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An Analysis on Learning Styles and Personality Types of Students in the Techniques of Architectural Presentation Course

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Abstract

Determining the learning styles of the students in the process of constructing curricula is significant for the development of architectural education. This study aimed to evaluate the relationship between the learning style of first-year architecture students and their successful performance in "The Techniques of Architectural Presentation" course and to discuss the relationship between learning styles-gender and learning styles-course curriculum. Kolb and Briggs Myers learning style inventories were used in the study. It was determined that the students with a diverging style had a large share of participants, and no significant relationship was established between gender, course success, and Kolb's learning style. According to the MBTI inventory, it was determined that the differences in the mean scores of the students' genders in the "Intuition", "Feeling," and "Perception" profiles were significant. An increase in success rate in 3D studies indicates the importance of the development of syllabi with 3D applications.

Keywords: *Architecture education, learning styles, personality types, Kolb, Briggs Myers.*

Mimari Anlatım Teknikleri Dersinde Öğrencilerin Öğrenme Stilleri ve Kişilik Tipleri Üzerine Bir Analiz

Öz

Öğrencilerin öğrenme stillerinin ders müfredatının oluşturma sürecinde belirlenmesi mimarlık eğitiminin gelişimi açısından önemlidir. Bu çalışma birinci sınıf mimarlık öğrencilerinin öğrenme stili ile "Mimari Anlatım Teknikleri" dersindeki başarı performansı ilişkisinin değerlendirilmesini; öğrenme stilleri-cinsiyet ile öğrenme stilleri-dersin müfredatı arasındaki ilişkinin tartışılmasını amaçlamıştır. Çalışmada Kolb ve Briggs Myers öğrenme stili envanterleri kullanılmıştır. Değiştiren stiline sahip olan öğrencilerin büyük paya sahip oldukları, ve cinsiyet, ders başarısı ve Kolb öğrenme stili arasında anlamlı bir ilişki kurulamadığı tespit edilmiştir. Briggs Myers envanteri öğrencilerin cinsiyet faktörü bağlamında değerlendirildiğinde "Sezgisel", "Hisseden" ve "Algılayan" profillerindeki puan ortalamaları arasında anlamlı farklılıklar saptanmıştır. Üç boyutun dahil edildiği çalışmalarda başarı oranının artması ders izlencesinin üç boyutlu uygulamalar ile geliştirilmesinin önemini belirtmektedir.

Anahtar kelimeler: *Mimarlık eğitimi, öğrenme stilleri, kişilik tipleri, Kolb, Briggs Myers.*

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1. Introduction

Architecture education in the changing-transforming environment, as in other fields, requires updating. The structure of architectural education is influenced by variables such as curricula, teaching environments, changing technological and socio-cultural environments, and related professional dynamics, and student, and teacher characteristics. Student characteristics include variables such as age, gender, intelligence type, and learning style. Hemdan, Taha & Cherif (2023) state that students' performance depends on the school characteristics, educator's influence, and students' attributes which include personality and abilities.

Understanding individual differences will help architecture education and educators improve design teaching techniques and help students improve themselves and achieve their goals. While students need to identify their own learning needs, it is also the responsibility of the university to recognize and plan to meet them (Hodgkinson, 1994). However, there are limited studies on the contribution of learning style and personality types to the educational process and its relationship with the curriculum in architectural education. This study investigates the learning styles and personality types of architectural students and the relationship between these styles and the level of success in the student's education. The results obtained are intended to aid in the curriculum's development. The principal aims of this study are.

- to determine differences in learning styles and personality types among first-year architecture students
- to investigate the relationship between learning styles, personality types, and success in the Techniques of Architectural Presentation course
- to determine the correlation between different learning styles, personality types, and the gender of students taking the course
- to determine the relationship between homework evaluations, learning styles, and personality types

To these ends, learning style inventories were applied to first-year undergraduate students who took the ARCH101-Techniques of Architectural Presentation course in the Department of Architecture at Gebze Technical University. These inventories were evaluated together with homework evaluations and course success through SPSS.

1.1. The Learning Styles and Personality Types

Demirkan and Demirbaş (2010, p.1390) define learning as an internal process that is different for each individual and learning style as an individual's way of acquiring new knowledge. Dunn and Dunn (1993) define learning style as the way individuals start to concentrate, process, internalize, and store new and difficult information, further asserting that the interactions of these elements occur differently in each individual. Vygotsky (1978) argues that learning styles are gender, culture, and discipline-specific and are both the product and the process of socio-cultural learning environments.

Learning style theory asserts that students are academically successful in learning environments that suit their learning styles (Dunn 1983; Kolb 1984). Various models have been developed since the 1960s to investigate these styles. Coffield, Ecclestone, Moseley & Hall (2004, p. 8-9) examined the learning style literature and determined that out of seventy models surveyed, the most valid and widely used are those of Jackson, Riding, Sternberg, Dunn and Dunn, Gregorc, Honey and Mumford, Kolb, Entwistle, Herrmann, Myers-Briggs, Apter, Vermunt and Allinson and Hayes, of which Kolb's learning style inventory is the most widely used. Kolb's model, however, determines only an individual's learning preferences, while others, such as those of Apter, Jackson, and Myers-Briggs, help to identify both the learning preferences and personality type. This study uses both the Kolb learning style inventory and the Myers-Briggs personality type inventory to probe into the relationship between differences between individual students and course success by determining both their personality types (MBTI) and learning styles (KOLB).

1.1.1. The Kolb learning style

Experiential Learning Theory, developed by David Kolb in the early 1970s, along with the Learning Style Inventory (LSI) designed to test the theory, is one of the most widely used models in the literature (Tucker, 2008). Kolb, dissatisfied with traditional teaching methods, developed an inventory idea that would determine individual learning differences and indicate the resulting preferences (Kolb, 1981). Experiential Learning is a dynamic learning model based on a learning cycle driven by the dual dialectic of action/thinking and experience/abstraction. It defines learning as the process that occurs through the transformational experience of gaining knowledge (Kolb, 1984). Moreover, it asserts that learning arises from the synthesis of grasping and re-transforming experiences (Kolb, 1984). Grasping experience refers to the process of receiving information while transforming experience comprises how individuals interpret and act upon that information. The Experiential Learning model encompasses four dialectically related modes: two (Concrete Experience-CE and Abstract Conceptualization-AC) in the experience cognition dimension, and two (Reflective Observation-RO and Active Experimentation-AE) in the transforming experience dimension (Fig. 1).

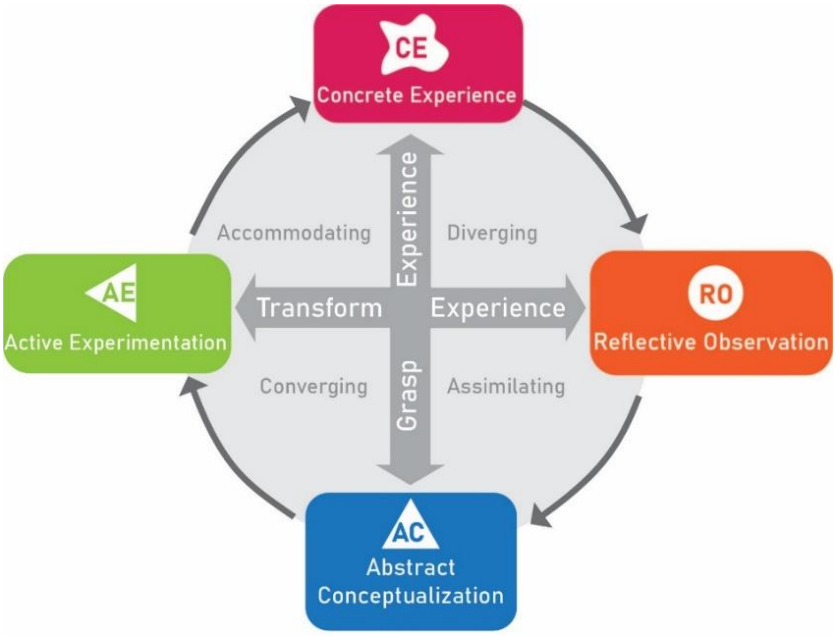


Figure 1. Kolb's learning style inventory (Kolb, 1984)

CE focuses on being involved in experiences and dealing with human situations. It emphasizes emotion rather than thinking, is concerned with the uniqueness and complexity of existing reality instead of theories and generalizations, and takes an intuitive, "artistic" approach to problems rather than a systematic, scientific one. RO focuses on understanding reality through examination and description of ideas and situations. It emphasizes reflection and understanding rather than action and practical application, concerned more with the best approach to determining what is right or what will work. AC focuses on the use of logic, ideas, and concepts, emphasizing thinking over feeling, constructing general theories over intuitively understanding specific areas and taking a scientific rather than an artistic approach to problems. AE focuses on actively influencing people and changing situations, emphasizing practical applications, unlike reflective understanding; it takes a pragmatic interest in what works rather than in absolute truth and focuses on doing rather than observing (Kolb & Kolb, 2013, p. 7-8). Out of the definition of this dual matrix emerge four learning styles: converging, diverging, assimilating, and accommodating.

Type 1: Converging (abstract, active) is based on abstract conceptualization and active experience; those with this learning style are good at problem-solving, decision-making, and the practical application of ideas, perform best in situations such as traditional intelligence tests, are controlled in the expression of emotion, and prefer to deal with technical rather than interpersonal issues.

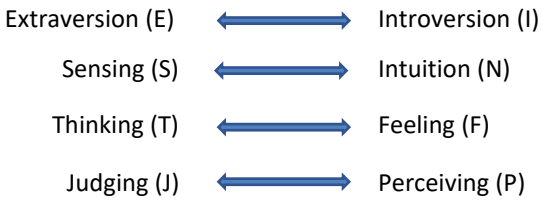
Type 2: Diverging (concrete, reflective) emphasizes concrete experience and reflective observation; those with this learning style are creative and aware of meaning and values, see concrete situations from many angles, adapt through observation rather than action, and are interested in people and emotion-oriented.

Type 3: Assimilating (abstract, reflective) is based on abstract conceptualization and reflective observation; those with this learning style like to reason by induction, and create theoretical models; they are more concerned with ideas and abstract concepts than with people and think that the abstract rationality of ideas is more important than their practice.

Type 4: Accommodating (concrete, active) emphasizes concrete experience and active experience; those with this learning style like to make plans and get involved in new experiences, are good at adapting to changing conditions, solve problems intuitively through trial and error, and communicate efficiently with others; however, they can sometimes be perceived as impatient and aggressive (Coffield et al., 2004, p. 60-61).

1.1.2. Myers-Briggs type indicator (MBTI)

The Myers-Briggs Type Indicator (MBTI) was developed in the early 1940s to make Jung's (1991) theory of human personality understandable and useful in daily life (Coffield et al., 2004, p. 46-47). The MBTI inventory that Myers and Briggs developed comprises 16 personality types through the addition of the Judging and Perceiving (J-P) dichotomy to Jung's eight basic psychological types (Myers & McCaulley, 1998). The development of several variants followed the publication of the first MBTI guidelines in 1962 (Form G, form M, form J, and form K) (Myers & McCaulley 1985). For this study, form M, comprising 93 questions, was used. The inventory consists of two answer questions addressing four different dichotomies (Coffield et al., 2004, p. 46-47).



Through the evaluation of each of the four dichotomies separately, the dominant dimensions can be brought together, and the personality type is revealed (Table 1).

Table 1. Personality types and characteristics (Myers & McCaulley, 1998, p. 38)

		Feeling Types				Intuitive types			
		With thinking		With feeling		With feeling		With thinking	
Introverts	Judging Types	**ISTJ**		**ISFJ**		**INFJ**		**INTJ**	
		I	Depth of concentration	I	Depth of concentration	I	Depth of concentration	I	Depth of concentration
		S	Reliance on facts	S	Reliance on facts	N	Grasp of possibilities	N	Grasp of possibilities
		T	Logic and analysis	F	Warmth and sympathy	F	Warmth and sympathy	T	Logic and analysis
		J	Organization	J	Organization	J	Organization	J	Organization
	Perceiving Types	**ISTP**		**ISFP**		**INFP**		**INTP**	
		I	Depth of concentration	I	Depth of concentration	I	Depth of concentration	I	Depth of concentration
		S	Reliance on facts	S	Reliance on facts	N	Grasp of possibilities	N	Grasp of possibilities
		T	Logic and analysis	F	Warmth and sympathy	F	Warmth and sympathy	T	Logic and analysis
		P	Adaptability	P	Adaptability	P	Adaptability	P	Adaptability
Extraverts	Perceiving Types	**ESTP**		**ESFP**		**ENFP**		**ENTP**	
		E	Breadth of interests	E	Breadth of interests	E	Breadth of interests	E	Breadth of interests
		S	Reliance on facts	S	Reliance on facts	N	Grasp of possibilities	N	Grasp of possibilities
		T	Logic and analysis	F	Warmth and sympathy	F	Warmth and sympathy	T	Logic and analysis
		P	Adaptability	P	Adaptability	P	Adaptability	P	Adaptability
	Judging Types	**ESTJ**		**ESFJ**		**ENFJ**		**ENTJ**	
		E	Breadth of interests	E	Breadth of interests	E	Breadth of interests	E	Breadth of interests
		S	Reliance on facts	S	Reliance on facts	N	Grasp of possibilities	N	Grasp of possibilities
		T	Logic and analysis	F	Warmth and sympathy	F	Warmth and sympathy	T	Logic and analysis
		J	Organization	J	Organization	J	Organization	J	Organization

MBTI is evaluated in single, binary, or quart categories. Keirsey & Bates (1974) also sort personality types into four categories to better understand and correlate them: NF, SP, NT, and SJ.

1.2. Learning Style, Personality Types and Architecture

In architectural education, active learning takes place when students question design theories, relate these theories to existing design problems, and engage in a creative exploration process.

The architecture studio creates a context that promotes active learning through group or individual problem-based projects. The challenge of defining a problem and its boundaries and developing a creative approach to its solution helps develop justified reasoning, interpersonal skills, thinking in action, and critical thinking for the practices that form the foundation of architectural education (Schön, 1983). Design is a process where potential solutions to a problem are first generated in the mind, followed by processes of analysis and synthesis, and the best of these potential solutions is then turned into a design output (Yurtgün & Çınar, 2023, p. 297). In this experiential learning model, students pose and negotiate design problems while teachers act as facilitators prodding students in the direction of learning. Kvan and Jia (2005) stated that the characteristics of students' learning styles can be utilized to further the development of learning in design. Under the influence of these perspectives, the use of learning styles in the architectural profession has been a research topic since the last quarter of the 20th century.

Demirbaş & Demirkan (2003), arguing that design education can be examined through Kolb's Experiential Learning Theory, conducted a study examining the effects of learning styles on the design processes of design students. They observed statistically significant differences in the performance

scores of students with different learning styles at various stages of the design process. Students with an assimilating style had the largest and those with an accommodating style the smallest increase in performance scores; however, accommodating students were more successful overall in the project course. Tucker (2007) emphasized that there was a significant relationship between KOLB learning styles and participation in a study year for first and third-year students in the architectural design course, and as the learning process progressed, there was a shift toward the abstract conceptualization axis (converging and assimilating) in the learning style graph. Tucker also noted that students further along the axis of abstract conceptualization were more successful. Yazıcı (2014, p. 155-168) also used Kolb's Learning Style Inventory to determine the learning styles of students in a study investigating the relationship between perspective drawing success and the learning styles of architecture students, finding that students with an assimilating style were more successful, followed by those with a diverging style, and then by those with a converging style. Students with an accommodating learning style showed the weakest performance. Özdemir (2016) investigated the connection between learning style and success among first-year Basic Design students in the architectural department, determining that students with assimilating and diverging learning styles were more successful. Yazıcı investigated again in 2021 the relationship between successful evaluations in architectural design courses over 8 semesters and the learning styles of students who started architectural education in two different academic terms, 2010 and 2012, using the Kolb Learning Style Inventory, noting that the academic success of both sets of architectural students showed similar results. The most successful students were, in descending order, those with diverging, converging, assimilating, and accommodating styles. Kolsal & Kandemir (2021) determined that 76.4% of the first-year architecture students evaluated through the Kolb learning style inventory had a diverging learning style, followed by assimilating and accommodating, with no students in the converging group. They also noted that students with an assimilating style in the design process were more successful.

Various learning style studies on architectural education have been conducted using the MBTI inventory since the 1990s. Brown, Hallett & Stoltz, (1994) found that NT and NF were the dominant learning style groups in their research on landscape architecture students in Canada. Russ and Weber (1995) used the MBTI inventory to examine the personality traits of two hundred and thirty-four interior architecture students at twelve accredited universities in the USA. Of these students, 40.2% were identified as NF and 16.2% as ENFP personality types. Durling, Cross, and Johnson (2019) applied the MBTI inventory to extract the personality profiles of 71 first-year design students in England. Their results indicated that the dominant personality groups were ENTP, ENFP, and ENTJ, at 26.8%, 15.5%, and 9.9% of the students surveyed, respectively. Poursafar, Devi, and Rodrigues (2015) employed the MBTI inventory to investigate personality types in architectural offices, e-surveying one hundred twenty-six Indian and one hundred seventy-six Iranian architects; the most dominant personality types were ESTJ (25.17%), ISTJ (15.56%), ENTJ (12.25%), and ENFJ (8.61%). Robert Gaarder applied the Myers-Briggs inventory to 100 architects in the US and determined the dominant personality type (31% of the total) to be ENTJ (Architect Magazine, 2011). The literature seems to indicate that different features in the Myers-Briggs inventory can be associated with the architectural profession. At the same time, similar studies in different cultures have produced different results.

2. Material and Method

In line with the stated aim of the research, in the fall semester of 2019-2020, Kolb and MBTI inventories were used to classify forty-seven first-year architecture students at Gebze Technical University's Department of Architecture's ARCH 101 Techniques of Architectural Presentation course. To complete the study, an ethical declaration numbered E-100822 was provided by the Ethics Committee of Gebze Technical University.

2.1. The Course of Techniques of Architectural Presentation

The course is one of the basic vocational courses given in the first semester of the first year for six hours a week. Its purpose is to provide students with the ability to use different representational environments to solidify design thinking. Although hand drawing is the predominant representational

method in the course, the students also use computer technologies to experience three-dimensional model applications (Table 2).

Table 2. The Content of ARCH 101

Weeks	Content	Scope	Techniques	Homework
1	Freehand sketching, writing and line drawing, line types, hatching techniques	2D	theory+practice	H01, H02, H03
2	Dividing a line segment, circular drawings	2D	theory+practice	H04, H05, H06, H07, H08, H09, H10
3	Projection drawings, descriptive geometry	2D+3D	theory+practice	H11, H12
4	Projection drawings, descriptive geometry	2D+3D	theory+model+computer+practice	H13
5	Projection drawings, descriptive geometry	2D+3D	theory+model+computer+practice	H14, model
6	scale, furnishing (room drawing)	2D+3D	theory+practice	H15, model
7	Projection drawings (plan, section, elevation)	2D+3D	theory+model+practice	H16, H17, H18
8	Projection drawings (plan, section, elevation)	2D+3D	theory+model+practice	H19, H20, H21
9	Mid-Term Exam			H22, H23
10	Sample project 1/200, 1/100 scales	2D+3D	theory+practice	H24, H25, H26, H27
11	Sample project 1/50 plan-section-elevation	2D+3D	theory+practice	H28, H29
12	Sample project 1/50 plan-section-elevation	2D+3D	theory+practice	H30
13	One-point perspective	2D+3D	theory+practice	H31, H32, H33, H34
14	Two-point perspective	2D+3D	theory+practice	H35, H36, H37

2.2. The Implementation of Kolb and MBTI Inventories

Kolb and MBTI inventories were applied to forty-seven students over one hour. A pilot study was conducted, and the test period was determined before implementation. A personal data form was used to obtain information such as age and gender. Inventories were evaluated according to the Kolb and MBTI Form M answer keys.

The Kolb inventory consists of twelve questions with four choices each. Participants rank the choices in each question from 1 to 4 points (4 being most suitable and 1 least suitable). In the evaluation process, the points applicable to each dimension (CE, AC, RO, AE) are categorized accordingly. By subtracting the RO score from the AE score and the CE score from the AC score, the x and y values of the matrix, which indicate the learning style of the participant, are revealed.

In the evaluation process of the MBTI inventory, the answers given by the participant for each question are calculated along four dichotomy axes (E-I, S-N, T-F, J-P). Each dichotomy is examined in itself, and the answers applicable to each dichotomy dimension are subtracted from the others to determine the dominant dimension. Then, the preference clarity category is then determined by considering the size of the dominant dimension (Table 3).

Table 3. Preference Clarity Categories (Myers & McCaulley, 1998)

Dichotomy	Greatest Raw Points	Preference Clarity Category
E-I	11-13	Slight
	14-16	Moderate
	17-19	Clear
	20-21	Very Clear
S-N	13-15	Slight
	16-20	Moderate
	21-24	Clear
	25-26	Very Clear
T-F	12-14	Slight
	15-18	Moderate
	19-22	Clear
	23-24	Very Clear
J-P	11-13	Slight
	14-16	Moderate
	17-20	Clear
	21-22	Very Clear

The data obtained from the inventories were evaluated with the SPSS statistical program.

3. Findings and Discussion

A total of 47 students participated in the research, 30 females and 17 males. Data taken from the Kolb and MBTI inventories were examined separately and thereafter evaluated jointly.

3.1. KOLB

According to the Kolb inventory, the distribution of learning styles was: 7 participants (14,9%) accommodating, 32 participants (68,1%) diverging, 2 participants (4,3%) converging, 5 participants (10,6%) assimilating, and 1 participant (2,1%) diverging- assimilating.

Although Figure 2 highlights a significant gender disparity in the proportion of diverging learning styles, the results of the independent samples' t-test indicate that the differences between the mean scores of the "converging", "diverging", "assimilating" and "accommodating" profiles for female and male students were not significant. (Table 4).

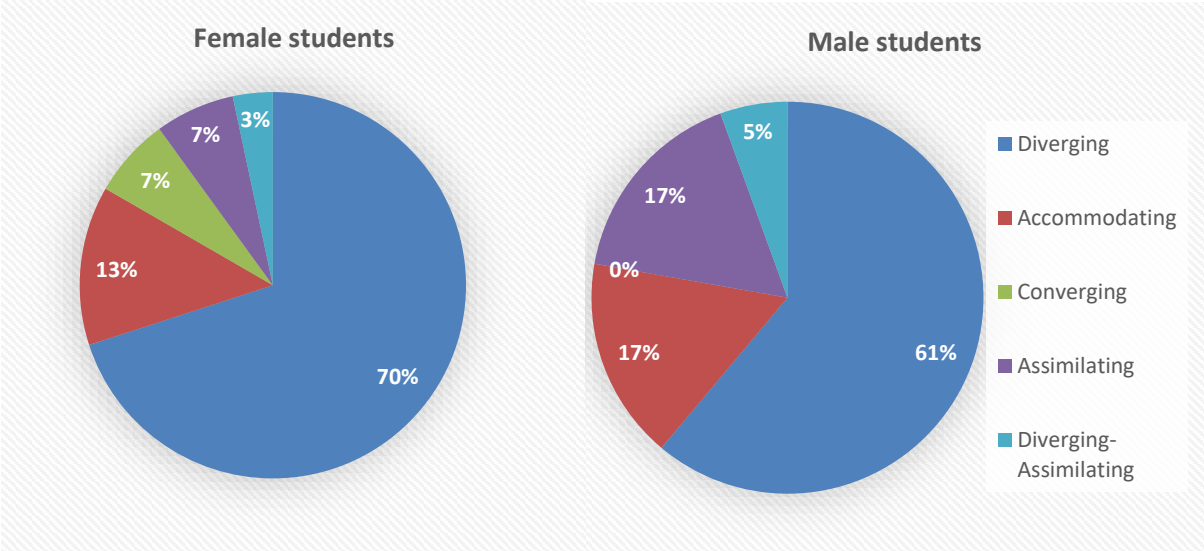


Figure 2. Learning styles according to gender variable

Table 4. Independent samples' t-test results of gender variable

No	Gender	Independent samples t-test	Converging	Diverging	Assimilating	Accommodating
		t value	-1,145	-,450	-,287	-,880
		Significance Level	,258	,655	,775	,383
30	Female	Mean	26,00	26,066	34,233	33,400
		Std. Deviation	5,988	5,394	5,144	5,443
		Std. Error	1,093	,984	,939	,993
17	Male	Mean	28,058	26,082	34,705	34,941
		Std. Deviation	5,803	5,779	5,881	6,309
		Std. Error	1,407	1,407	1,426	1,530

The forty-seven students' coursework was categorized as 2D or 3D based on the scope (Table 2). The averages of the coursework obtained in each group were evaluated on three scales (0-69, 70-84, 85-100). The coursework averages of the participants were then grouped with their Kolb learning styles. According to Table 5, while diverging and accommodating learning styles were associated with higher scores in 3D studies, no significant difference was observed in students with converging and assimilating learning styles.

Table 5. The relationship between Kolb learning styles and coursework

	Points	Diverging	Accommodating	Converging	Assimilating	Diverging-Assimilating	Total
2D	0-69	3 (9,37%)	1 (14,28%)	0	0	0	4
	70-84	25 (78,12%)	5 (71,42%)	2 (100%)	4 (80%)	1(100%)	37
	85-100	4 (12,5%)	1 (14,28%)	0	1 (20%)	0	6
Total		32 (100%)	7 (100%)	2 (100%)	5 (100%)	1 (100%)	47 (100%)
3D	69	2 (6,25%)	0	0	0	0	2
	70-84	18 (56,25%)	4 (57,14%)	1 (50%)	4 (80%)	0	27
	85-100	12 (37,5%)	3 (42,86%)	1 (50%)	1 (20%)	1 (100%)	18
Total		32 (100%)	7 (100%)	2 (100%)	5 (100%)	1(100%)	47(100%)

When set against course grades, there were more significant differences between the grades of those in the "Diverging" category, with insignificant disparities recorded for the other learning styles (Figure 3).

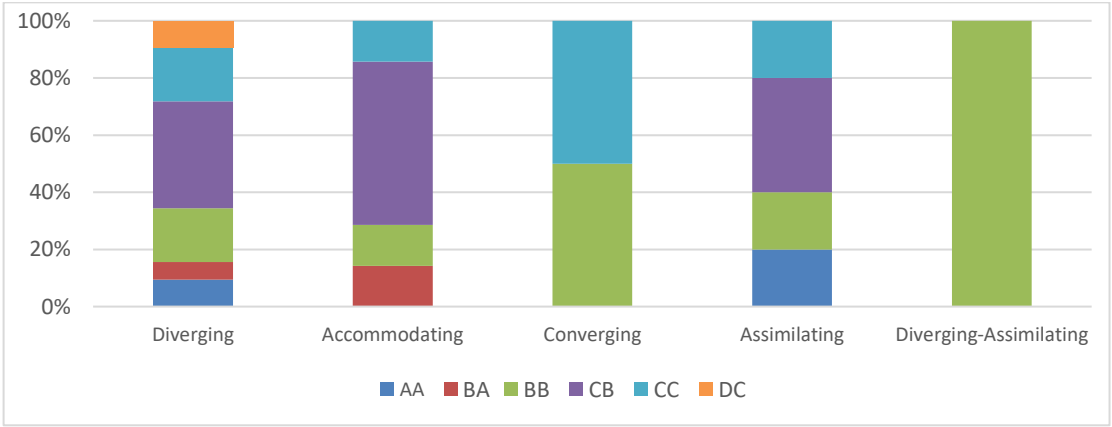


Figure 3. Participants' learning styles vs. course grades.

A one-way ANOVA test comparing participants' course grades and Kolb learning styles indicated no significant differences, suggesting there is no meaningful relation between Kolb learning styles and course grades (Table 6).

Table 6. The relationship between participants' learning styles and course grades.

		Sum of squares	Df	Mean square	F	Sig.
Converging	Between groups	70,425	5	14,085	,371	,865
	Within groups	1554,511	41	37,915		
	Total	1624,936	46			
Diverging	Between groups	66,153	5	13,231	,411	,838
	Within groups	1318,400	41	32,156		
	Total	1384,553	46			
Assimilating	Between groups	69,219	5	13,884	,453	,809
	Within groups	1254,100	41	30,588		
	Total	1323,319	46			
Accommodating	Between groups	147,748	5	29,550	,882	,502
	Within groups	1374,167	41	33,516		
	Total	1521,915	46			
Diverging-Assimilating	Between groups		5			
	Within groups		41			
	Total		46			

When the relationship between Kolb and course grades is examined through the scatter chart, there again appears to be no significant difference (Figure 4). However, evaluation of the coefficient averages of the students' Kolb categories and course grades together (coefficient values: AA:4; BA:3.5, BB:3; CB:2.5; CC:2; DC:1.5) indicate some differences. On a 4-point scale: assimilating 2.8; accommodating 2.64; diverging 2.61; converging 2.5.

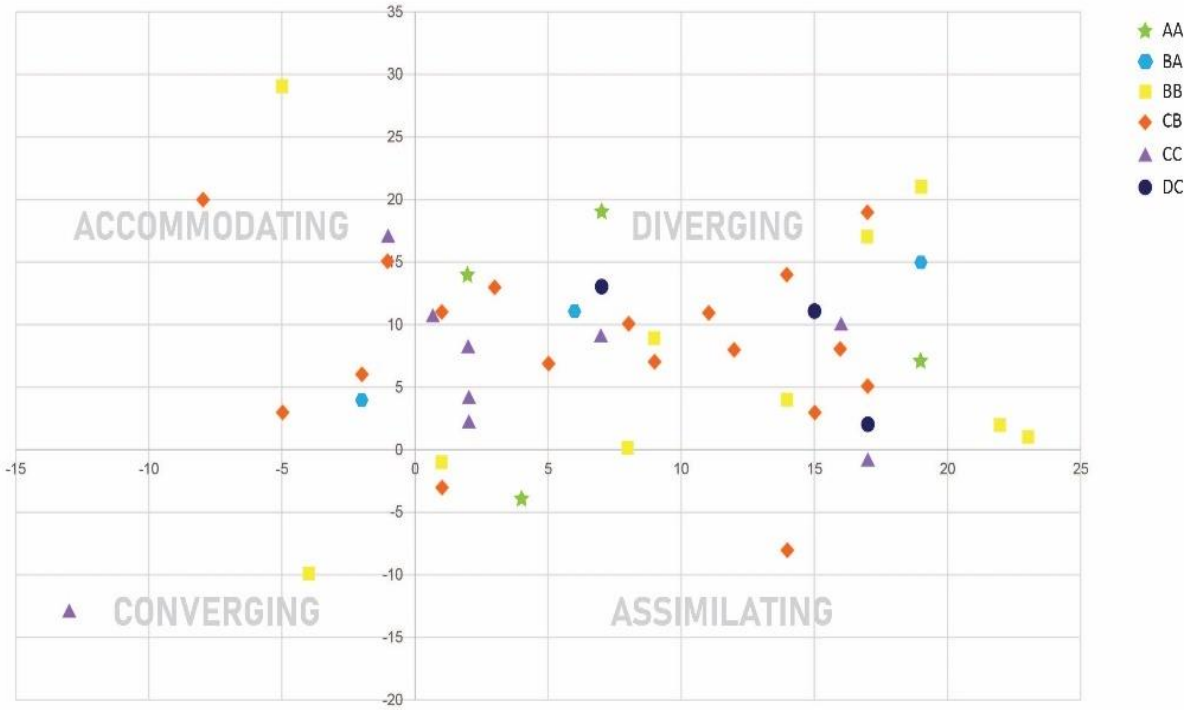


Figure 4. Scatter chart of Kolb learning styles vs. course grades

3.2. MBTI

The distribution of the participants' MBTI profiles in a single grouping was as follows; E:20, I:27, S:12, N:35, T:21, F:26, J:27, and P:20. Binary groupings revealed differences in the MBTI profiles of the participants according to gender (Figure 5).

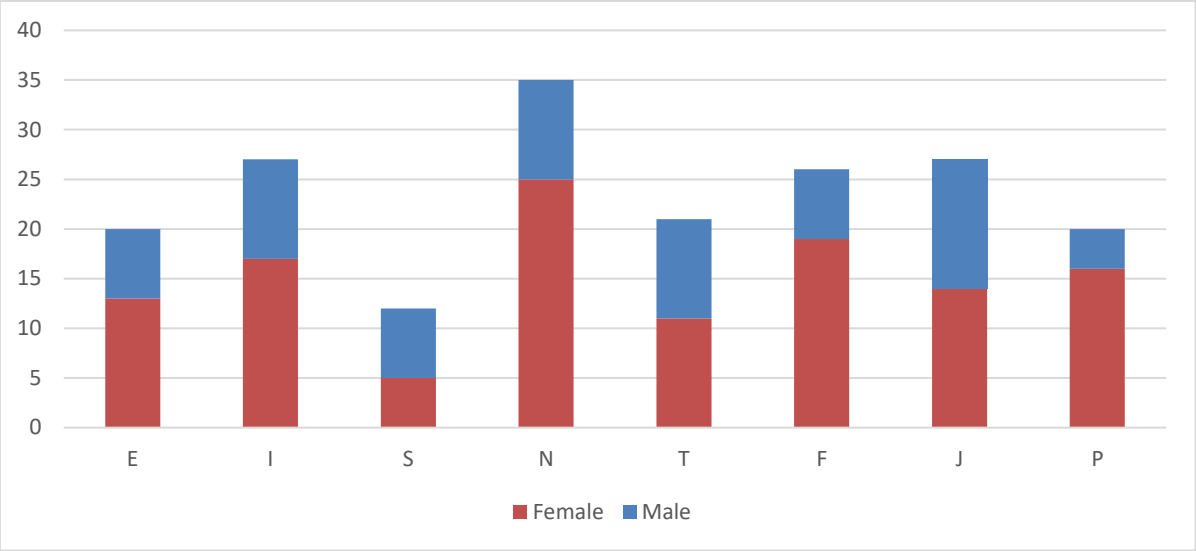


Figure 5. MBTI profiles of participants by gender

According to the results of an independent t-sample test analysis performed between the MBTI profiles (single) of the participants and the gender variable (Table 7), there were significant differences between the mean scores of the participants' genders in the N, F, and P profiles ($p<0.05$). In the same test performed with binary grouping profiles (Table 8), a significant difference was found at a 95% confidence level in the JP profile ($p<0.05$).

Table 7. Differences between participants' MBTI profiles (single) by gender variable

No	Gender	Independent samples t-test	E	I	S	N	T	F	J	P
		t value	,609	1,355	1,648	2,171	1,334	2,351	1,684	2,683
		Significance Level	,546	,182	,106	**,035***	,189	**,023***	,099	**,010***
30	Female	Mean	9,26	11,16	11,63	14,03	11,23	11,40	10,46	11,80
		Std. Deviation	2,59	2,52	2,189	2,189	1,77	1,65	3,52	3,44
		Std. Error	,47	,460	,399	,399	,324	,301	,642	,629
17	Male	Mean	9,76	10,17	12,64	12,70	12,00	9,764	12,29	9,058
		Std. Deviation	2,86	2,18	1,69	1,64	2,09	3,13	3,67	3,21
		Std. Error	,694	,530	,410	,400	,507	,759	,890	,778

Table 8. Differences between participants' MBTI profiles (binary) by gender variable

No	Gender	Independent samples t-test	E-I	S-N	T-F	J-P
		t value	1,298	1,016	1,296	2,704
		Significance Level	,209	,315	,211	**,010***
30	Female	Mean	20,433	25,666	22,633	22,266
		Std. Deviation	,678	,994	,889	1,201
		Std. Error	,123	,181	,162	,219
17	Male	Mean	19,941	25,352	21,764	21,352
		Std. Deviation	1,477	1,057	2,681	,931
		Std. Error	,358	,256	,650	,225

Table 9 gives both the 2D and 3D coursework score distribution alongside the personality types (NF, NT, SJ, SP) of the participants. The success rates of all participants were higher in the 3D-related coursework.

Table 9. The relationship between MBTI and coursework

	Points	SJ	SP	NF	NT	Total
2D	0-64	0	1 (16,67%)	1 (5%)	2 (13,33%)	4
	65-84	3 (50%)	5 (83,33%)	18 (90%)	11 (73,33%)	37
	85-100	3(50%)	0	1 (5%)	2 (13,33%)	6
Total		6	6	20	15	47
3D	0-64	0	0	0	2 (13,33%)	2
	65-84	1 (16,67%)	4 (66,67%)	14 (70%)	8 (53,33%)	27
	85-100	5 (83,33%)	2 (33,33%)	6 (30%)	5 (33,33%)	18
Total		6	6	20	15	47

Figure 6 below illustrates the relationship between MBTI profiles and course grades.

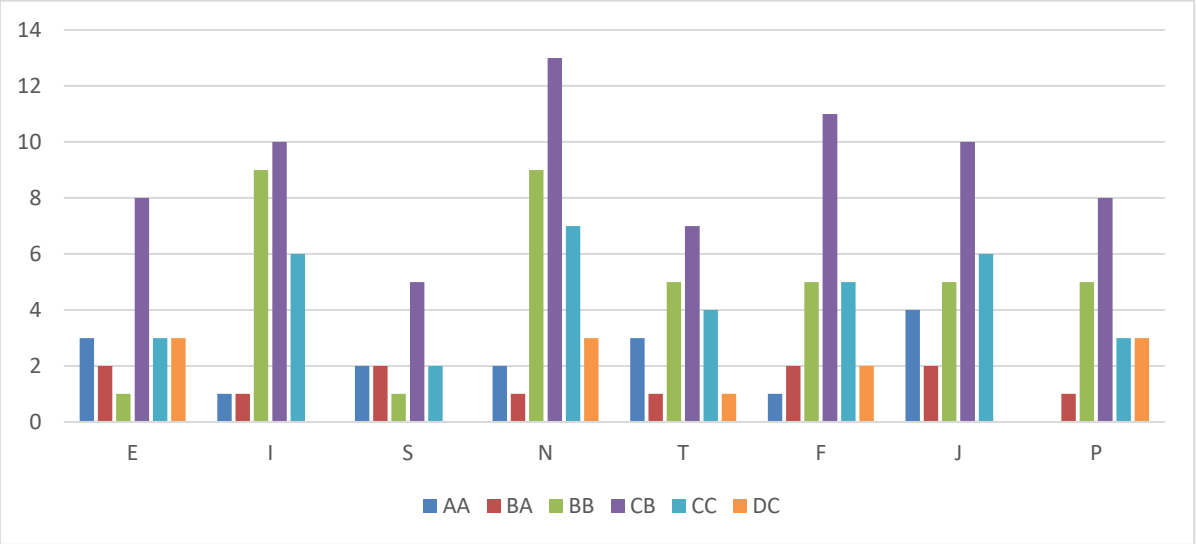


Figure 6. Participants' learning styles according to the variable of course grades.

No significant difference was found in a one-way ANOVA test comparing the MBTI profiles (binary) and the course grades of the participants (Table 10).

Table 10. The relationship between participants' MBTI profiles (binary) and course grades

		Sum of squares	Df	Mean square	F	Sig.
E/I	Between groups	6,170	5	1,234	1,130	,360
	Within groups	44,767	41	1,092		
	Total	50,936	46			
S/N	Between groups	6,284	5	1,257	1,247	,305
	Within groups	41,333	41	1,008		
	Total	47,617	46			
T/F	Between groups	8,313	5	1,663	,494	,779
	Within groups	137,900	41	3,363		
	Total	146,213	46			
J/P	Between groups	5,909	5	1,182	,823	,541
	Within groups	58,900	41	1,437		
	Total	64,809	46			

The results of a one-way ANOVA test comparing the MBTI profiles (single) and course grades of the participants indicate significant differences between the "E" and "S" profiles (Table 11).

Table 11. The relation between participants' MBTI profiles (single) and course grades

		Sum of squares	Df	Mean square	F	Sig.
E	Between groups	99,134	5	19,827	3,527	**,010***
	Within groups	230,483	41	5,622		
	Total	329,617	46			
I	Between groups	63,093	5	12,619	2,485	,047
	Within groups	208,183	41	5,078		
	Total	271,277	46			
S	Between groups	59,067	5	11,813	3,537	**,009***
	Within groups	136,933	41	3,340		
	Total	196,00	46			
N	Between groups	37,350	5	7,470	1,864	,122
	Within groups	164,267	41	4,007		
	Total	201,617	46			
T	Between groups	20,922	5	4,184	1,169	,341
	Within groups	146,822	41	3,581		
	Total	167,745	46			
F	Between groups	18,732	5	3,746	,623	,683
	Within groups	246,544	41	6,013		
	Total	265,277	46			
J	Between groups	102,501	5	20,500	1,652	,168
	Within groups	508,733	41	12,408		
	Total	611,234	46			
P	Between groups	87,510	5	17,502	1,424	,236
	Within groups	503,767	41	12,287		
	Total	591,277	46			

The sorting of the categories in the context of course grades, according to the category system of Keirsey and Bates (1974), were as follows: NF (2,45), SP (2,5), NT (2,7), and SJ (3,25). Statistically, there was no significant relationship between category and course grades, but it should be noted that the majority of students (71.4%) were from the NF and NT categories (Figure 7).

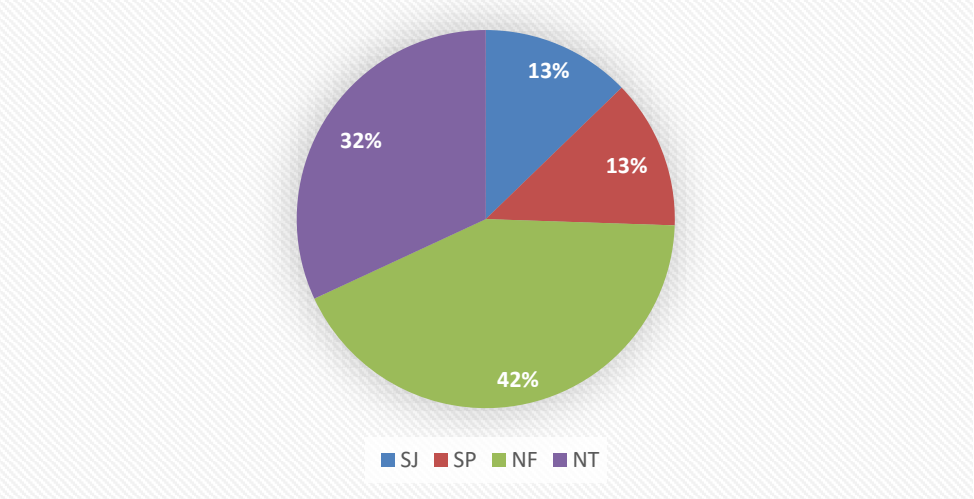


Figure 7. MBTI profiles of the participants by category

According to MBTI data regarding quartile grouping, the most frequently observed personality types were as follows (in descending order): INFJ, INTP, INTJ, ENFP, and ENFJ (Table 12).

Tablo 12. The participants' MBTI profiles

	ESTJ	ESFJ	ENTJ	ENFJ	ESTP	ESFP	ENTP	ENFP	ISTJ	ISFJ	INTJ	INFJ	ISTP	ISFP	INTP	INFP
Frequency	2	3	3	**5**	0	1	1	**5**	0	0	**5**	**8**	4	1	**6**	2
Percentage	4,2	6,3	6,3	**10,6**	0	2,1	2,1	**10,**	0	0	**10,6**	**17,0**	8,5	2,1	**12,7**	4,2

3.3. Discussion

The research revealed that 68.1% of the participants had a diverging learning style. The predominance of this style is compatible with the profession of architecture, as it emphasizes concrete experience and reflective observation and encompasses professions related to creativity. Analysis of concrete situations through an approach of reflective observation is also in accord with the concept of reflective practice put forward by Schön (1983). Schön (1983) states that designers should originally evaluate the design problems instead of applying standard problem-solving techniques, regarding designs as problematic, reframing them, and giving new meanings to the problem. Through the evaluation of new meanings, new criteria are brought to the problem, and the designer reframes the reshaped problem. In this process, the designer develops a deeper understanding of the problem.

Tucker (2007) stated in his study that as the learning process progresses, there is a shift toward the abstract conceptualization dimension (converging and assimilating) in the learning style graph, particularly successful architecture students showing more aptitude along this axis.

Kolsal &Kandemir (2021) noted that according to the Kolb learning style surveys applied to the first-year students of the architecture department, 76.4% of the students were diverging, with the rest in the assimilating and accommodating groups and none in the converging group. Similarly, the current study observed that 68.1% of the first-year architecture students had diverging, 10.6% assimilating, 14.9% accommodating, and 4.3% converging learning styles. It was observed that the learning styles were mostly on the north axis, in concrete experience (accommodating and diverging). The fact that students remained in the concrete experience zone in both current studies suggests that the exam-oriented pre-university education system in Turkey may also have an effect. All the students participating in the research were first-class novice students. Because of the architectural education curriculum, a change in learning styles may be observed over the course of students' studies. The study also highlights that students with concrete experience express themselves better in 3D studies.

In the study of Yazıcı (2014), which analyzed success in the perspective drawing of architecture department students based on Kolb learning styles, it was noted that students with assimilating, diverging, and converging learning styles performed best, in descending order of success. Yazıcı's more current study (2021), covering eight semesters of the undergraduate process, indicated that students with a diverging learning style showed the highest success rates, followed by those with converging, assimilating, and accommodating styles (in descending order). Kolsal & Kandemir (2021) argued that students with an assimilating style are more successful in the design process. In a similar finding, Demirbaş & Demirkan (2003) recorded that an assimilating style was associated with the highest progress in a project course, and Özdemir (2016) determined that students with assimilating and diverging learning styles were more successful in a Basic Design course. Although certain differences were observed between Kolb learning style and course grades in previous studies, no significant differences were found in this study.

Tucker (2007) concluded that, at least in the context of the architectural design course, gender does not affect academic achievement. In this study, no significant results were obtained when contrasting gender and Kolb learning style. In this context, Halpern & Collaer (2005), who argued that gender differences are socially based, emphasized that with the Women's Movement began in the 1960s, gender discrimination may almost disappear in the future due to equal learning opportunities for men and women, and the society will advance to a gender-neutral state.

When it came to MBTI profiles and gender, significant differences were observed in the N, F, and P profiles. The profiles of the female participants were dominant in the intuition, feeling, and perceiving profiles rather than the sensing, thinking, and judging profiles. When evaluated according to binary grouping, a significant difference was observed in the J/P dichotomy. In the context of 2D vs. 3D coursework, students belonging to the SJ, SP, NF, and NT categories were more successful in the 3D studies, while participants belonging to the SJ category were more successful in both 2D and 3D studies. According to Myers & Myers (1980), the attraction of S types to occupations that allow them to deal with a constant stream of facts can be associated with such first-year architecture students' success in a technical course.

The one-way ANOVA test comparing the MBTI profiles (single) and the course grades of the participants demonstrated that the differences between the mean scores of the participants' course grades were significant for those in the "E" and "S" profiles. The fact that the students in the SJ category had the highest success rates in the coursework evaluation is in accord with their high course grades overall, indicating that such extroverted students are more successful than introverted students in a technical course that includes hand drawing, modeling, and computer drawing.

In a study conducted by Russ & Weber (1995), 40.2% of interior architecture students were identified as being in the NF group. Brown et al. (1994) found the dominant learning style groups to be NT and NF in their research on landscape architecture students in Canada; similarly, NF and NT learning style groups were dominant in this paper, while the SJ group was more successful in course grades. An evaluation of the MBTI profiles of those students with higher average course grades gave the following results: NT:7 participants, NF:5 participants, SJ:4 participants, and SP:1 participants. When the students with grades above the class average were analyzed by KOLB inventory, of the 17 students, 12 were in the diverging, 2 in the accommodating, 2 in the assimilating, and 1 in the converging group. 70.59% of the successful students were in the diverging learning style group; a closer examination of these students reveals that 4 of the 11 students in the group were in the NT, 3 in the NF, 4 in the SJ, and 1 in the SP personality type group. There was a total of 6 students belonging to the SJ group among all participants, all of whom had diverging learning styles, and their success rates were higher than those of the other personality types. Although NF and NT personality types were observed more frequently in the study, the course grades of the SJ personality type were higher. The fact that the learning styles of all the participants with the SJ personality type varied is not data that can be emphasized due to the small number of participants. However, in future studies, the learning style tendency of the SJ personality type group can be investigated with a larger number of participants.

Labip et al. (2017) highlighted the interconnections between the different learning style model dimensions and learning styles with the relevant learner characteristics. It was concluded that a learner related to Kolb's Concrete Experience (Kolb-CE) and MBTI's Sensing (MB-S) dimensions had several common characteristics like literal manner, tangible facts, direct and hands-on experience, practical, and concrete thinking. In this context, having diverging learning styles (CE) of the SJ group among all participants, and their higher success rate than those of the other personality types point out they have common characteristics that increase success in architectural education and there may be an interconnection between Kolb-CE and MB-S. The personality types observed most frequently in the study were the INFJ, INTP, INTJ, ENFP, and ENFJ groups, but these data do not match those of the literature (Russ & Weber, 1995; Durling et al., 2019; Poursafar et al., 2015; Architect Magazine, 2011).

The higher success rate in 3D studies in both the Kolb and MBTI coursework evaluation tables requires that the syllabus be developed with 3D applications. In the world of the Fourth Industrial Revolution, where information technologies are developed and systems progress autonomously, architecture education needs to interpret current trends and reflect them in the curriculum.

4. Conclusion and Suggestions

This study aimed to evaluate the relationship between the learning styles and personality types of first-year Architecture students using the Kolb learning style and MBTI personality type inventories. The findings of the study were correlated to observe the impact of gender and impact on course success. As a result of the KOLB inventory, it was determined that the students with a diverging learning style had a large share, and no significant relationship was established between gender, course success, and learning style. The learning styles of 82,98% of students were on the concrete experience axis of the inventory (accommodating and diverging). Although significant correlations were found between KOLB learning style and course grades in the literature, no such significant results were obtained in this study. This finding can be derived from the fact that the students participating in the research were novice architecture students. When the same students reach their fourth year, an inventory can be applied to determine the change in their learning styles.

In the context of the MBTI inventory, the differences between the mean scores of the students' genders in the "Intuition," "Feeling," and "Perception" profiles were significant. A significant difference was also found between the "Judgment-Perception" profile of female and male students. However, the personality type differences between genders do not correlate with either the learning styles of the students or course grades.

The dominant personality types observed in the study were INFJ, INTP, INTJ, ENFP, and ENFJ; these data do not match those of the literature. Various dominant personality types have been identified in studies conducted in different countries, therefore cultural differences can thus be regarded as a variable in personality type, as determined before. To examine this variable, a regional study with a higher number of participants may be conducted in the future.

Students in the NT, NF, SP, and SJ categories of the MBTI inventory were also evaluated based on their KOLB learning styles; the most frequently successful students belonged to the NT and NF groups, while those in the SJ group saw the highest overall success. Since the number of participants with the SJ personality type was small, these data cannot be considered valid. In future studies, the learning style tendency of the SJ personality type group can be investigated with a larger number of participants.

The relationship between Kolb learning styles, MBTI, and success in coursework was investigated, and a higher likelihood of success in 3D studies was observed for certain learning styles, which highlights the importance of the development of 3D applications within the syllabus.

This study is limited to coursework and course grades in an undergraduate course; the information obtained is therefore not valid for students' learning abilities in other courses. Despite these limitations, the study can contribute to the improvement of the techniques of architectural presentation courses in the architecture departments. In future studies, changes in students can be observed by repeating the study in the fourth year with the same participants.

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The article complies with national and international research and publication ethics. Ethics Committee approval in the study, Ethics Committee of the University of Gebze Technical University dated 13.04.2023 and E-100822 numbered.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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