Architecture

The study of architecture students' learning styles and their relationships with gender, academic performance, and duration of study in this discipline

S. S. Mirmoradi[*]

Assistant Professor, School of Architecture, Babol Noshirvani University of Technology, Babol, Iran

Abstract

The present paper focused on architecture students' learning styles based on Kolb's Experiential learning theory (ELT) and evaluated relationships between students' learning styles, degree of their academic achievement, gender, and duration of study in architecture. The present study aimed to see whether a dominant learning style can be outlined for architecture students in different studies on various disciplines. The present descriptive study was conducted according to a cross-sectional methodology in 2017. The statistical population included architecture students studying for BA courses at Babol Noshirvani University of Technology in Iran, among whom 85 students were selected as the sample. Kolb's learning style inventory (LSI) was used for data collection. Based on the results of this research, divergent, accommodating, assimilating and convergent styles were the architecture students' dominant learning styles, respectively. Furthermore, there was an unbalanced distribution of dispersed different learning styles as more than a half of the students' preferred divergent learning styles while divergent and accommodating styles in the half north of scatter plot generally covered more than 85% of the participants. Furthermore, no significant differences were observed between the students' mean scores of learning style test at the end of the first to fourth years of study. It was found that there were significant relationships between male students' learning styles and their achievement in architecture education. Accordingly, male students with divergent learning styles had higher academic achievement in terms of their total grade point average, compared to that of assimilating and accommodating groups. Finally, there was a significant relationship between the students' academic performance and gender. In general, female students had better performance in architecture in terms of their total grade point average.

Keywords: *Learning styles, Gender, Academic performance, Education, Architecture student, Duration of study.*

1. INTRODUCTION

The validity of an educational system depends on its learners' levels of learning. Learning is a very complex variable which is affected by numerous factors. The identification of these factors is important for solving educational problems and failures. These factors include intelligence, motivation, proper environment, familial factors, community, quality of educational center, and instructor quality. In addition, learning styles are regarded as other factors which affect learners' learning and they are acquired by experience and learning like other skills. In addition, all people understand content based on their learning styles. Therefore, individual differences in learning styles should be effectively considered in educational processes in order to fulfill learners' needs. Professors and educators' attention to learners' learning styles will develop the educators' teaching and improve learners' learning. Selection of different teaching methods

based on students' learning styles ensures greater success of curriculum and better quality of education. Explaining Kolb's four learning styles, Kolb and Wolfe predicted the students' preference in different disciplines based on various artistic, technical, and scientific fields, and introduced accommodating style as the dominant style for architects' learning [1-2].

Further, Kolb considered art and human sciences students as those with divergent learning styles and introduced them as creative people. On the contrary, they considered people with convergent learning styles as successful people in technical and technological works [3]. Despite the fact that all sciences, techniques and arts, which have been created by human thought and action, have inner and outer sides which appear with different intensity and weakness in each discipline and subject, architecture is a two-dimensional discipline known by a majority of researchers. Artistic and technical aspects of architecture are the minimum aspects and orders for architecture. Multidimensionality of architecture has a serious impact on its education so that it can distinguish architecture from numerous common methods and subjects in other disciplines. Architecture, on one hand,

* Corresponding author: S.Mirmoradi@nit.ac.ir
Tell: +9801132331707

is an art which deals with creative human aspect, and on the other hand, it has a close relationship with technology, materials, and construction and it is considered as a technical discipline. Therefore, architecture students may not be easily put in a group of learning styles by relying on just one aspect of architecture discipline. The conducted studies on Kolb's learning styles in architecture students have also released different reports of architecture students' dominant styles as well as successful rates of different learning styles in this discipline [4-8]. The present study aimed to evaluate architecture students' preferences of learning styles and their relationships with gender, duration of study, and their academic achievement.

2. REVIEW OF LITERATURE

2.1. Learning styles

The concept of learning can be defined in different ways. Learning covers a very broad field. Hergenhahn and Olson considered learning as one of the most important fields in today's psychology and one of the most difficult concepts for definition at the same time. In another definition, learning means the process of creating a relatively stable change in behavior or behavioral ability resulted from experience and cannot be attributed to temporary body conditions. Learning is an activity, which is undertaken by learners and created by their direct involvement and teacher only plays the role of providing the conditions and facilities which facilitate learning. Slavin considers learning as an inner process for learners, and the teacher's role as the facilitator of knowledge

creation process. In addition, Watkins et al. considered learners as the sources of learning and external assistance and education as facilitators.

Learning style can be defined as the learners' personal approach to learning, problem-solving, and information processing, or a method which is preferred by learners to other ways. It is worth noting that, unlike intelligence and talent, which are abilities, learning style is not ability, but learning style is the only preferred way by a person for study and learning. Ormord believes that students with similar intelligence often deal with assignments differently and think about educational subjects differently [9-14].

Learning styles are very diverse and can be divided into cognitive, affective and physiological group. David Kolb's four learning styles are among the cognitive learning styles and they are created based on a four-step cycle called experiential learning cycle. In fact, this theory considers learning as a cycle which begins with experience, continues with reflection, and ultimately leads to action [3]. There are four learning methods in Kolb's experiential learning model as follows:

1. Concrete experience (CE)
2. Observation and thinking about experience, Reflective observation (RO)
3. Developing a hypothesis or a kind of theory, Abstract conceptualization (AC)
4. Testing the hypothesis or theory in practical situations, Active experimentation (AE)

Kolb's experiential learning theory (ELT) depicts two bipolar learning dimensions called "perceiving" (vertical axis of Fig. 1) and "processing" (horizontal axis of Fig. 1). By combining the scores of these two dimensions, we can classify learners into four different learning styles:
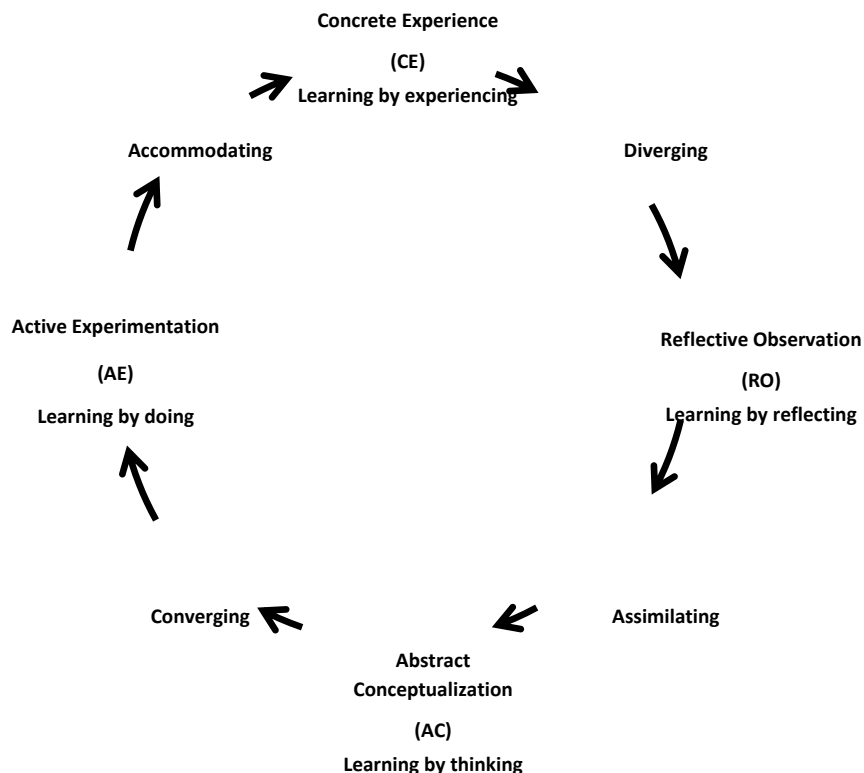
Fig 1 Kolb's Experiential learning cycle, four learning styles, (revised from Kolb, 1999:4)

*Divergent learning style***:** This learning style is derived from a combination of concrete experience (CE) and reflective observation (RO). People with this type of learning style have the greatest ability to see concrete situations from different aspects. They usually prefer to observe situations rather than taking action. These people prefer situations which require the expression of diverse ideas and are interested in cultural attractions and information gathering According to source, these learners possess a great ability to solve problems by collecting different perspectives, giving various ideas, and achieving creative solutions. They tend to be strong in imagination and are interested in art, human sciences and cultural attractions. Zanich maintains that divergent styles are regarded as the characteristics of people with artistic backgrounds. Disciplines, which deal with humans, are usually characterized by this type of learning style. According to Sharp, they concretely receive information and reflectively process it. These learners have great imagination ability and are superior to others in creativity and teamwork [3,15-17].

Assimilating learning style**:** This learning style is obtained from the combination of abstract conceptualization (AC) and reflective observation (RO). People with this learning style are capable of obtaining and understanding broad information and turning it by precise, summarized, and logical methods. According to these people, theories, which are logically correct, are preferable to theories which are functional. People with this learning style are more successful in jobs which require extensive information and knowledge. These learners prefer deductive reasoning and focus on abstract concepts. According to source, these people are capable of creating theoretical models and they are interested in investigating information and analyzing the details. They creatively use previous experience and are active in organizational research and planning. Sharp maintains that these people are called "assimilators" because they excel in knowledge acquisition. They usually learn by reading, observing, collecting information, and analysis. These people enjoy pure learning (learning to learn). Basic science and mathematics are often their favorite disciplines [16-18].

Convergent learning style**:** This learning style is acquired from the combination of abstract conceptualization (AC) and active experimentation (AE) stages of learning. People with this learning style have higher ability in practical application of ideas and theories. Those possessing this learning style prefer dealing with technical tools and assignments rather than social and interpersonal issues. People with this type of learning style are more successful in technical and technological work. People who have convergent learning styles gain and organize their knowledge through hypothetical-deductive reasoning and they are usually non-emotional and prefer working with objects to individuals and are specialized in mechanical and physical sciences. According to source, convergent are interested in experiencing whatever they learn. They abstractly receive and actively process information. They are often non-emotional and usually tend to specialize in some of fields such as computer and

engineering sciences [15-17].

Accommodating learning style: This style is obtained from the combination of concrete experience (CE) and active experimentation (AE) stages of learning. People with this learning style learn more from first-hand experience and enjoy drawing plan and engaging with challenges. These people usually prefer practical and tangible affairs to rational analyses. Zanich also argues that people with this type of learning style are flexible and superior to other people in situations where they should accommodate themselves to certain conditions, and thus they are called accommodating styles. According to source, they work well in critical situations and are interested in teamwork and prefer to be teachers or leaders [15-17].

According to [19], each of the above-mentioned learning styles has its own strengths and weaknesses, and learners, who are using only a certain style, are not perfect learners. To be perfect learners, they should use appropriate learning styles in different situations. Describing perfect learners, Kolb and Fry argue that perfect learners are very flexible and relativist in dealing with the world and their experiences and they can easily resolve dialectical contradictions between four main learning styles namely concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE) by their integration.

2.2. Learning styles among architecture students

According to a review of architecture curriculum, it is a combination of three major fields, namely human sciences, technology and positive sciences, and design creativity. Despite the fact that the importance and contribution of these three fields are varied at different architecture schools, the design creation plays a significant role in most of architectural schools because designing is where human science insights and knowledge of positive and technological sciences are manifested in the form of architecture. Duration of design lessons in bachelor of architecture equals to a half of total design course. Hudson conducted numerous studies on different groups with different thinking styles, and found that capable students in convergent thinking were attracted to sciences, while their more divergent counterparts were interested in arts [20]. In addition, this may cause most of the students who first enter the field of architecture to have a divergent learning style and may not be sure with confidence whether the student's learning style is the result of the training they receive during their studies or it has been shaped up longer, leading to a greater tendency toward different academic disciplines.

However, all scientists and artists need both convergent and divergent thinking, but perhaps only designers need this skill with equal proportions. Therefore, design training is a balanced equilibrium between instructing students to acquire knowledge and experience with non-mechanization of their thinking processes to such an extent that it does not impede the emergence of original ideas. Therefore, despite the fact that designing is divergent in its entirety

[21], There are many steps which require convergence in any designing process. Designers can solve the problem by the output designed through the design process. In studio, designers express and explore ideas, generate and evaluate alternatives, and ultimately make decisions and take action [22].

The design process has many steps and designing clearly includes both convergent and divergent types of thinking. According to Cross, design process is a convergent activity including a number of divergent stages and selecting the most appropriate and feasible solution from different options according to objectives of design, while a divergent person produces a wide range of design options. Convergent thinking is related to intelligence, but divergent thinking is an important feature of creativity. Convergent and divergent thinking are two main aspects of human thought. Regarding the main difference between two types of thinking, the result of thinking is already known in convergent thinking and there is always a right or wrong answer, but there is no definite answer in divergent thinking, and a large number of possible answers are possible and each may be logically correct. Therefore, the creation is defined in terms of divergent thinking in Guilford's theory. Guilford was the first researcher who introduced divergent thinking in the psychology of creativity. With regard to the multidimensionality of architecture and coherence of artistic and technical aspects and its theoretical and practical aspects, it seems that both convergent and divergent aspects should be equally strengthened in architecture students. Obviously, according to the above-mentioned theories, creation and creativity are more in line with divergent thinking style, but the contribution of technical courses is also very important in architecture courses. In addition, both divergent and convergent thinking styles are necessary in the same design courses which are associated with creativity [21, 23-24].

2.3. Research questions

The present study aimed to find dominant learning style among architecture students, compare the architecture students' learning styles in their first to fourth years of study in this field, and find possible relationships between learning styles and their sub-scores with students' gender and academic performance in all educational courses. The research began with the fundamental question of whether a dominant learning style can be outlined for architecture students as investigated in studies on various disciplines and those studies focused on the comparison of students' learning styles in different disciplines. In addition, it emphasized whether higher duration of study in architecture may change the students' dominant learning styles, and whether the students' total point average in different architecture courses including several combined artistic, technical and basic fields, are related to their learning styles. Therefore, the main questions of this study are as follows:

- Is it possible to introduce a dominant learning style for architecture students with an emphasis on their disciplines?
- Are there any significant differences between the students' dominant learning styles in the first to fourth years? Or, does the duration of study in architecture affect the preference of student learning style?

Given the multidimensionality of architecture courses, is there any significant correlation between the students' total grade point average in different courses of study and their preferences of learning styles?

3. METHOD

The present descriptive research was conducted according to a cross-sectional methodology during 2017. The statistical population included all architecture students studying for BA during 1-4 years of study at Babol Noshirvani University of Technology in Iran, among whom 85 were selected as the sample. Kolb's learning style inventory (LSI) was used for collecting data. Four learning styles, namely concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE), were first obtained using a total of the student responses 1-4 options for each question. Then, the scores of abstract conceptualization were subtracted from concrete experience (AC-CE) while the scores of active experimentation were subtracted from reflective observation (AE-RO). Then, the students were classified into one of four learning styles namely divergent, accommodating, assimilating, and convergent styles. This research used a standard Persian version of Kolb's questionnaire with approved validity and reliability in various conducted studies in Iran such as Rahmani Shams (2000). The collected data of the questionnaire was organized by the help of Smith and Kolb's questionnaire guide [25]. Finally, the students' total grade point average in their study in architecture at the end of the first to the fourth year was classified into 8 groups: Group 1 (18-20), group 2 (17.5-18), Group 3 (17-17.5), Group 4 (16-17), Group 5 (15-16), Group 6 (14-15), Group 7 (12-14) and Group 8 (10-12).

4. RESULTS

4.1. Descriptive results

Eighty-five students were selected as the sample, among whom 76 (55 females vs. 21 males) completed the questionnaires. As indicated in Table 1, the students were educating in the fourth year of bachelor of architecture including those at the end of the first year to the end of the fourth year, respectively. Table 2 indicates the related data in four groups based on their educational degrees. As displayed in Table 3, the students' dominant learning styles were divergent (60.5%), accommodating (26.3%), assimilating (9.2%) and convergent (3.9%) style, respectively.

The number and percentage of the selected students in four learning styles based on the duration of their study are presented in Table 4. Accordingly, the learning styles had similar order in all four years when more than a half of the students in each class had divergent learning styles. Table 5 presents the number and percentage of the students' groupings into four learning styles based on their gender.

Table 1 The distribution of participants through gender

	Frequency	Percent
Female	55	72.4
Male	21	27.6
Total	76	100.0

Table 2 The distribution of participants through duration of study

	Frequency	Percent
Forth year	19	25.0
Third year	21	27.6
Second year	15	19.7
First year	21	27.6
Total	76	100.0

Table 3 The distribution of participants through the learning styles

	Frequency	Percent
Diverging	46	60.5
Accommodating	20	26.3
Assimilating	7	9.2
Converging	3	3.9
Total	76	100.0

Table 4 Cross tabulation of learning styles of participants through duration of study

		Styles				Total
		Diverging	Accommodating	Assimilating	Converging	
Forth year	Count	11	4	3	1	19
	% within Group	57.9%	21.1%	15.8%	5.3%	100.0%
Third year	Count	11	6	2	2	21
	% within Group	52.4%	28.6%	9.5%	9.5%	100.0%
Second years	Count	9	5	1	0	15
	% within Group	60.0%	33.3%	6.7%	0.0%	100.0%
First year	Count	15	5	1	0	21
	% within Group	71.4%	23.8%	4.8%	0.0%	100.0%
Total	Count	46	20	7	3	76
	% within Group	60.5%	26.3%	9.2%	3.9%	100.0%

Table 5 Cross tabulation of learning styles of participants through the gender

			Styles				Total
			Diverging	Accommodating	Assimilating	Converging	
Gender	**Female**	Count	33	15	4	3	55
		% within Gender	60.0%	27.3%	7.3%	5.5%	100.0%
	Male	Count	13	5	3	0	21
		% within Gender	61.9%	23.8%	14.3%	0.0%	100.0%
	Total	Count	46	20	7	3	76
		% within Gender	60.5%	26.3%	9.2%	3.9%	100.0%

4.2. Correlation between the students' learning styles, academic achievement, gender and duration of study

The present study aimed to find the possible relationships between the students' learning styles, duration of study at university, gender, and their academic achievement. Accordingly, their total grade point average was classified into 8 groups including 1(18-20), 2(17.5-18), 3(17-17.5), 4(16-17), 5(15-16), 6(14-15), 7(12-14) and 8(10-12). As shown in Table 6, only a weak positive relationship between was observed between the students' gender and their academic achievement. In other words, the girls had better academic achievement, compared to the boys. However, regarding other variables, no significant relationship was found.

Table 6 Spearman's rho correlations between learning styles, Academic performance, Gender, Duration of study

Styles/A.Performance	Styles/Gender	Styles/Year	A.Performance /Gender	Year/ A.Performance
.195	-.016	-.153	.299[*]	-.175

*. Correlation is significant at the 0.05 level (2-tailed).

Based on the scatter plot and regression line for the relationship between academic achievement and learning styles based on the gender Fig. 2, there was a positive correlation between learning styles and academic achievement among boys while no correlation was found between learning styles and academic achievement among girls.
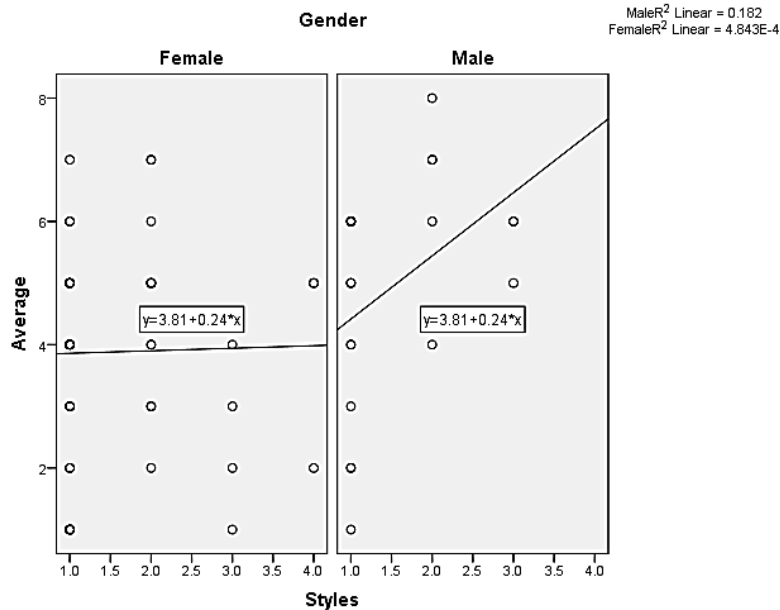
Fig. 2 Dotscatter and regression line for correlate of academic performance and Learning style through gender

Therefore, we re-measured the correlation between learning styles and academic achievement among boys group. As shown in Table 7, a significant relationship was observed between the students' learning styles and their academic achievement in architecture. Accordingly, male students with divergent learning styles had higher academic achievement than accommodating and assimilating learning styles, while no convergent style was reported among males.

Table 7 Spearman's rho correlations between learning styles and academic performance of males students

			Average
Spearman's rho	**Learning styles**	Correlation coefficient	**.490**[*]
		Sig. (2-tailed)	.024
		N	21
*. Correlation is significant at the 0.05 level (2-tailed).			

As illustrated in Fig. 3, there was a positive correlation between the students' learning styles and gender in all four groups and different academic years. Further, based on the results in Table 8, a weak positive correlation was observed between their academic achievement and gender (r=0.299).
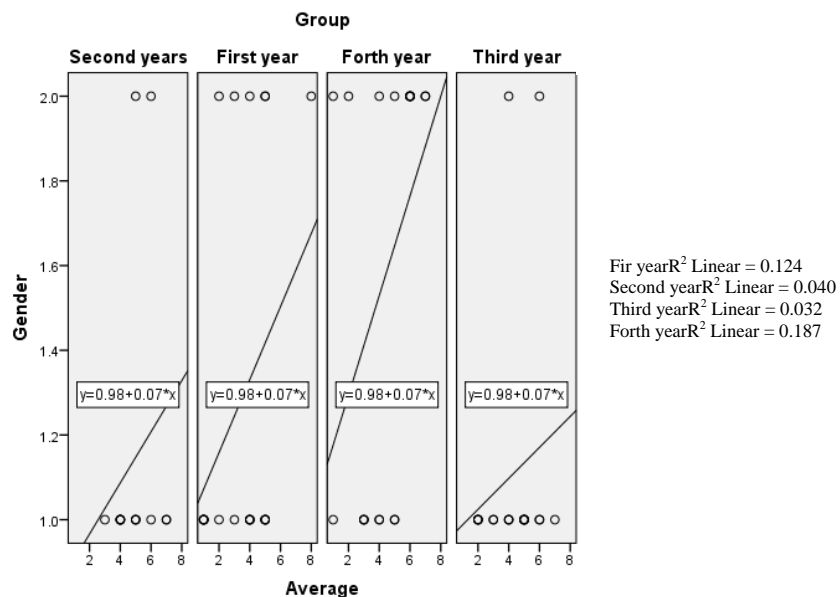

Fig. 3 Dotscatter and regression line for correlate of academic performance and gender through duration of study

Table 8 Spearman's rho correlations between academic performance and gender

			Gender
Spearman's rho	**Academic performance**	Correlation coefficient	**.299**[*]
		Sig. (2-tailed)	.010

*. Correlation is significant at the 0.05 level (2-tailed).

4.3. Relationship between the sub-categories

As shown in Table 9, there was a significant negative relationship between the architect students' scores of academic achievement and active experimentation (AE), while no significant relationship was observed between academic achievement and concrete experience (CE), reflective observation (RO), and abstract conceptualization (AC).

Table 9 Spearman's rho correlations between academic performance and scores

			CE	RO	AC	AE
Spearman's rho	**Academic performance**	Correlation coefficient	.126	.023	.141	**-.355****
		Sig. (2-tailed)	.287	.848	.234	**.002**

**. Correlation is significant at the 0.01 level (2-tailed).

Then, a possible correlation between four learning methods, namely, AC, CE, RO and AE, and their two combined scores including AC-CE and AE-RO. As indicated in Table 10, CE/AC, RO/AE, CE/RO, AC/AE, AC/RO learning styles had a negative correlation coefficient of 0.4, 0.42, 0.32, 0.42, and 0.28, respectively. However, CE/AE no significant relationship was observed between CE and AE. In addition, no significant correlation was reported between two AC-CE and AE-RO. Among learning styles and combined scores, only AC-CE/AE learning styles and scores had a significant positive correlation of 0.23.

As expected, the obtained scores of CE and AC were not correlated with AE-RO, and the scores of AE and RO had no significant correlation with AC-CE [25]. However, based on the results of the present research Table 10, a significant positive correlation was observed between the score of active experimentation (AE) with the subtraction of abstract conceptualization from concrete experience scores (AC-CE). The dialectical poles of AC and CE should have a negative correlation with RO and AE, which was congruent with the results of the present study.

Table 10 Pearson correlations between learning phases and scores

AC-CE/AE-RO	AC-CE/RO	AC-CE/AE	AE-RO/CE	AE-RO/AC	CE/AC	RO/AE	CE/RO	AC/AE	CE/AE	AC/RO
-.132	.009	**.237**[*]	-.156	.074	**-.400****	**-.425****	**-.329****	**-.426****	-.075	**-.287**[*]

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.4. The study on differences between the scores of subcategories in different education years and gender with different academic performance

Kruskal-Wallis test was used to find possible significant differences between the scores of subcategories of learning style in different groups studying at Faculty of Architecture from the end of first year to end of fourth year. Based on the data in Table 11, there was no significant difference between the students' mean scores of learning style test in these four groups. Kruskal-Wallis test was then utilized to find possible significant differences between the scores of learning style subcategories in eight groups of weak to strong academic performance. As shown in Table 12, no significant difference was observed between the students' total grade point average obtained from learning style test and their different academic performance except for AE which indicating a significant difference between various groups.

Table 11 Kruskal Wallis Test for LSI scores for different year of study of students

	AC-CE	AE-RO	CE	RO	AC	AE
Chi-Square	1.379	3.181	1.442	4.281	1.807	1.274
df	3	3	3	3	3	3
Asymp. Sig.	.711	.365	.696	.233	.613	.735

Table 12 Kruskal Wallis Test for LSI scores for different academic performance of students

	AC-CE	AE-RO	CE	RO	AC	AE
Chi-Square	2.985	10.669	4.935	4.298	4.877	17.078
df	7	7	7	7	7	7
Asymp. Sig.	.886	.154	.668	.745	.675	**.017**

5. DISCUSSION AND CONCLUSION

5.1. The first research question

Several studies emphasized the students' learning styles in different architectural areas. For example, Demirbas and Demirkan studied the impact of design students' learning styles preferences on their performance through Kolb's experiential learning theory (ELT) in Turkey. They concluded that there was a statistical significant difference between students' performance with different learning styles at different stages of design process. Based on this study, the design students' learning style preferences were convergent, assimilating, divergent and accommodating styles, respectively [4].

Kvan and Jia investigated the architecture students' all learning styles through Kolb's experiential learning theory (ELT) in China. They compared the students' learning styles and their performance in design studios. Results indicated that a significant relationship was observed between learning styles and academic performance. Students with convergent learning styles significantly had lower scores in design studios than assimilating learning styles. Based on this study, the architecture students' learning style preferences were assimilating, divergent, accommodating and convergent styles, respectively [6].

In another study, Demirbas and Demirkan focused on the learning styles and their relationships with gender and scores related to four artistic, technical, basic, and design courses and new students' total grade point average in three consecutive semesters [5]. In this study, the students' convergent and assimilating learning styles were the preferences of the students' styles. No significant difference was found between gender and learning styles among the students. Male students' scores in technical course were higher than the females. Female students' scores in art and basic sciences as well as their total grade point average were higher than those among males. In addition, significant difference was reported in students' design scores with divergent and convergent learning styles while this difference was higher in design students, compared with convergent learning styles.

In another study in Nigeria, the design students' learning styles were measured in the first and final years of their education by using the experimental model of Kolb learning style [7]. The results indicated that the design students' dominant styles during the first year were diverging (44%) and assimilating (32%), respectively. In addition, the prevailing styles of students in the final year of study were diverging (50%) and assimilating (24%), respectively [7].

Further, in another study in Thailand, the same instrument was used for measuring the students' learning styles in the field of interior architecture and interior design. Based on the results, the dominant learning style of internal architecture students were diverging and assimilating, respectively, while the dominant styles among interior design students were converging and assimilating, respectively [8].

A small number of students had convergent learning styles in a research conducted by Kvan and Jia (3%), compared to Demirbas and Demirkan who reported higher percentage of convergent learning styles than other groups (33%). Furthermore, Demirbas and Demirkan (2007) reported convergent learning style as the first dominant style among groups (47.3%). Kolb's prediction of architects' dominant learning styles was also emphasized. Kolb and Wolfe (1981) suggest that accommodating learning styles is the architects' dominant style (they are more interested in action and less interested in feeling), while it was not confirmed in other studies [4,6-8]. A low number (less than 15%) of participants had accommodating learning styles in all conducted studies.

Demirbas and Demirkan displayed a dispersion distribution of different learning styles in Fig. 4 which displayed a fairly uniform distribution of different styles. However, the dispersion distribution of learning styles was obviously unequal in different styles as shown in Fig. 5 in the study of Kvan and Jia as convergent and accommodating styles included a very small percentage of participants.
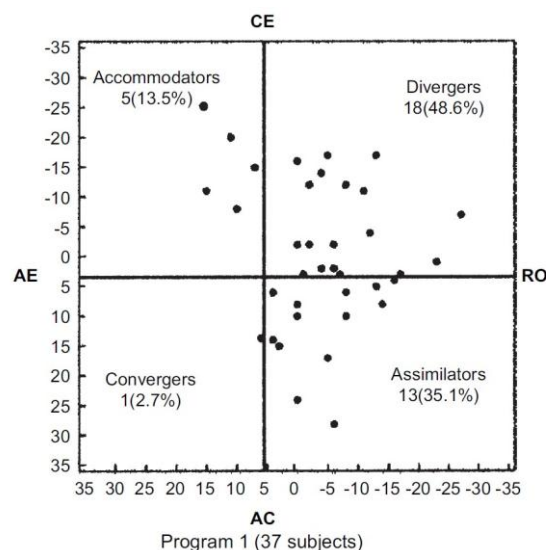

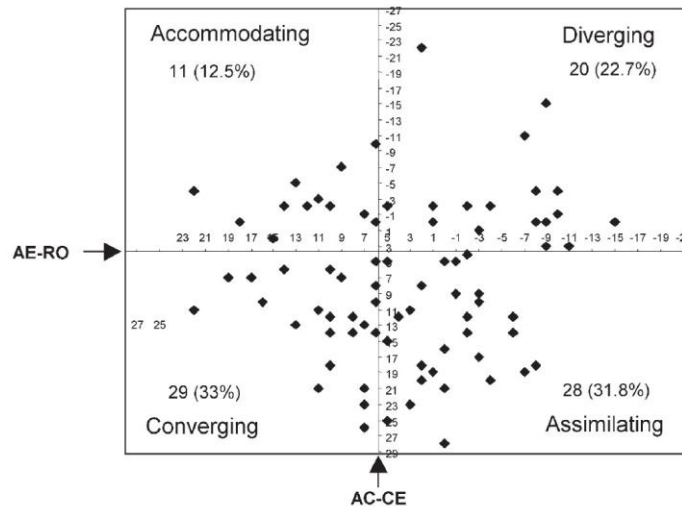**Fig. 4** Learning style distribution of participants in Kvan and Jia, 2005 study

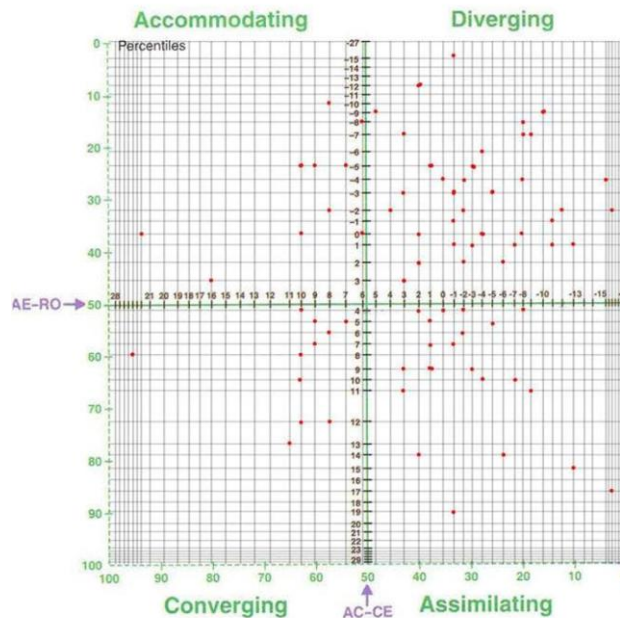**Fig. 5** Learning style distribution of participants Demirkan and Demirbas, 2003 study

Fig. 6 Learning style distribution of participants in Akinyode study [7]

Similar to the study of kvan and Jia, the dispersion distribution was not consistent with the Akinyode's study, as illustrated in Fig. 6 [4, 6-7].

In the present study, as shown in Table 3, the students' dominant learning styles were divergent (60.5%), accommodating (26.3%), assimilating (9.2%) and convergent (3.9%) styles, respectively. This unbalanced distribution of dispersion was obvious among different learning styles in recent study, so that more than a half of students preferred divergent learning style. Divergent and accommodating styles in a northern half of scatter diagram covered more than 85 percent of participants; and learning styles of southern half or the assimilating and convergent styles covered a low percentage of participants. In this regard, convergent learning style covered less than 4% of students, which was inconsistent with the study of Demirbas and Demirkan which the students' dominant style was less emphasized. A small number of students in convergent learning styles confirmed

the result of other conducted studies [4-8].

It is worth noting that the difference was found among the architecture students' dominant styles [6], compared to the study of Demirbas and Demirkan [4], in which cultural differences were emphasized in China and Turkey. In addition, Hayes and Allinson emphasized the effect of culture on different learning styles. [26] The results of the present study were compared with those of Kvan in China, Akinyode in Nigeria and Maturakan in Thailand, which came from three different cultures. Further, the study of Demirbas and Demirkan in Turkey is regarded as the only different study in terms of architecture students' learning styles [4-5].

Therefore, we cannot totally and simply accept Kolb's prediction of architects' dominant learning styles [2] called "accommodating style". Perhaps, other variables except for course of study can affect the students' preferences of learning styles.

5.2. The second research question

According to [18], the results of LSI test on the freshman and senior students indicated that a significant movement occurred in their learning styles from eastern reflective regions to western active regions with regard to the increase in their study duration, due to the students' growth and development towards playing more active roles in their learning during their education. However, based on the results of the present study Table 11, no significant difference was observed between the mean scores of learning style test among the students at the end of the first to fourth years of education. However, the present study compared four groups of students, who studied at the end of the first to fourth years of architecture discipline as this research was conducted in a certain period May, 2017.

In the study of Akin, the learning style among freshman and senior students of designing was studied cross-sectionally. The results showed that the prevailing learning style of students in the first year was divergent (44%) and absorbent (32%) which changed into absorption (40%) and divergent (31%) during the second year. However, it changed into divergent (50%) and absorbent (24%) during the final year. Therefore, academic education cannot play a significant role on the dominant students' learning style.

Regarding the evaluation of different learning styles among sophomore and senior students in other academic fields, a small number of studies were reported, among which we can refer to the study conducted on the changes in learning styles among the social science students based on Kolb's learning tool. Based on the results, education curriculum failed to play a significant effect on students' learning styles during their academic years. The results of the present study are similar to two other studies.

In addition, in another study conducted by Mammen et al. regarding the changes in medical students' learning styles during 12 years, a slight change was observed in the convergence of other styles toward convergent style although learning style no significant change occurred during this course of study. Further, in another similar study on medical students, no change occurred in the students' learning style during five years of medical education, and the convergent style was dominant among the students in both groups. However, a significant change was reported in other learning styles toward convergent style [7, 27-29]

In order to obtain more precise results, other studies can be performed to study a group of architecture students from admission to architecture discipline until the end of their education at several stages longitudinally in order to compare possible changes in the obtained scores based on the comparison of the preferences of their learning styles over time.

5.3. The third research question

Based on the results in Table 6, no significant relationship was observed between all students' academic performance and their learning styles. However, there was a significant correlation between male students' learning styles and their academic achievement in architecture Table 7. Accordingly, male students with divergent learning styles had higher academic achievement in their total grade point average than accommodating and assimilating learning styles, and there was no convergent learning style among male students. Demirbas and Demirkan failed to find any significant correlation between architecture students' mean scores in different learning styles and it was only reported that students with convergent learning styles obtained better scores in design course than divergent group. In the study of Kvan and Jia, students with convergent learning styles obtained lower scores in architectural design studios.

Regarding the results of the present study, a significant correlation was reported between the students' academic performance and gender. Female students generally had a better performance in architecture in their total mean scores. The result was consistent with the study of Demirbas and Demirkan which reported that females had better performance than males in their mean scores of courses with different fields in architecture.

Based on the comparison of the students' scores of LSI test subcategories with academic performance only the active experimentation (AE) score had a significant difference with the students' academic performance among weak to strong groups. In this case, previous studies did not report any results, and it was impossible to compare results [5-6].

6. DATA ANALYSIS AND RESULT

The present study aimed to find the dominant learning style among architecture students during 1-4 years of studying in this field, and evaluate the possible relationship between learning styles and their underlying scores with the gender and academic performance in all of the taught courses. Based on the results, diverging learning style was regarded as the dominant learning style among architecture students. However, a small number of students had a convergent and accommodating learning style.

Regarding the learners' characteristics with a divergent learning style, they are more in line with the artistic and humanitarian aspects of architecture, and these learners have a strong imagination and great creativity, which is largely related to the educational conditions in this field of study. Divergent learning style involves some advantages such as the ability of people to express ideas and ideas, the strength of imagination, and the success of creative solutions [3,15-17]. In addition, individuals with this learning style are less advantageous, compared to other learning styles. In fact, an efficient learner is flexible in different situations and can use different learning styles to accommodate with different situations [19], which is regarded as the ability to use all learning styles, especially in architecture, due to its specific characteristics. Architecture is a multidisciplinary discipline, which technical aspect is important, along with its artistic and human aspects. Architecture course covering half of the

undergraduate units should be effective in both parts, due to the dual characteristics of the divergence and the convergence of the design process [21,23]. Therefore, both scientists and artists need both convergent and divergent thinking. However, just a designer needs to be equipped with both skills in most circumstances. Therefore, the architecture teachers should recognize their dominant learning styles, remind the students of the importance of each student's skills in different stages of designing the architecture and identify their strengths and weaknesses according to the prevailing learning styles, by which they can strengthen their strengths and offset their weaknesses.

The need for a strong link between theoretical discussions and design courses in architecture requires the students' ability for generalization and organization. However, those with assimilating learning style possess such an ability which is taught to students in the field of architecture, technical and theoretical, lessons while divergent people are devoid of this feature[15-16]. For example, architects may learn building science and take their exams with excellent grades. However, there is little evidence of using this knowledge in their design projects [30]. According to [19], each of the learning styles has its own strengths and weaknesses, and learners, who are using only a certain style, are not regarded as perfect learners. In other words, efficient learners should use appropriate learning styles in different situations. According to Kolb and Fry, perfect learners are very flexible and relativist in dealing with the world and their experiences and they can easily resolve dialectical contradictions between four main learning styles through integrating these styles. Further, it is highly recommended to be a perfect learner by moving around the entire Kolb learning cycle in the field of architecture.

Based on the results, no significant difference was observed among the students' dominant styles during 1-4 years and the duration of education is not considered as an effective factor in preferring their learning style.

In general, capable students in convergent thinking are attracted to sciences, while those with more divergent counterparts are interested in arts [20]. Thus, having a divergent dominant learning style may cause most students to select architecture. However, it has not been confirmed whether the students' learning styles in different disciplines are related to the training they have received in their curricula from the outset, based on the students' interest, or their interest in selecting various academic disciplines based on their learning styles.

In addition, the results indicated that there is no significant difference between the students' dominant learning styles in their first and final years of study. Changing learning styles over time is a novel area and similar results have not been reported in this regard. Some studies indicated that there is no significant change in the students' learning style during their education [7-8] while some reported the difference in the students' learning style during their studies [28-29]. Therefore, a longitudinal research should be conducted on a group of students from the moment they enter the field of architecture and evaluate the changes in their learning styles during their studies.

Selecting the students is regarded as the most important part of architecture education. If the students' learning styles do not easily change after studying for four years, students should be attracted to the appropriate learning style in different disciplines at the beginning of the recruitment of students in each discipline. Further, teachers should use methods other than lectures and theories in teaching the technical, historical, and theoretical lessons of architecture since students learn divergent and adaptive learning styles with objective and observational methods [16,18].

Based on the results in the present study, male students with a diverging learning style had a higher academic performance than those with other learning styles. The results indicated no significant relationship between the academic performance of the students and their learning styles. However, a significant relationship was observed between the learning style of male students and their success in studying architecture. Consequently, regarding females, divergent learning style had higher rate of educational success than other learning styles.

Based on the literature review related to the curriculum of architecture, the architecture program is a combination of three major areas of human sciences including technology and design creativity. Although the importance and the contribution of these three domains in different schools of architecture are different, the creative part of the design plays a significant role in most architectural schools since the design domain is where the insights of the human sciences and technology are manifested in the form of architecture and space. The share of design courses in an undergraduate architecture program equals to half of the total design time. Due to the multidimensional nature of the architecture and the coherence of the artistic and technical aspects and the theoretical and practical aspects, it seems that both convergent and divergent aspects should be strengthened in architecture students simultaneously. In addition, it has been reported that creativity is more consistent with the divergent thinking style [3,16-18]. However, the share of technical lessons should be emphasized in the course of architecture education. Further, both divergent and convergent thinking should be considered in the same design courses related to creativity [21]. Furthermore, the predicted goals for each, the discipline at any university, and the expected capabilities of learners at the end of their school year should be highlighted. It is worth noting that given the widespread study of the field as well as the performance of architecture, all graduates of architecture baccalaureate necessarily need to reinforce only in terms of creativity which is fit into the characteristics of the divergent learning style, as well as the expectations of various universities in the country. Further, it is not going to be the same and definitely needs to be engaged in different areas of work based on the personal needs of different areas among architecture graduates. Thus, the potentiality of other learning styles should be highlighted.

Therefore, having a divergent learning style means more success in architecture in terms of its mutual

characterization combining art and technology education) and the dual feature of design (synchronizing the aspect of convergence and divergence in different stages of design). In fact, the students with a diverging learning style are more successful in the creative design of architectural design, imagination, and different solutions during the first stage of design. Therefore, a successful learner in multidimensional architecture is a person who is adapted to different, flexible and relativistic situations and can use different learning styles appropriate to the position [31]. Finally, this kind of architecture should strengthen the ability to move around the entire learning cycle and use different learning styles in different stages of design.

7. CONCLUSION

According to the results of present study and their comparison with the results of previous research, other factors except for course of study can affect the students' preferences in learning styles although divergent style was the architecture students' dominant style in this research. Therefore, it is essential to pay more attention to learning styles in different cultures and educational systems and the results of this study should be generalized to all architecture students. Furthermore, it is worth noting that each of Kolb's learning styles have their weaknesses and strengths, and relying on a certain style and ignoring other styles cause serious failure for learners in architecture according to multidimensional courses of this discipline. Therefore, teachers should provide situations where all learners can successfully pass four learning stages and consider the skills and abilities of other styles while possessing the characteristics of one of these styles. Thus, students with different learning styles can be employed at different stages of undertaking architecture projects in the classrooms to help and familiarize other students with their thinking styles. In addition, Teachers should describe strengths and weaknesses of each learning style at different stages of an architecture project and different courses of this discipline for students in order to enable them to take steps towards reinforcement and completion of styles by identifying their own strengths and weaknesses. Given the interactive architecture discipline and teachers' more communication with the students during practical projects of architecture, the identification of students' learning styles can help teachers to assist students in overcoming their weaknesses by critical consultation and corrections. An increase in teachers' awareness of learning styles results in increasing the flexibility of teachers' teaching styles and strengthening the communication between teacher and students.

8. LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

Due to the limitation of this study, the changes were evaluated in learning styles during education on four student groups at four years of study in architecture. It is suggested that possible changes should be studied among the students' learning styles with higher education by focusing on a group

of students during four years of education and evaluation of changes in their learning styles from the admission at architecture and during four years of education in architecture. In addition, this research investigated the students' total grade point average in different courses at university. It is suggested that other researchers can focus on the students' total grade point average in different fields of study due to the multidimensionality of architecture courses in order to reveal the exact impact of learning styles on all of the courses.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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AUTHOR (S) BIOSKETCHES

Mirmoradi, S. S., *Assistant Professor, School of Architecture, Babol Noshirvani University of Technology, Babol, Iran*
Email*: S.Mirmoradi@nit.ac.ir*

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