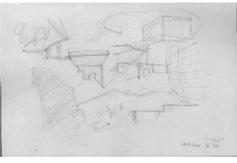
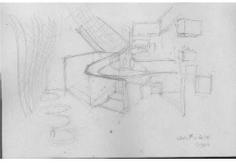
7.5. Drawing Croquis from Images

Croquis exercise is a practice in the short term to draw the totality of the collage and read space by different people from a specific collage. This exercise helps to clarify, in some places, the space that was formed in the collage maker's mind and was not seen at all, in others, parts of the collage that have not been resolved and are a little meaningless. The croquis of other people from a specific collage causes, to a large extent, the desired collage to be better understood and the space to be dissolved. Croquis shows that the images that were created have new meanings, and an inseparable integrated whole is built. By investigating the croquis, the elements are repeated that form the spatial totality, and by studying them, the best space occurs, and the architecture plots are gradually formed. When space is repeated in a croquis, it can be assumed that those spaces must have definitely existed. The difference in croquis might trace to each person's subconscious and how space is perceived in general. The difference in croquis might be due to the difference in perspective and sitting position.

7.5.1. Changing the Perspective while Drawing Croquis From Collage

In order to perceive the abstraction and read the space from the collages, the change in the perspective from the croquis was considered an exercise. Five exercises were conducted on the three selected collages. These exercises were to perceive the change in the perspective in perceiving the space by the drawn croquis from the collages of the practice (Table 2). Exercise 1 was conducted for preparation. In Collage exercises 3 and 4 from a fixed collage, the students' place was changed and croquis was drawn from collages at a specific time. However, since these exercises were conducted subsequently, the changes were intangible. In exercises 2 and 5, which were conducted from a fixed collage yet with more time intervals, the changes in the perspective were entirely tangible. The selected collages in this exercise were all realistic. If the abstract collages were used, the spaces would be read differently. The exercise of drawing croquis from the collages to read the space will be effective as an exercise on the spatial-visual ability of the architecture students.

Table 2. Exercise of Changing the Perspective while Drawing Croquis (Changing the Angle View Leads to Read More and Different Spaces in the Collages)

Collage 1	Collages 2 and 5	Collages 3 and 4
		
		
		

(Croquis Drawn by the Students of College of Fine Arts from the Selected Collages)

7.6. Making Maquette and Transferring the Collage Space From Subjectivity to Objectivity

This step of the collage process has had a significant impact on the spatial-visual ability and was successful in turning the subjectivity into objectivity. The embodied simulation by the mirror neurons of the brain happens in the brain. For example, by examining the façade of the Cathedral of Santa Maria del Fiore, they noticed how the proportions of this building change the breathing and make it slow and impose definite pressures on the feet and head. The twisted column can

stimulate the tension situation in our bodies; because our mirror system intrinsically simulates the twist of the column. The mental image of the students is displayed in making the maquette. This exercise is merely a translation from the produced two-dimensional abstract image by the student (Fig. 12).

The visual abstract, ambiguous, and incomprehensible spaces are translated by the student's recognition and the general schema results. In making the maquette, simultaneously establishing a relationship between the spaces and the sense of collage method is very

tricky. Observing the proportion and dimensions requires a long way in making the maquette. Since the full description of the collage method is not a matter

of the current research, and the purpose is to enhance the visual-spatial ability of the students using collage method, the last step has been omitted.



Fig. 12. Draft Maquette (Process of Maquette Making)
(Adibi, 2008)

8. DATA DESCRIPTION

Library studies on the subject literature showed that in the collage method process, the selected images in the “initial perception” are formed in the collages construction stage using the metaphor and abstraction strategies in the visual stimulus, and information interpretation in “reasoning” turns into intellectual models in “imagination (unconsciousness) by various practices, such as drawing croquis from collages, analyzing and making maquette. The purpose of the survey study is to study the metaphor and abstraction strategies in the collage method. The research sought to discover a conceptual model and the effect of architectural design education using collage method on enhancing the visual-spatial ability of architecture students.

8.1. Statistical Population, Sample Size, and Sampling Method

Sampling was conducted using a stratified sampling method of the statistical population involved in the

architectural design process. The first class included the students who are taking the architectural design 2 courses using this method in the School of Architecture of College of Fine Arts in Tehran University. The research was conducted over three consecutive semesters from October 2017 until February 2018 by direct observation and in-depth interviews and group discussions and studying the students’ manuscripts over consecutive years who took notes at the end of each session and their perception of the mentioned practice. The second category is the views of professors in the field of architecture design education regarding the exercises of the collage method in the top universities of Tehran. Since the number of students in this course is very high, the number of statistical samples was considered to be the maximum of Cochran's formula, i.e. 380 samples out of which 90 samples were allocated to students during three consecutive semesters, 278 samples were allocated to students 'manuscripts of previous years, and 12 items were allocated to professors' opinions.

Table 3. The Questions of the Closed Questionnaire (Evaluating the Effect of the Collage Method on the Spatial-Visual Ability Using Abstraction and Metaphor Strategies)

Exercise of the Collage Method	Spatial-Visual Ability		
	Interpreting the Visual Images	Visualizing the Various Visual Images in the Mind	Manipulating the Images
Selecting Images from the Implicit Memory into the Collage Area	When making the collage, the images are selected freely and without any rules and lead to...	There is no obligation in selecting only architectural images and leads to ...	Selecting the images is based on the personal characteristic of each student and indicates ...
	There is a special moment in finishing the construction of collage and indicates...		The arrangement of the images together is conducted through...

Exercise of the Collage Method	Spatial-Visual Ability		
	Interpreting the Visual Images	Visualizing the Various Visual Images in the Mind	Manipulating the Images
Drawing Croquis and Changing the Perspective (Reading Space Through Collages)	In croquis exercise, reading the spaces in the collage leads to...	The three-meter distance between the collages for drawing croquis is due to.....	Different people's croquis from a fixed collage causes...
Analyzing the Space From	Placing characters in collages when exploring space is due to ...	Analyzing the images and interpreting the materials, color, light, darkness, and depth leads to ...	The use of collage filming tools in the analysis stage leads to ...
Extracting the Three-Dimensional Collage from a Two-Dimensional One through Making Maquette	Exercise of making draft maquette of collage in the initial stages leads to....	Selecting appropriate materials with the used collage when making the maquette leads to...	Taking heights and depth of the space in making the maquette from the collage leads to...
	Observing proportions in making the maquette is an attempt to...		
Abstraction and Metaphor Strategies			
The Metaphor is "When we Shift our Focus from One Realm to Another and Look at the Subjective and Objective Subject as if it were Another Subject."			
Tangible Metaphor	In design process using collage method the initial origin of each step is a type of concept, humane state or a special quality and leads to ...		
Combined Metaphor	In design process using collage method, the initial origin of each step is the visual-material feature, which is a means to reveal the superiors, qualities, and specific visual form characteristics, leading to...		
Abstraction is removing the extra and focusing on the specific attributes of the visual object (extracting the essence of the visual object)			
Realistic Collage	In reading the space from collage or making the maquette, drawing croquis leads to...		
Abstract Collage	Due to its higher semantic concept, it leads to ...		

8.2. Research Question

1. How do the metaphor and abstraction strategies in the collage method in architectural design lead to

enhancing the visual-spatial ability of the users?
2. How do the exercises adopted from collage method lead to enhancing the students' visual-spatial ability?

8.3. Information Collection Tools

The field survey was conducted using a closed questionnaire at the beginning of each semester from October 2017 until February 2018. This questionnaire contained 22 items, out of which 17 items were allocated to evaluating the exercises of the collage method steps, and five items were assigned to the abstraction and metaphor strategies. The questions of the questionnaire were presented in Table 3. In the current study, given that the questionnaire is researcher-made, convergent validity and divergent validity were used to confirm

the validity of the questionnaire. The Average Variant Extracted must be more than 0.5 for convergent validity. In divergent validity, it is necessary that for each of the reflective latent variables, the root mean square of variance is more than the correlation of that structure with other structures. Two criteria of Cronbach's alpha coefficient and composite reliability coefficient were used to determine the reliability of the measurement tools. Cronbach's alpha coefficients of all variables in this study are more than the minimum value (0.7). Table 4 presents the results of the reliability and validity of the measurement tool.

Table 4. Convergent Validity (Reliability of the Measurement Tool)

Research Variables	Average Variant Extracted			Composite Validity Coefficient			Cronbach's Alpha		
	Interpreting the Visual Images	Visualizing the Various Visual Images in the Mind	Manipulating the Images	Interpreting the Visual Images	Visualizing the Various Visual Images in the Mind	Manipulating the Images	Interpreting the Visual Images	Visualizing the Various Visual Images in the Mind	Manipulating the Images
Selecting the Images From the Implicit Memory and Involve them in the Collage									
Drawing Croquis and Changing the Perspective (Reading the Space From Collage)	0.79	0.63	0.68	0.87	0.88	0.86	0.81	0.78	0.76
Analyzing the Space From Collage	0.81	0.7515	0.6843	0.8887	0.8606	0.8666	0.9367	0.7854	0.9331
The Collage of the Extracted Three Dimensional Space From the Two-Dimensional Space by Making Maquette	0.78	0.67341	0.8324	0.9477	0.8984	0.9520	0.8045	0.7725	0.8332
Tangible Metaphor	0.88	0.8041	0.7473	0.9392	0.9392	0.8940	0.7815	0.7731	0.7731
Intangible Metaphor	0.68	0.814	0.8086	0.8941	0.8941	0.9356	0.879	0.8031	0.8322
Combined Metaphor	0.89	0.6731	0.8790	0.8975	0.8996	0.9232	0.7702	0.8035	0.8036
Realistic Collage	0.8142	0.6936	0.8558	0.8925	0.8975	0.8854	0.7721	0.7739	0.8321
Abstract Collage	0.8856	0.7517	0.8020	0.8751	0.8475	0.8895	0.8798	0.7801	0.7816

9. DATA ANALYSIS AND CONCLUSION

Research findings included two parts of descriptive statistics and inferential statistics. The descriptive statistics were conducted using SPSS software to answer the first question of the research regarding the effectiveness of the metaphor and abstraction strategies in collage method in the architectural design, which leads to enhancing the visual-spatial ability of the users.

To this end, at the beginning of the semester, the multiple intelligence value of the students was evaluated using Gardner's multiple intelligence questionnaire, and at the end of the semester, it was reevaluated. The obtains results were presented comparatively in Figure 13. The graph shows that the education using this method affected the most abilities of students and its effect was considerable on their visual-spatial ability.

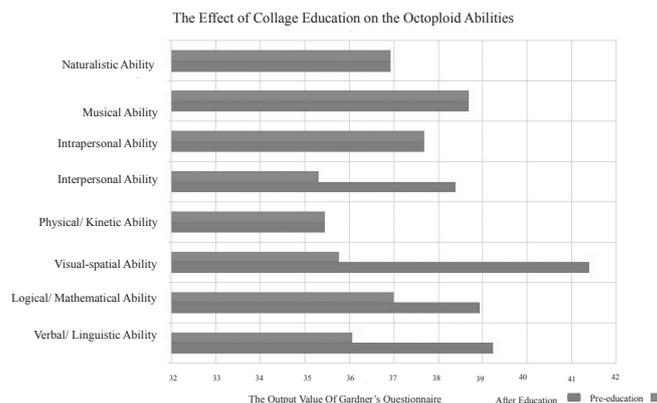


Fig. 13. The Graphs of the Multiple Intelligences (The Comparative Graphs of the Output of the Gardner's Questionnaire)

In the second section, to discover the communication models, Structural Equation Modeling was used to analyze the data. The software used in the current research was SMART_PLS, which applies Partial Least Squares to present the structural equation models. Given the interpretive pattern in the structural equation modeling, if the t-statistics value related to a path is more than 1.96, it can be said that the related path is significant at the confidence level of 95% and the hypothesis related to that path is confirmed. In the following, given the information obtained from Model test (Table 5), each of the research paths is investigated separately. The relationship between the collage method exercises and the variable of spatial-visual ability is confirmed; because the significance level obtained from the fitness of the structural model for this path equals 0.000, which is lower than 0.05. On the other hand, the significance value obtained from this coefficient equals 6.73, which was obtained from 1.96. Thus, it can be said that the effect of the collage method

exercises on the spatial-visual ability is confirmed at the error level of 0.05 and confidence level of 0.95. The relationship between the collage method exercises and the metaphor strategies is confirmed; because the significance value obtained from the structural model fitness for this path equals 0.0000, which is lower than 0.05. On the other hand, the significance value obtained from this coefficient equals 6.15 obtained from 1.96. Thus, the effect of the collage method exercises on the metaphor strategies is confirmed at the error level of 0.05 and confidence level of 0.95. The relationship between the collage method exercises and abstraction strategies is confirmed; because the significance level obtained from structural model fitness for this path equals 0.000, which is lower than 0.05. On the other hand, the significance value obtained from this coefficient equals 11.95 obtained from 1.96. Thus, it can be said that the effect of the collage method exercises on the abstraction strategies is confirmed at the error level of 0.05 and confidence level of 0.95.

Table 5. The Summary of the Results of Hypotheses (According to the Standardized Coefficients and Significant Coefficients)

Independent Variables	Dependent Variables	Standardized Coefficients	Significance Coefficients	Statistical Result
Collage Exercises	Visual-Spatial Ability	0.510	3.44	Hypothesis is Confirmed.
Metaphor Strategies	Visual-Spatial Ability	0.508	6.15	Hypothesis is Confirmed.
Abstract Strategies	Visual-Spatial Ability	0.650	11.95	Hypothesis is Confirmed.

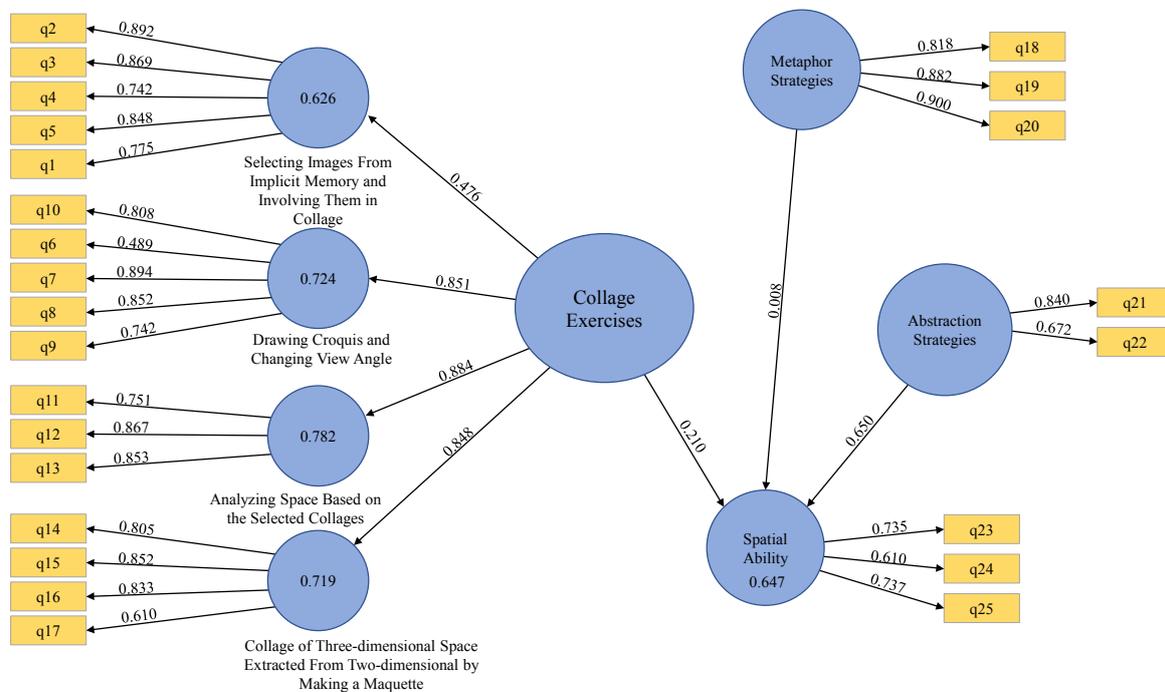


Fig. 14. Graphic Classification of the Research Variables

10. CONCLUSION

Regarding methodizing the design practice in creating a built environment, especially architecture, using the visual perception of the form in producing the space has been introduced by many scholars. Geoffrey Broadbent, Anthony Ward, and McGinty identified the application-based, schematic or typical, analogical or metaphorical, combined or geometrical methods in creating the space in different historical periods. What most scholars of the design process align with is the existence of at least two stages of exploration and integration in this process. Meanwhile, as an experience-oriented design method, the collage method tries to facilitate teaching this method to the learners by introducing thematic exercises and allowing the influence of spontaneous thought in planned thought in two stages of analyzing and integration. In this method, different areas of intelligence are allowed to work together and simultaneously.

The findings of the current research are in line with the results of studies conducted by Vijay Kumar, who introduced a model of the design process at the HITS Chicago conference. He recalls the innovation in the design process as jumping from “perception” to “concept” or from “I see” to “I find out” and there is a “moment” in collage method after which other built

collages cannot be manipulated. It is a special moment in the exercises of this method, and achieving the final design is done by intuition.

The results obtained from the quantitative section of the research conducted among the students and the manuscripts of the previous students and researchers of this area indicate that there is a significant relationship among the research variables; for example, there is a significant relationship between the collage method exercises of “selecting images, analyzing, drawing croquis, and maquette making” to effect and enhance the visual-spatial ability of architecture students using abstraction and metaphor principles. This relationship was identified by recognizing the direct impact on three principles, manipulating images, visualizing the different visual images in the mind and interpreting the visual images, which are the features of the visual-spatial ability. In particular, the abstract collages, which is the extracted essence of the numerous visual factors and the more required and general features of what is displayed are influential in enhancing this ability. What often happens in the architectural design process using collage method is the relationship with the sense of the environment, which becomes stronger, and with the central approach of space and the use of principles of abstraction, the promotion of visual-spatial ability occurs.

END NOTE

1. Collage Method: Collage used in the current research is originally French.

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