IDA: International Design and Art Journal
ISSN: 2687-5373
Volume: 5, Issue: 1 / 2023

Research Article

Investigating students' challenges in learning architectural design process

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Received: 08.02.2023
Accepted: 12.04.2023

Citation:
Khaleghimoghaddam, N. (2023). Investigating students' challenges in learning architectural design process. *IDA: International Design and Art Journal*, *5*(1), 87-98.

Abstract
Architectural design education is one of the curricula taught at different levels and requires identifying factors that influence students' design process. Meanwhile, learning styles and reflective thinking are two variables influencing the design process. Matching teachers' teaching styles with students' learning and thinking styles strengthens the design product. The present study aims to investigate the relationship between reflective thinking and learning styles with the design ability of architecture students. The method used is descriptive-analytical and descriptive-correlative. Accordingly, the preference of 140 architecture students from Tehran Azad University and Konya Technical University for Kolb's learning styles was investigated. In this respect, Kember and Leung's reflective thinking questionnaire was used for the four components of habitual action, understanding, reflection, and critical reflection, and Kolb's learning style questionnaire was used for the four components of divergent, convergent, assimilative, and accommodative learning styles. The results showed that there was a direct relationship between reflective thinking and students' design ability. In other words, with reflective thinking and intellectual ability, appropriate prediction for architectural design can be achieved. In addition, design ability is related to the student's learning style.

Keywords: Reflective thinking, Learning style, Design process, Design product, Architecture student

Extended Abstract

Introduction: Education in the field of architectural design is considered the most controversial issue in the development of the educational plan. In this regard, the important task of architectural education is to create comprehensive thinking that allows architecture students to enter the design process. Since students are different in terms of their individual characteristics, a major point of pedagogical mistakes is ignoring students' abilities and inclinations (Labib et al., 2019). In this regard, architecture students' knowledge of "thinking processes" and "learning styles" is considered as one of the most effective factors. Clara (2015) suggests "Reflective Thinking" as a significant concept for education and learning. DeWitt et al. (2016) consider "Reflective Thinking" as the fundamental purpose of learning. Therefore, with the aim of professional development and training of qualified designers, it is necessary to review and evaluate the education of the design process based on the level of reflective thinking in the educational planning of architecture schools (Karvan, 2021). Learning styles are proposed as another influential variable in architectural education, which refers to the differences between people in learning methods (Faizi & Dezhpasand, 2019: 149). Considering the importance of thinking styles, learning methods, and referring to these talents for the profession of architecture and especially for the design process, it is necessary to understand them properly.

Purpose and scope: The present study aims to investigate the relationship between reflective thinking and learning styles with the degree of student progress in the design process and design products. In this context, to achieve the research objectives, it seems necessary to evaluate and answer the following questions: Is it possible to predict the design product, including the content, method, and design evaluation of students with reflective thinking and different learning styles? Is there any relationship between reflective thinking and students' design products? Are there any relationships between students' learning styles and design products? To answer the corresponding questions, the study first determines the role of intellectual skills, including reflective thinking, on the degree of improvement of students' design product and then examines the relationship between learning styles and design products. To this end, Kolb's (1984) learning style model and Kember's (2008) reflective thinking patterns in student assessment, as well as the relationship between these two

variables and the grade resulting from their design, were evaluated. Then, through the analysis and examination of the theoretical basis and statistical results of the research, suggestions for teaching the architectural design process were presented. In this context, Kolb's learning style model and Kember's reflective thinking patterns were evaluated in assessing students and the relationship between these two variables and the grade they received for their design. Then, through the analysis and examination of the theoretical framework and statistical results of the research, suggestions for teaching the architectural design process were presented.

Method: The present study was conducted using the descriptive-analytical and descriptive-correlative methods. The statistical population of this study includes 60 architecture students at Azad University of Tehran (North Branch) in Iran (24 males & 36 females; M=21.15) and 80 architecture students at Konya Technical University in Turkey (46 males & 34 females; M=20.75). A total of 140 students (35 students from Basic Design 2 course, 35 students from Design Studio 2 course, 35 students from Design Studio 5 course, and 35 students from Design Studio 7 course) volunteered to participate in this study. As a first step, Kember et al. (2000) reflective thinking questionnaire was used to measure reflective thinking. The corresponding questionnaire includes 16 measures and 4 components, namely habitat, action, understanding, reflection, and critical reflection. The habitat action component includes questions 1 through 4, comprehension includes questions 5 through 8, reflection includes questions 9 through 11, and critical reflection includes questions 12 through 16, formed on a five-point Likert scale (strongly agree = 1 to strongly disagree = 5). In the second step, Kolb's (2005) learning styles questionnaire was used to measure learning styles, which contains 12 questions, each with 4 suggested answers. Based on this questionnaire, the suggested answers were ranked from 1 to 4 according to the learning style. The sum of the points of these options gives four points, which represent four learning styles. Thus, the first option in each question is the learning style of concrete experience, the second option is the learning style of reflective observation, the third option is the learning style of abstract conceptualization, and the fourth option is the learning style of active experimentation. From the two-by-two difference of these styles, two scores were obtained that formed four quadrants and four learning styles named divergent, convergent, assimilator, and accommodator.

Findings and conclusion: The results showed that there is a relationship between reflective thinking and learning styles and students' design products. Specifically, the results of the present study showed that the predominant learning styles of architecture students are accommodative for males and divergent for females, which can be attributed to the logical and executive thinking of males and the emotional and detailed thinking of females in the design process. It was also found that female architecture students use divergent and assimilative styles during their four years of study. Male architecture students prefer the convergent style in the first two years of study and the accommodative style in the last two years. This result not only sheds light on the distribution of learning styles in the field, but also indicates the possibility of flexibility and changeability of learning styles among students. In this regard, it is necessary for teachers to continuously teach different materials and content according to the needs of learners so that, taking into account their preferred different teaching styles, their effective learning opportunities are provided. This kind of teaching benefits from the interaction between the learner and the teacher and tries to consider learners' individual needs, their different attitudes, intellectual abilities, personalities and learning styles to create favorable conditions for understanding and learning. To strengthen their motivation to learn and their academic progress.

Keywords: Reflective thinking, Learning style, Design process, Design product, Architecture student

INTRODUCTION

The design process and its education in the fields of art and architecture are considered the most controversial issues in preparing the educational plan of schools worldwide. In other words, the root of art and architectural education are formed based on design. In this regard, the significant assignment of architectural education is to create exhaustive thinking that provides the ability to step into the design process for architecture students. The architectural design course is one of the curriculums of architecture students, which is taught at different levels, and it requires the identification of factors affecting the development of students' design. Today, the traditional methods of the training design process in architecture do not meet the students' expectations. Given that students are different in the aspect of individual characteristics such as ability, knowledge, insight, and reflection in design processes, in most architectural design training methods, students are considered equal. In such a situation, a significant point of educational mistakes is caused by ignoring the capabilities and tendencies of students (Labib et al., 2019: 962). Providing an efficient program for training the design process requires recognizing students' differences, promoting their capabilities and creative insight. In this respect, architecture students' knowledge of *Thinking Processes* and *Learning Styles* is considered one of the most effectual factors. Edward De Bono (2020) believes that design is rooted in the way of thinking named *Design*

Thinking. Heidegger considers training to be difficult than learning because teaching requires the creation of learning conditions for the learner (Babich, 2016). In line with this, Clara (2015) proposes "Reflective Thinking" as a significant concept in training and learning. DeWitt et al. (2016) consider "Reflective Thinking" the fundamental purpose of learning. Hence, with the aim of professional development and training of skilled designers, it is necessary to review and evaluate the education of the design process based on the level of reflective thinking in the educational planning of architecture schools. Reflective thinking is not only focused on examining approaches but also involves intellectual changes and seeks to create new opportunities and situations by solving problems. Indeed, reflective thinking refers to a mental involvement in cognitive processes to understand conflicting factors, which is a necessary component of the learning process. This mental engagement leads to a person actively creating insight about developing a strategy (Karvan, 2021).

Learning styles are proposed as another influential variable in architectural course training, which refers to the differences between people in learning methods (Faizi & Dezhpasand, 2019: 149). According to Sternberg (2016), learning and thinking styles are not strategic attitudes to improve skills but help individuals to use their talents. There are differences in the ways people understand and acquire knowledge, form ideas, think, and act (Aljojo, 2017; Kolb & Kolb, 2005). Considering the importance of the way of thinking, learning methods, and referring to these talents for the architecture profession and especially for the design process, it is necessary to understand them properly. For this reason, the present study aims to investigate the relationship between reflective thinking and learning styles with the degree of student progress in the design process and design products. In this context, to achieve the goals of the research, it seems necessary to evaluate and answer the following questions:

1. Is it possible to predict the design product, including the content, method, and design evaluation of the students with reflective thinking and various learning styles?
2. Is there a relationship between reflective thinking and students' design products?
3. Are there connections between students' learning styles and design products?

To answer the relevant questions, the study firstly determines the role of intellectual ability, including reflective thinking, on the degree of improvement of the student's design product, and then the relationship between learning style and design product is examined. To this end, Kolb's learning style model (1984) and Kember's reflective thinking patterns (2008) in assessment students and the relationship of these two variables with the grade obtained from their design have been evaluated. Then, suggestions for teaching the architectural design process have been presented by analyzing and examining the research's theoretical foundations and statistical findings. In this regard, Kolb's learning style model and Kember's reflective thinking patterns in assessment students and the relationship of these two variables with the grade obtained from their design have been evaluated. Then, by analyzing and examining the theoretical framework and statistical findings of the research, suggestions have been presented for teaching the architectural design process.

CONCEPTUAL FRAMEWORK

Design Process

Design is an effort to create solutions before implementation. Designers' ideas are the result of a process that has come from the combination of sciences. In the book *Design in Mind*, Lawson (1994) explains design as creating new things and innovative activities. In most cases, design is considered an analytical process in which potential design solutions, identified in the recognition phase, are devised (Lang, 2004: 64). Designing requires a complex mental process of the ability to obtain many types of information, combine them into a coherent set of ideas, and create a realized form of those ideas (Lawson, 2006: 17). Indeed, the architectural design process is a crucial aspect of the field of architecture, and learning this process is essential for aspiring architects. The process involves a series of steps that guide architects in creating functional, aesthetically pleasing, and sustainable buildings. To learn the architectural design process, students must first understand design principles and learn how to effectively communicate their ideas. They must also develop critical thinking and problem-solving skills in order to navigate complex design challenges. The design process could be examined in this regard from two perspectives of reflective thinking and learning methods.

Reflective thinking

Thinking is a cognitive process that leads to behavior or attempts to find a solution to a problem. In other words, thinking is a process by which we bring our information to a new result (Karvan, 2021: 26). Indeed, thinking organizes past learning to use it in the current situation (Solso, 2006: 521). In such a process, thinking attempts to evaluate and reason about problems by reviewing and organizing mental content (Pakzad & Bozorg, 2012). The ability to think critically, as well as the ability to recognize intellectual data, can promote a person's success and progress in various areas of learning and education (Lin, 2001: 27). One of the educational goals in dealing with architecture students is to pay attention to teaching them creative thinking and idea generation. This means that they should be taught to change their already-formed mental patterns. This trait makes people change the mental patterns formed based on their specific subject under appropriate conditions. The enhancement of thinking skills and their proper application led to success and progress. This usefulness and success are the result of thinking that brings about the training of professional specialists and designers (De Bono, 2020).

The designer's intellectual background and thinking capacity during the design process is one of the issues under the influence of cognitive psychology. The designer's way of thinking and approach play a direct role in the thinking process, i.e. the process from question to answer, the result of which is reflected in the design product. The results of recent studies from the perspective of cognitive psychology under the influence of human behavior and perceptual process show the need to pay attention to the thinking process in the field of architectural design education (Karvan, 2021: 27). Designers often unconsciously use strategies on design and idea generation. Such strategies, independently or in combination, help develop design concepts and ideas during the design process. Kember et al. (2000) generally classified design thinking strategies and introduced reflective thinking into four groups. In this classification, the four levels of reflective thinking include habitual action, understanding, reflection and critical reflection. The levels of habitual action and understanding are classified as non-reflective behaviors. The levels of reflection and critical reflection are classified as reflective behaviors. Habitual action is considered the lowest level. At this level, learners have already learned and performed the actions so often that they perform them automatically and without further reflection. Students have perceived the concept at the level of understanding, but they cannot reflect on its role in various personal and practical situations. At the reflection level, people measure and evaluate their learning experiences to improve them in the future, and to this end they consider different solutions and possibilities. At the highest level, critical reflection, learners criticize the accepted assumptions and propose an innovative solution. Kamarudin et al. (2016) believe that the characteristics of reflective thinking are possible through exploration, experimentation, manipulation, changing ideas, and applying reflective thinking. Reflective people make fewer mistakes, are more critical, and learn more in their jobs (Lindh & Thorgren, 2016).

Learning styles

One of the variables that can influence students' abilities is the teachers' teaching methods. Teachers must use active teaching methods and employ skills that improve the quality of their work (Hosseini et al. 2021: 46). They should create a suitable framework for students' learning through an ideal combination and organization of different teaching methods, make them available to students, and provide a way to achieve students' goals and develop their competencies (Zolfagharian et al., 2018; Diaz et al., 2010). In this regard, the architectural design process includes techniques that identify solutions to the design problem. Information processing and decision-making are very important in the concept generation phase, where different ideas are produced and evaluated. Researchers have found that the design learning process is an internal process and that each person in each learning environment prefers a particular method for receiving information. This personal preference is called learning style (Bastani & Mahmoodi, 2019:75). Various models of learning styles are used in the design process pedagogy. The best known are the style of Katherine Myers and Isabel Briggs, the style of David Kolb, the style of Felder and Soloman, and the style of Ned Herrmann. Of all the learning style recommendations mentioned, the style proposed by Kolb is the most widely accepted among researchers and his theories of academic learning are highly regarded. This theory is one of the most important and influential studies in the field of learning and education. Kolb has conducted extensive research in the areas of experiential learning, social and individual change, and vocational education. Although this theory was developed primarily for use in adult education, it has led to extensive pedagogical applications in higher education (Faizi &

Dezhpasand, 2019: 156). Kolb defines learning as a process in which knowledge is acquired through the transformation of personal experience. The basis of this definition is rooted in individual differences. In Kolb's view, the teacher is only a guide and facilitator of learning (Farzian, & Karbasi, 2014: 97; Kolb, 1984). According to Kolb, experiential learning takes place when the learner experiments in his environment. Therefore, this method seems to be appropriate for learning practical knowledge, including architecture. This means that architecture students need to experiment a lot to reach a final idea. This kind of learning can be effective (Karvan, 2021: 28).

According to Kolb's (2005) theory, there are two basic phases of learning: first, the acquisition of new information and experience, referred to as "concrete experience" and "reflective observation"; second, information processing, referred to as "abstract conceptualization" and "active experimentation". In concrete experience, the person learns to communicate with people, understand emotions, and rely more on inner feelings and experiences. In reflective observation, the person perceives situations differently, relies on objectivity and judgment, and constantly refers to thoughts and theories. In abstract conceptualization, the person begins logical analysis. In this phase, a principled and regular design and rational understanding of situations takes place. In the active experimentation phase, learning takes a more active role and causes a change in position and influence. Also, the person has a genuine interest and an active approach to the problem. Thus, for effective learning, these four steps must be completed. The following model refers to Kolb's experimental learning steps. This model represents a four-step process. The first part shows concrete experience, where the learner first performs the action; the second part refers to reflective observation, where the learner thinks about that action; the third part refers to abstract conceptualization, where the learner makes a hypothesis; the fourth part is active experimentation, where the learner finally tests the hypothesis.

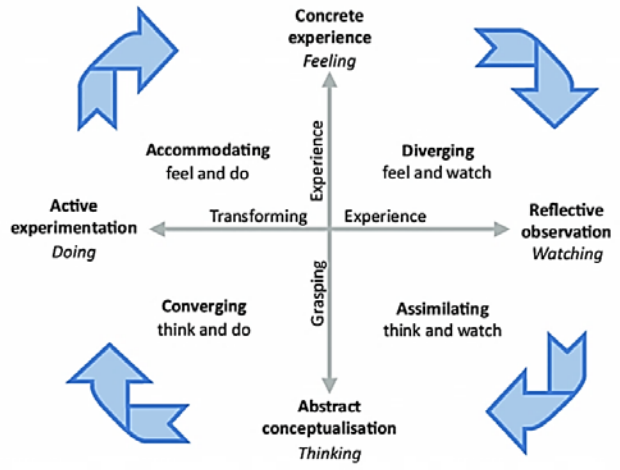

Figure 1. Kolb's experimental learning steps

By combining Kolb's experimental learning steps, the following four learning styles were proposed:

Divergent learning style results from concrete experience and reflective observation. This learning style causes individuals to evaluate situations objectively from different perspectives. Because these individuals can generate different ideas, their style is considered divergent. Their approach to situations is observational rather than action. In general, people with a divergent style have great imagination, prefer teamwork, and listen to different points of view in formal learning situations. Therefore, the group training method contributes to better learning in divergent people. These characteristics are useful for success in artistic and recreational activities.

Convergent learning style consists of two methods or two learning steps: abstract conceptualization and active experimentation. People with this learning style find practical applications for ideas and theories efficiently. For this reason, when faced with a problem, they try to quickly find the right solution or focus their efforts on that one solution. On the other hand, convergent people tend to experience new ideas and laboratory work. They are also successful in specialized work and technology.

Assimilative learning style consists of a combination of abstract conceptualization and reflective observation. People with this learning style can grasp and understand extensive information and put it into a concise, accurate, and logical form. These people emphasize abstract ideas and concepts. People with an absorptive learning style are successful in scientific and informational occupations. These people are interested in working with others to evaluate, set goals, get things done, test theories, and complete their projects.

Accommodator learning style created that are: Concrete experiences and active experimentation result from the combination of two learning styles. People with an accommodative learning style learn firsthand and enjoy implementing plans and engaging in challenging activities. These people prefer tangible things rather than logical analysis. The reason this style is called adaptive is because people with this style are able to adapt to new situations. People with this learning style are more successful in marketing and sales jobs than others. These people prefer reading, lectures, exploratory models, and enough time to think about things.

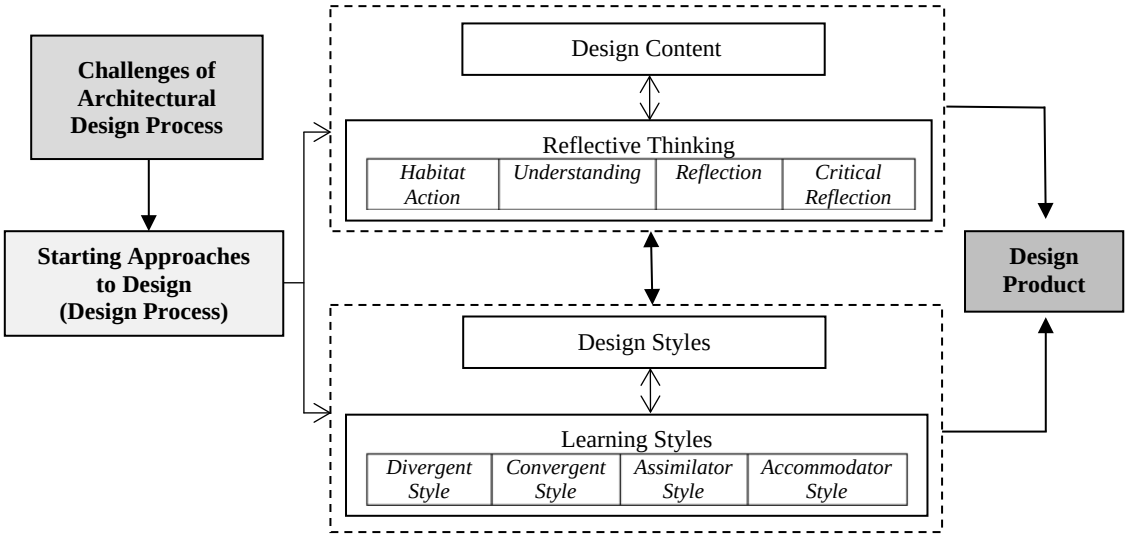

Figure 2. Conceptual model of the study

METHOD

The present study was conducted using descriptive-analytical and descriptive-correlative methods. The statistical population of this study includes 60 architecture students at Azad College of Tehran (North Branch) in Iran (24 males & 36 females; M=21.15) and 80 architecture students at Konya Technical University in Turkey (46 males & 34 females; M=20.75). A total of 140 students (35 students from Basic Design 2 course, 35 students from Design Studio 2 course, 35 students from Design Studio 5 course, and 35 students from Design Studio 7 course) volunteered to participate in this study. In a first step, Kember et al. (2000) reflective thinking questionnaire was used to measure reflective thinking. The corresponding questionnaire includes 16 measures and 4 components related to habitat action, understanding, reflection, and critical reflection. The habitat action component includes questions 1 to 4, understanding includes questions 5 to 8, reflection includes questions 9 to 11, and critical reflection includes questions 12 to 16, which are recorded on a five-point Likert scale (strongly agree= 1 to strongly disagree=5). The Cronbach reliability coefficient of Kember's reflective thinking questionnaire is 0.73 in different studies, and the Cronbach reliability coefficient of the habitat, comprehension, reflection, and critical reflection components are 0.53, 0.58, 0.67, and 0.67, respectively. In this study, the reliability of the reflective thinking questionnaire based on Cronbach's alpha index for habitat action is 0.69, comprehension is 0.79, reflection is 0.81, and critical reflection is 0.74.

In the second step, to measure the learning style, the Learning Styles Questionnaire by Kolb (2005) was used, which contains 12 questions, for each of which 4 answers are suggested. Based on this questionnaire, the suggested answers were ranked from 1 to 4 depending on the learning style (if the suggested answer completely

corresponds to learning: 4; if the suggested answer corresponds to learning to some extent: 3; if the suggested answer corresponds to learning a little: 2; if it corresponds very little: 1). The sum of the points of these options gives four points, representing four learning styles. Thus, the first option in each question is the learning style of concrete experience, the second option is the learning style of reflective observation, the third option is the learning style of abstract conceptualization, and the fourth option is the learning style of active experimentation. Two scores are obtained from the two-to-two difference of these styles, i.e., the difference between the scores for abstract conceptualization and concrete experience and the difference between the scores for active experimentation and reflective observation. These two scores are arranged on two coordinate axes (corresponding to the negative and positive outcome scores). A vertical axis includes concrete experience at the top of the axis and abstract conceptualization at the bottom, and a horizontal axis includes reflective observation on the right and active experimentation on the left (see Figure 1). These two coordinate axes form four quadrants, and four learning styles, labelled divergent, convergent, assimilative, and accommodative, are placed in one of the quadrants. Based on previous studies, the reliability of Kolb's learning styles questionnaire was calculated using Cronbach's alpha: concrete experience 0.82, reflective observation 0.73, abstract conceptualization 0.83, active experimentation 0.87, concrete experience-abstract conceptualization 0.88, and reflective observation-active experimentation 0.81 (Karvan, 2021: 33).

FINDINGS AND DISCUSSION

The number of students and the distribution of the corresponding frequencies are shown as follows:

Table 1. Frequency distribution by gender of students

		Gender	
Year	**Number**	**Male**	**Female**
1 Freshman	35	19 (54.29%)	16 (45.71%)
2 Sophomore	35	20 (57.14%)	15 (42.86%)
3 Junior	35	16 (45.71%)	19 (54.29%)
4 Senior	35	15 (40%)	20 (60%)
Total	140	70 (50%)	70 (50%)

Pearson's correlation coefficient test and regression analysis were used to analyse the data. To compare the way of understanding and processing information in male and female students, an independent t-test was also performed. The comparison of how male and female students understand, and process information shows that the mean scores of male students are higher than those of female students in the method of abstract conceptualization (M=34.25) and active experimentation (M=30.48). On the other hand, the mean scores of female students in reflective observation (M=33.65) and concrete experience (M=30.22) are higher than those of male students.

Table 2. Comparison of learning styles among male and female students

Learning Style	Gender	Mean	SD	t	Sig
Concrete Experience	Male	27.39	4.02	1.07	0.742
	Female	30.22	4.09		
Reflective Observation	Male	29.21	4.07	1.33	0.869
	Female	33.65	6.67		
Abstract Conceptualization	Male	34.25	6.91	1.41	0.768
	Female	26.33	5.68		
Active Experimentation	Male	30.48	4.12	1.02	0.814
	Female	27.32	4.01		

The following table shows students' preferred learning styles by year of entry into the university and by gender. The results show that architecture students prefer the divergent (N=42), the assimilative (N=35), the accommodative (N=33), and the convergent (N=30) styles, respectively. The convergent and accommodative styles are preferred by men. In this context, according to Kolb's definition of convergent and accommodative learning styles, which are composed of abstract conceptualization and active experimentation steps, the results show that male students approach the design process in a ratiocinate and logical manner (see Table 2; abstract conceptualization, M=34.25). They are also more likely to be concerned with the technical and structural aspects of the design (see Table 2; active experimentation, M=30.47). On the other hand, the data in Table 3 support such a finding and are consistent with the data in Table 2, which show high scores for convergent (N=23) and accommodative (N=25) learning styles for all fourth-year male students. For females, the results show that they are more likely to use divergent (N=42) and accommodative (N=35) learning styles. Using the definition of divergent and assimilative styles, which is the combination of concrete experience and reflective observation, it is concluded that female students are introverted, emotional (see Table 2; concrete experience, M=30.22), theoretical, and planning (see Table 2; reflective observation, M=33.65) in their approach to the design process. In this regard, the data presented in Table 3 support such a finding and are consistent with the data presented in Table 2, which show a high value for divergent (N=30) and assimilative (N=27) learning styles for all fourth-year female students.

Table 3. Distribution of students' preferred learning style based on gender

Year	N	Preferred Learning Style							
		Divergent		Assimilator		Convergent		Accommodator	
		M	*F*	*M*	*F*	*M*	*F*	*M*	*F*
1 Freshman	35	4	8	4	6	3	1	2	1
		12 (34.29%)		10 (28.57%)		4 (11.43%)		3 (8.57%)	
2 Sophomore	35	3	6	2	6	5	2	4	2
		9 (25.71%)		8 (22.86%)		7 (20%)		6 (17.14%)	
3 Junior	35	3	7	1	8	7	1	9	3
		10 (28.57%)		9 (25.71%)		8 (22.86%)		12 (34.29%)	
4 Senior	35	2	9	1	7	8	3	10	2
		11 (31.43%)		8 (22.86%)		11 (31.43%)		12 (34.29%)	
Total	140	12	30	8	27	23	7	25	8
		42 (30%)		35 (25%)		30 (21.43%)		33 (23.57%)	

To answer the questions raised in the introduction, the present study aimed to test the following hypotheses:

1. Reflective thinking and learning styles predict students' design products.
2. There is a relationship between reflective thinking and students' design products.
3. There is a relationship between learning styles and students' design products.

To assess students' design product, the researcher evaluated semester project design issues in 12 stages, from idea to presentation. Each scale was graded from 0 to 10, resulting in a range of scores ranging from 0 to 120: 1. The design concept, 2. Research and design integration, 3. Site plan, 4. Functional designing, 5. Spatial qualities, 6. Form (proportion of building mass and space), 7. Aesthetic, 8. Structure, 9. Materials, 10. Environmental conditions, 11. Rendering, 12. Maquette. As seen in the following table, the correlation coefficient between reflective thinking and design product is $r=0.843$ and $p<0.01$; that is, there is a direct and strong relationship between reflective thinking and students' design products. Higher scores for reflective thinking scores mean that the evaluation score of the students' design product is higher. The correlation between the variables of divergent learning style and design product is $r=0.811$ and $p<0.01$, as well as the correlation between assimilative learning style and design product is $r=0.764$ and $p<0.01$. In other words, there is a direct and significant correlation between divergent learning style and assimilative learning style with the design product of female students, that is, the higher the values of these learning styles, the higher the quality of the design product. Furthermore, the correlation between the variables of convergent learning style and design product is $r=0.731$ and $p<0.01$, as well as accommodator learning style and design product, is $r=0.752$ and $p<0.01$; In other words, there is a direct and significant relationship between the convergent learning style

and accommodator learning style with the male students' design product, that is the higher scores of these learning styles show the higher quality of design product.

Table 4. Pearson's correlation coefficient between reflective thinking and learning styles with product design

Variable		Design Product	
		r	p
Learning Styles	Divergent Learning Style	0.811	0.0001
	Assimilator Learning Style	0.764	0.0001
	Convergent Learning Style	0.731	0.0001
	Accommodator Learning Style	0.752	0.0001
Reflective Thinking		0.843	0.0001

To test hypothesis 1, stepwise regression analysis was used. The results in the following table show that reflective thinking was assessed in the first step and learning styles were assessed in the second step by the stepwise regression analysis. The adjusted squared results of the multiple Pearson correlation coefficient show that based on the first model, reflective thinking determines 0.73, or 73%, and based on the second model, reflective thinking and learning styles determine 0.67, or 67%, of the variance of the design product. Thus, it can be argued that reflective thinking and learning styles can explain or predict students' design product. The regression analysis results show that based on the first model of reflective thinking ($F=426.137$, $p<0.01$) and based on the second model of reflective thinking and learning styles ($F=226.401$, $p<0.01$), the design product can be significantly predicted and there is a relationship between reflective thinking and learning styles with students' design products.

Table 5. A: The regression model of reflective thinking and learning styles on the level of the design product; B: The variance analysis for the significance test of the regression model of criterion predictor variables.

Variable	R	R^2	SE	
Reflective Thinking	0.84	0.73	9.61	
Reflective Thinking Learning Styles	0.78	0.67	9.32	
Model	**Variables Source**	**Total Squares**	**F**	**Significance Level**
1	Regression	2412.616	426.137	0.0001
2	Regression	1662.660	226.401	0.0001

CONCLUSION

The study of the field of educational sciences and their efforts to introduce necessary solutions to improve education shows the neglected points of this field in architectural education and design process. One of the ways to facilitate and mitigate these deficiencies is to address learning styles and the need for alignment between learning styles and educational programs. In this context, to develop a design process in architectural education and improve students' quality level, the present study investigated the role of Kolb's learning styles by examining a suitable model of learning styles applicable to architectural design courses. In general, according to the results, it is expected that the type of assignments given to students will result in a higher quality design product if they are consistent with their learning styles. Thus, it seems that the reflection-based (thinking-oriented) educational program significantly impacts architecture students' learning rate. Considering this importance, the present study's results showed a relationship between reflective thinking and learning styles with students' design products By examining the components of reflective thinking, including reflection (understanding and paying attention, continuous and active attention to any idea with deep thinking) and critical thinking (awareness of problems), it can be claimed that reflective processes have a profound effect on the way of looking at problems and mental perceptions. In other words, people with reflective thinking make their decisions based on scientific and experimental approaches and using the collected information and its analysis and are better able to evaluate the situation.

Specifically, the results of the present study show that the predominant learning styles of architecture students are accommodative for males and divergent for females, which can be attributed to the logical and executive thinking of males and the emotional and detailed thinking of females in the design process. It was also found that female architecture students use divergent and assimilative styles during their four years of study. Male architecture students prefer the convergent style in the first two years of study and the accommodative style in the last two years. This result not only sheds light on the distribution of learning styles in the field, but also indicates the possibility of flexibility and changeability of learning styles among students. Architecture students use a specific style and coordinate different styles with different situations and tasks. The content of the architecture field includes two aspects: of construction engineering and arts. Therefore, the learning styles required for this field are mostly divergent (to strengthen the artistic dimension) and convergent (to strengthen the engineering dimension) based on Kolb's learning styles. The results of this study show that current architectural education influences students' learning styles and tends to convergent-assimilative styles for males and divergent-accommodative styles for females. Then, it is worth noting that efficient architects should use all four learning styles to succeed That is, they should engage in experiences (concrete experience) and be able to observe and reflect on experiences from different perspectives (reflective observation). They should also form concepts and hypothesise or present an appropriate plan from their field observations (abstract conceptualisation) and take these hypotheses and plans to the stage of proof and implementation and make decisions to solve problems (active experimentation). This theme aligns with architecture's interdisciplinary nature and the need to acquire information in other sciences and use other disciplines' learning methods.

To identify students' learning styles and match teaching patterns to them, it is proposed to test students' learning styles in the early stages of architectural studies to find appropriate solutions. In architecture schools, students are divided into different workshop groups to continue and focus the activities; this division can be done according to students' learning styles and criteria. In this regard, it is necessary for teachers to continuously teach different materials and content according to the needs of learners so that, considering their preferred different teaching styles, their effective learning opportunities are provided. This kind of teaching benefits from the interaction between the learner and the teacher and tries to take into account learners' individual needs, their different attitudes, intellectual abilities, personalities and learning styles to create favorable conditions for understanding and learning. To strengthen their motivation to learn and their academic progress.

Authors' Contributions

The author contributed 100%.

Competing Interests

There is no potential conflict of interest.

Ethics Committee Declaration

Ethics committee approval dated 07.04.2023 and numbered 04/01 was obtained for the study titled "Students' challenges in architectural design process" from Selçuk University.

REFERENCES

Aljojo, N. (2017). Differences in styles of thinking 'In light of Sternberg's theory': A case study of different educational levels in Saudi Arabia. *Journal of Technology and Science Education, 7*(3), 333-346. https://doi.org/10.3926/jotse.291

Babich, B. (2016). On Heidegger on education and questioning. In Peters, M. (Eds). *Encyclopedia of Educational Philosophy and Theory*. Springer, Singapore. https://doi.org/10.1007/978-981-287-532-7_151-1

Bastani, M., Mahmoodi, A. S. M. (2019). Learning styles and analogical thinking method during the design process of architecture. *Honar-Ha-Ye-Ziba: Memary Va Shahrsazi*, *24*(1), 71-84. https://doi.org/10.22059/jfaup.2019.261784.672064

Clara, M. (2015). What is reflection? Looking for clarity in an ambiguous notion. *Journal of Teacher Education, 66*(3), 261-271. https://doi.org/10.1177/0022487114552028

De Bono, E. (2020). *How to have a beautiful mind: (Vermilion life essentials)*. Vermilion.

DeWitt, D., Alias, N., Siraj, S. (2016). Problem solving strategies of Malaysian secondary school teachers. *Educational Technology to Improve Quality and Access of Education to Prosperous Society*, Universitas Negeri Jakarta, Bali, 1-14.

Díaz, M. J. F., Santaolalla, R. C., González, A. G. (2010). Faculty attitudes and training needs to respond the new European Higher Education challenges. *Higher Education, 60*(1), 101-118. https://doi.org/10.1007/s10734-009-9282-1

Faizi, M. & Dezhpasand, S. (2019). Analysis of learning styles to improve architectural education (Case study: Architecture students of Urmia University). *JIAS Journal of Iranian Architecture Studies, 7*(14), 149-169. https://doi.org/10.22052/1.14.149

Farzian, M., Karbasi, A. (2014). Handcrafts - personal experience learning by doing in architectural design education. *Honar-Ha-Ye-Ziba: Memary Va Shahrsazi*, *19*(3), 87-96. https://doi.org/10.22059/jfaup.2014.55411

Hosseini, E. S., Falamaki, M. M., Hojat, I. (2021). Explaining pattern of individual-centered design process and Architectural design training model based on learners' cognitive differences. *Hoviatshahr*, *15*(3), 43-58. https://doi.org/10.30495/hoviatshahr.2021.16357

Kamarudin, M. Y., Mohd, N., Nik, R., Ahmad, H. Y., Abdul Ghani, K. (2016). Inculcation of higher order thinking skills (HOTS) in Arabic language teaching at Malaysian primary schools. *Creative Education* (*Scientific Research Publishing)*, *7*(2), 307-314. https://doi.org/10.4236/ce.2016.72030

Karvan, F. (2021). Design process: From idea to presentation, based on reflective thought and learning styles in architecture students, *Soffeh, 31*(93), 23-38.

Kember, D., McKay, J., Sinclair, K., Wong,F. K. (2008). A four-category scheme forcoding and assessing the level of reflectionin written work. *Assessment & Evaluationin Higher Education, 33*(4), 369-379. https://doi.org/10.1080/02602930701293355

Kember, D., Leung, D. Y. P., Jones, A., Loke, A. Y., McKay, J., Sinclair, K., Tse, H., Webb, C., Kam Yuet Wong, F., Wong, M., Yeung, E. (2000). Development of a questionnaire to measure the level of reflective thinking. *Assessment & Evaluation in Higher Education, 25*(4), 381-395. https://doi.org/10.1080/713611442

Kolb, A.Y., Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education, 4*(2), 193-212. http://dx.doi.org/10.5465/AMLE.2005.17268566

Kolb, D. A. (1984). *Experimental learning*. Englewood Cliffs, Prentice Hall.

Labib, W., Pesina, I., Abdelhadi, A., Bayram, G., Nuruunabi, M. (2019). Learning style preferences of architecture and interior design students in Saudi Arabia: A survey. *MethodsX, 6*, 961-967. https://doi.org/10.1016/j.mex.2019.04.021

Lang, J. T. (2004). *Creating architectural theory: The role of the behavioral sciences in environmental design* (A. Aeinifar, Trans.). Tehran University Publishing.

Lawson, B. (2006). *How designers think*. Routledge.

Lawson, B. 91994). *Design in mind*. Butterworth Architecture.

Lin, X. (2001). Designing metacognitive activities. *Educational Technology Research and Development, 49*(2), 23-40. https://www.jstor.org/stable/30220309

Lindh, I., Thorgren, S. (2016). Critical event recognition: An extended view of reflective learning. *Management Learning, 47*(5), 525-542. https://doi.org/10.1177/1350507615618600

Pakzad, J. Bozorg, H. (2012). *Alefba-e-Mohit Baraye Tarahan*. Armanshahr, Tehran.

Soslo, R. (2006). *Cognitive psychology*. Allyn and Bacon.

Sternberg, R. J. (2016). Styles of thinking and learning. *Canadian Journal of School Psychology, 13*(2), 15-40. https://doi.org/10.1177/082957359801300204

Zolfagharian, M., Aminbeidokhti, A., Jafari, S. (2018). Structural relationship of faculty-student interaction and faculty's active teaching method with students' competencies development by mediating the knowledge acquisition. *Journal of Research in Educational Science, 12*(40), 181-204. https://doi.org/10.22034/jiera.2018.65182

Figure References

Figure 1. Kurt, S. (2021, 1 April). *Adaptive learning: What is it, what are its benefits and how does it work?* Educational Technology. https://educationaltechnology.net/adaptive-learning-what-is-it-what-are-its-benefits-and-how-does-it-work/ (09.04.2023)

Figure 2. Produced by author.

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