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# Learning Styles of Architecture Students and Performance in Construction Management Courses: A Case Study*

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The aim of this research is to explore the learning styles of architecture students and correlate their learning styles with their performance in construction management courses. A second purpose is to determine whether the learning styles of architecture students change with the effect of architectural education from the first year to the last year of education. The data were collected by administering the Kolb learning style inventory II, survey to students in an undergraduate architecture program. The questionnaire was administered to students by direct contact, and data were collected from 55 participants. The obtained data were analyzed statistically using by SPSS 18 software. There was a statistically significant relationship found between learning styles and performance scores in construction management courses, and converger students are more successful at construction management courses. At the end of the research project, primary learning style of the architecture students was found to be the accommodator, and the research also found that a student's learning style changes and is shaped by the architectural education.

**Keywords:** architectural education; learning style; construction management education

## 1. Introduction

Learning can be defined as an internal process that differs from person to person. On the other hand, the method of using skills and the preferred method of learning can be defined as a learning style. A learning style considers how individuals/students can best perform learning tasks and the most appropriate methods for them. Kraus et al. [1] defined the learning style as the "individual's preferred method for receiving information in any learning environment". Fox and Bartholomae [2] describe learning styles as a biological and developmental set of personal characteristics, which is defined by the way an individual processes information. Therefore, a learning style can be described as a specific method or combination of methods for perceiving, converting and transforming information. Felder et al. [3] stated that this predisposition also explains the variations in learning styles among students; there are different learning styles that are apparent in different academic strengths, weaknesses, skills and interests.

Different preferences in the learning process emerge as learning styles and result in individuals having different learning styles. In this manner, some students tend to focus on datasheets, tables and algorithms, while others deal comfortably with abstract theorems and mathematical models. Some tend to react to forms of visual information such as schemas, diagrams or pictures, while others are interested in written or spoken forms of information. In other words, some types of learning experiences suit some individuals better than others. By adopting a suitable, preferred learning style, an individual can learn more effectively; otherwise, the learning experience can be wasted.

Felder and Brent [4] reported that efforts to understand students' styles of learning have resulted in the following:

- "Helping students understand their preferred learning style and to formulate successful learning strategies.
- Improving performance of students with heavy reliance on one mode of learning.
- Providing a framework for instructors to redesign their course to such that they "teach around the cycle".
- Increasing collegial discussions about teaching and interest in enhancing teaching."

Numerous studies on the application of learning styles in education found in the pertinent literature clearly show that the benefits of its implementation are significant. Some researchers describe how they have reformulated their disciplines in an effort to address the whole spectrum of learning styles; others explain how they have achieved success by using a variety of techniques and learning activities, such as group problem solving, projects, and exercises. Therefore, as Felder and Brent [4], pointed out, understanding learning style differences is an important step in designing balanced instruction that is effective for all students.



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This study aims to investigate the learning styles of architecture students throughout the four-year curriculum and correlate their learning styles with their academic performance in construction management courses and gender. In addition, this study attempts to determine whether the learning styles of architecture students change over the four years of education due to the effect of architectural education.

## 2. Architectural education

Architecture is a multidisciplinary, multiskilled, multidimensional and multimedia practice. Designers need to know about many crafts, technologies, and theories and to have the ability to communicate with specialists in many fields. This is also true in the education process for the discipline. Architectural education is not simply vocational education achieved by training. The educational process is usually not just about teaching how to solve problems but about finding what the problems actually are. In this respect, architectural education has its own specifications, and it is distinct from both the practice of architecture and the education of other disciplines.

The objectives and the context of the education determine the characteristics of the educational program, while the academic vision of the curriculum actively shapes the students who are involved in the education process. In this respect, when the architecture curriculum is the focus of the discussion, it is seen that the multifaceted structure of the architectural field leads to the development of a wide spectrum of courses. Uluoglu [5], the author of one of the studies on architectural education and the distribution and classification of architectural courses in the curriculum, states that the courses in the curriculum of contemporary architectural education institutions can be classified into four categories. In the first category, there are courses that develop an architectural orientation; second, there are courses that provide the scientific foundation of architecture; the third category consists of the courses that strengthen the base of architectural design and expression; and finally, there are the design studio courses that synthesize the concepts of the previous three categories. Since the curricula of different design institutions differ from each other, the above categorization of Uluoglu [5] is still acceptable for a general descriptive overview of the curriculum content of architectural education.

### *2.1 Fundamental courses for the development of architectural education*

According to Uluoglu [5], fundamental courses are generally designed for transmitting theoretical knowledge to architectural students. In this first category, there are courses related to art and history such as art history, history of the built environment, and history of furniture. Some courses are related to the human aspects of design such as sociology, psychology, and ergonomics, and some courses prepare the students for real life situations such as professional practice and design documentation. The knowledge obtained in these courses is generally theoretical rather than practice based.

### *2.2 Technical courses that provide the scientific formation of architecture*

The second category proposed by Uluoglu [5] consists of courses that are both theoretical and practice based. Although the knowledge base of these courses seems theoretical, it is directly related to practice. These courses have names such as construction, structures, materials, control of physical environments, building physics, construction management and occupational health and safety. The acquired knowledge in these courses is generally theoretical knowledge that is directly adaptable to practice.

### *2.3 Artistic courses that strengthen the base of design and expression*

The third category consists of courses that are more artistic in nature. These courses are for developing skills in architectural expression and presentation techniques such as technical drawing, freehand drawing, perspective, and model making. There are also other courses that belong to this category such as design and building programming. The courses in this third category are more practice-based.

### *2.4 Design courses*

The last category consists of design courses that synthesize the courses in the previous three categories. These courses are generally called design studios and constitute the most important part of architectural education. To have an effective design education, the lectured courses in the curriculum mentioned above should be considered together with the design studio with its own procedures, rituals, discourse, etc.

## 3. Construction management education in architecture programs

As mentioned above, construction management and related courses can be gathered under the umbrella of technical courses that provide the scientific foundation of architecture. To provide a formal architectural education and train undergraduate students interested in careers in the con-

struction industry, it has become necessary to address and overcome the numerous challenges facing the construction industry today. Effective construction management is essential for successful construction projects. It is the responsibility of the educational institutions who offer construction management modules to prepare their students adequately for this task.

Betts and Lansey [6] stated that construction covers a wide range of technical and theoretical subjects, and architecture students must acquire not only basic knowledge (for example, about law and management) but also the necessary practical skills. Construction education encompasses a wealth of knowledge in various applied areas, including architecture, construction methods and techniques, construction management, professional skills, cultural sensitivity, and occupational health and safety. Ditcher [7] noted that the construction management curriculum should reflect the dynamic needs of society, including those of employers and students, and the wider economic and political demands. In today's construction education environment, due to technological advancements, graduates must equip themselves with the ability to think creatively, and they must also have command of state-of-the-art knowledge. Due to the multidisciplinary nature of the profession, architecture students are obligated to develop basic skills in such areas as law, management science, planning and coordinating, planning techniques, and teamwork, all of which are within the scope of construction management. The success of the sector is closely related to its employees' quality of education. Similarly, the employees' level of education determines in part the level of success that they will experience in their careers.

Most of the recent studies on learning styles that were conducted by Fulani, et al. [8], Ozdemir [9], Tezel and Casakin [10], Demirbaş and Demirkan [11, 12], Kvan and Yunyan [13] on architectural education using experiential learning theory focused on the architectural design process through learning styles with a cross sectional view or the relationship between the academic performance of students and their learning styles. On the other hand, there are a limited number studies that are concentrated on construction management education [e.g., 14–17]. When the content of these studies was analyzed, it was clearly seen that none of them concentrated on both the learning styles of the students and the students' academic performance in construction management. There is only one study that focused on the learning styles of civil engineering students and their success in construction management courses [18]. Therefore, there is a gap in the literature about the effect of architecture education on the learning styles of students and the relationship between learning styles and construction management academic performance.

## 4. Methods

It is possible to find different methodological studies and models on learning styles in the literature. The most frequently used learning style models are the Myers Briggs type indicator (MBTI) [19], Honey and Mumford learning styles [20]; Felder–Silverman learning style model [21] and Kolb's learning style inventory (LSI) [22]. Although all the models classify the different learning styles in different ways, their aims and approaches are similar. Since the instructional approaches around the learning cycle of the models are essentially identical, it is not important which model has been chosen. Among the several learning style theories, Kolb's [22] experiential learning theory, which defines learning as "the process whereby knowledge is created through the transformation of experience", was chosen to support this study.

### *4.1 Instruments*

Experiential learning theory considers learning as a cycle that begins with experience, continues with reflection, and later leads to action that becomes a concrete experience for reflection [22]. Within the Kolb learning styles, four learning modes are identified (Fig. 1), as follows: (1) concrete experience (CE), (2) reflective observation (RO), (3) abstract conceptualization (AC), and (4) active experimentation (AE).

The concrete experience (CE) mode describes people who feel more than they think. Individuals in this mode tend to be very good at relating to others, and they tend to be intuitive decision-makers. The reflective observation (RO) mode describes people who would rather watch and observe others than be active participants. Individuals in this mode tend to appreciate exposure to differing points of view. The abstract conceptualization (AE) mode describes people who think more than they feel. Such people tend to have a scientific approach to problem solving as opposed to a more artistic approach. The active experimentation (AE) mode describes individuals who take an active role in influencing others as well as situations. These individuals welcome practical applications rather than reflective exercises and prefer actively participating rather than observing.

Willcoxson and Prosser [23] stated that the four learning modes of Kolb's experiential learning theory form two bipolar learning dimensions: concrete/abstract (the perceive axis in Fig. 1) and active/reflective (the process axis in Fig. 1). From a

hypothetical point of view, any learner would consciously move through all the modes in the learning cycle [22, 24]. Nevertheless, most of the practical studies and academic research on the subject showed that not all the learners experienced each stage of this cycle equally. The preferences of learners among the stages of the cycle do not make them better or worse learners. Each individual has a preferred learning style resulting from the tendency to either learn through experience, called concrete experience (CE), or through the construction of theoretical frameworks, which is abstract conceptualization (AC), combined with the tendency to either learn by doing through active experimentation (AE) or through reflection by reflective observation (RO).

According to experiential learning theory, learning is a cycle, and one learning style is the primary one for each individual. Each person's learning style is a combination of two of these four learning modes. Finally, learners can thus be classified into one of four learning styles, namely, (1) converger, (2) diverger, (3) assimilator, and (4) accommodator, which is mapped in one of the four quadrants [22].

Accommodating learners (accommodators) are learners who combine the learning modes of CE and AE. Accommodating learners grasp their environments concretely through their feelings and utilize action to transform the information obtained. Accommodators learn primarily from hands-on experience. They prefer to act on feelings rather than on a logical analysis. In solving problems, they rely more heavily on people for information than on their own technical analysis [25, 26].

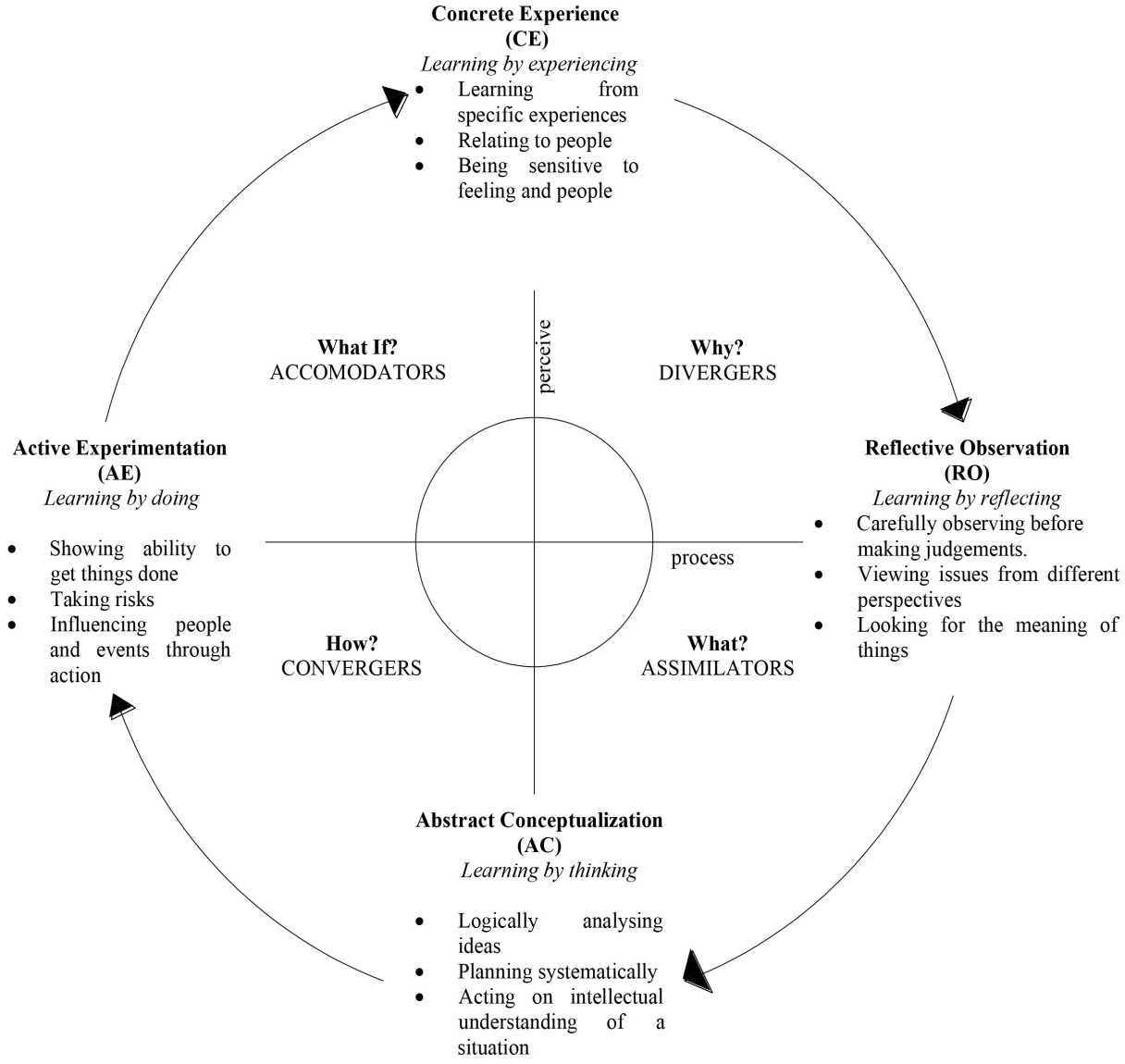


**Fig. 1.** Learning cycle and four learning modes of learning theory [12] (reprinted and modified with permission).

Diverging learners (divergers) combine the CE and RO modes. Divergers are best at viewing concrete situations from different points of view; they prefer brainstorming situations over taking action [26]. These types of learners are interested in people and tend to be imaginative and emotional [24]. Diverging learners have the ability to synthesize and/or assimilate a wide range of completely different observations into a comprehensive explanation that enables them to generate many ideas [25].

Assimilating learners (assimilators) are learners who combine the AC and RO modes. Assimilators are best at understanding a wide range of information and organizing it into a concise, logical form. They are more interested in abstract ideas and concepts than people. They value the logical soundness of a theory more than its practical value [26].

Converging learners (convergers) combine the AC and AE modes. Convergers are best at finding practical uses for theories and ideas and are good at solving problems and making decisions. Kolb suggests that they prefer dealing with technical tasks rather than with social and interpersonal issues [26].

The first purpose of this research was to determine the distribution of the learning styles of architecture students. Second, it was sought to determine whether there was any change in the learning styles of students over the four years of architecture education. Third, it was aimed to determine whether there were any relationships among gender, learning style and academic performance in construction management courses. Since the various construction management courses in architectural education involve different learning activities, the performance scores of students who have different learning styles might differ in these courses. Gender was chosen as a second variable since the individual difference can affect the performance scores of architecture students. To reach these goals, Kolb's learning style inventory was used as a survey instrument.

Kolb suggested that an individual's learning style may be identified by assessing her/his position on each of the bipolar dimensions by using a survey called the learning styles inventory (LSI) [22]. There are 12 open-ended questions that have four different alternative responses in the LSI. Each question asks respondents to rank-order four sentence endings in a way that best describes their learning preference in any learning setting. After answering all 12 questions, four scores are calculated by using the test key. These scores are clustered in the four modes of the learning cycle: concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). In the next stage, by subtracting the CE score from the AC score (AC - CE) and the RO score from the AE score (AE–RO), two combined scores are found. Then, according to Kolb's theory [27], the calculated scores are located on the learning style grid, and the learning styles of the participants are established as accommodators, divergers, assimilators, or convergers (Fig. 2). These combined scores show the position of the individual learner on the two bipolar scales. More specifically, they refer to the major different ways by which students learn: the first score (AC–CE) is 'how a student perceives' new information or experience, and the second score (AE–RO) is 'how a student processes what she/he perceives'. In other words, these combined scores give the learning style preference of that individual [27].

The closer the data point is to the center of the grid, the more balanced the learning style is. If the data point falls near any of the far corners of the grid, a particular learning style is heavily relied on. The results do not show whether the respondent is a good or bad learner. They only show the learning style preferences of the learner.

### *4.2 Participants*

The sample of this research is comprised of students in the Department of Architecture who were enrolled in four consecutive academic years at Cukurova University. The data gathering process lasted for four years, and the questionnaire was first conducted on the students who were enrolled in the university at the beginning of the 2012 fall semester. In the first year, seventy-two students participated in the survey. During the four years, some of these students left the university or spent one/two semesters away from the department due to national or

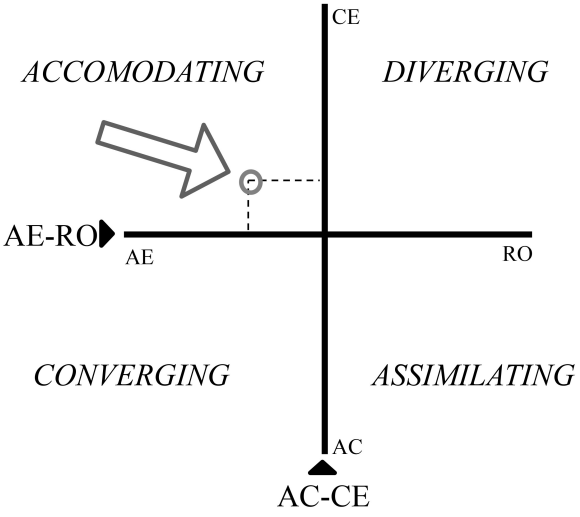


**Fig. 2.** Learning style type grid [27] (reprinted with permission).

international student exchange programs. Finally, fifty-five students participated in the study continuously during the consecutive four years.

### 4.3 Procedure

The curriculum of the Department of Architecture of Cukurova University requires that students take the following construction management courses: Construction Management and Economics, Occupational Health and Safety and Professional Practice. The performance scores of the students in these three courses were analyzed with respect to their learning styles and gender.

The official grading system of the university uses a double letter for performance scores. Passing grades range from 'AA' to 'DD' with 'FF' indicating a failing grade. The highest grade is 'A', while the lowest is 'F', and each grade has a quality-point equivalence (AA = 4.0, BA = 3.5, BB = 3.0, CB = 2.5, CC = 2.0, DC = 1.5, DD = 1.0, FF = 0.0).

The questionnaire (LSI) was administered to the students at the beginning of the first, second, third and fourth years, and the content of the subject group was not changed over the four years. With the aim of observing the effect of architectural education on the learning style, the architecture students were monitored continuously from the beginning of the first year of the education program. This methodology is based on the longitudinal research of Kolb and Kolb [26], which shows an increasing movement in learning style from a reflective to an active orientation over the years of higher education. It could also be said that these methodological characteristics differentiate the study from the former studies in the field, which focused on students who were in different years of study in the same academic year.

With the aim of obtaining practical results, various statistical analyses were performed in the context of the study. SPSS18 software was used to analyze the obtained data. There were 31 (56.4%) females and 24 (43.6%) males in the sample. Participation was voluntary, and the participants were informed of their learning style preferences at the end of the study.

## 5. Results

### 5.1 Learning styles of the students

The distribution of the students according to the four learning styles was determined using the results of the learning style inventory (Table 1). The number of assimilating students was lower than that of other learning style preferences, while most of the students' learning style preferences were accommodating and converging throughout the four years (Table 1 and Fig. 3).

### 5.2 The effect of architectural education on learning styles

The distribution of each student (for fifty-five students) sequenced over the four years according to the learning styles is depicted in Figs. 4–7. Using the learning style inventory, the obtained scores are located on the learning style grid (Figs. 4–7).

Each point symbolizes the learning style of one student for a specific education year. It can be monitored whether the data point is close to or far

**Table 1.** The distribution of participants' learning styles through the four-years architectural education

| | Freshman Students | | 2nd Class Students | | 3rd Class Students | | 4th Class Students | |
|---|---|---|---|---|---|---|---|---|
| Learning Styles | Frequency (f) | Percentage (%) | Frequency (f) | Percentage (%) | Frequency (f) | Percentage (%) | Frequency (f) | Percentage (%) |
| Accommodating | 25 | 45.5 | 22 | 40.0 | 25 | 45.5 | 22 | 40.0 |
| Diverging | 8 | 14.5 | 13 | 23.6 | 7 | 12.7 | 8 | 14.5 |
| Converging | 17 | 30.9 | 17 | 30.9 | 15 | 27.3 | 22 | 40.0 |
| Assimilating | 5 | 9.1 | 3 | 5.5 | 8 | 14.5 | 3 | 5.5 |
| Total | 55 | 100.0 | 55 | 100.0 | 55 | 100.0 | 55 | 100.0 |

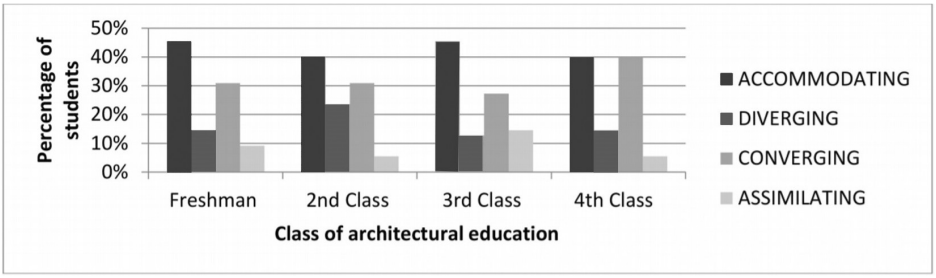


**Fig. 3.** The distribution of learning styles of students through architectural education.

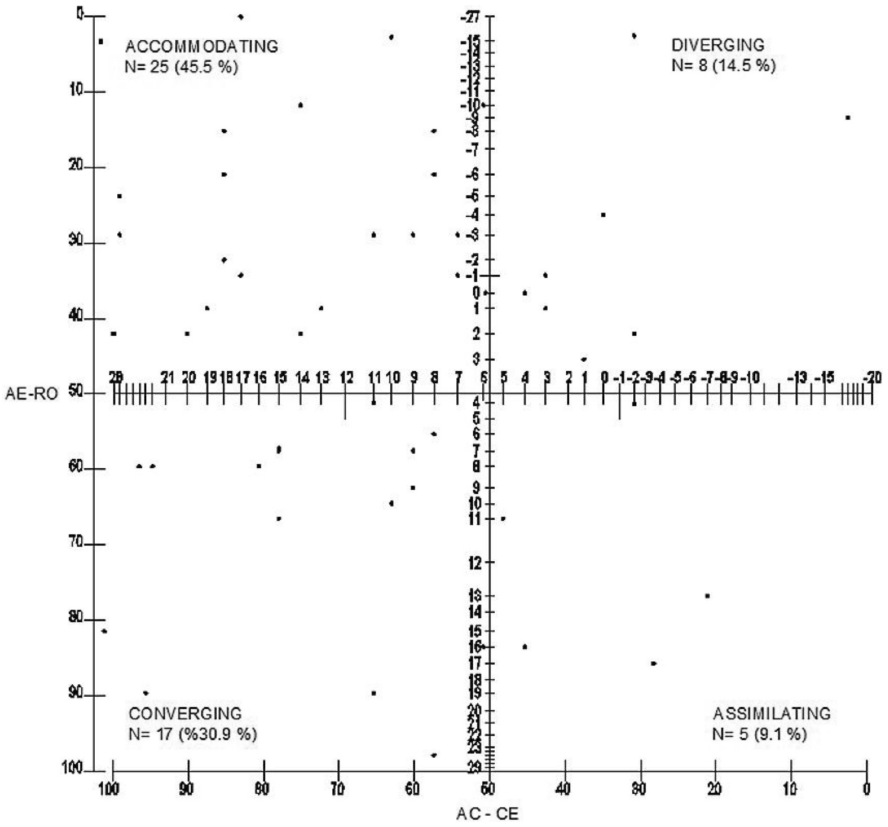


**Fig. 4.** The distribution of freshman students' learning styles.

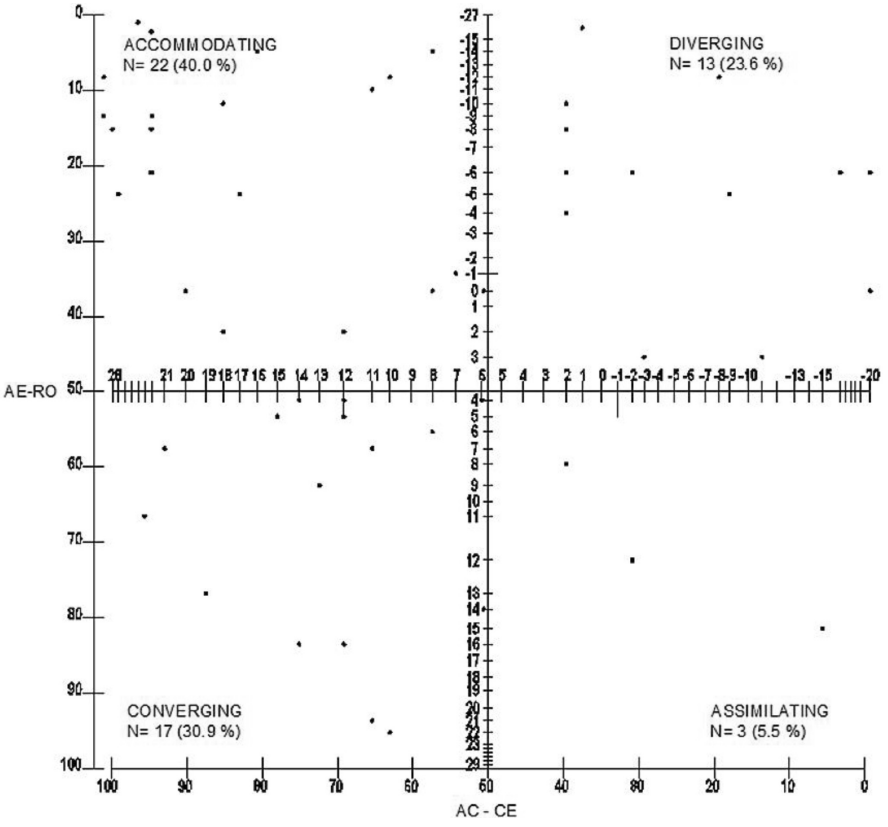


**Fig. 5.** The distribution of second year students' learning styles.

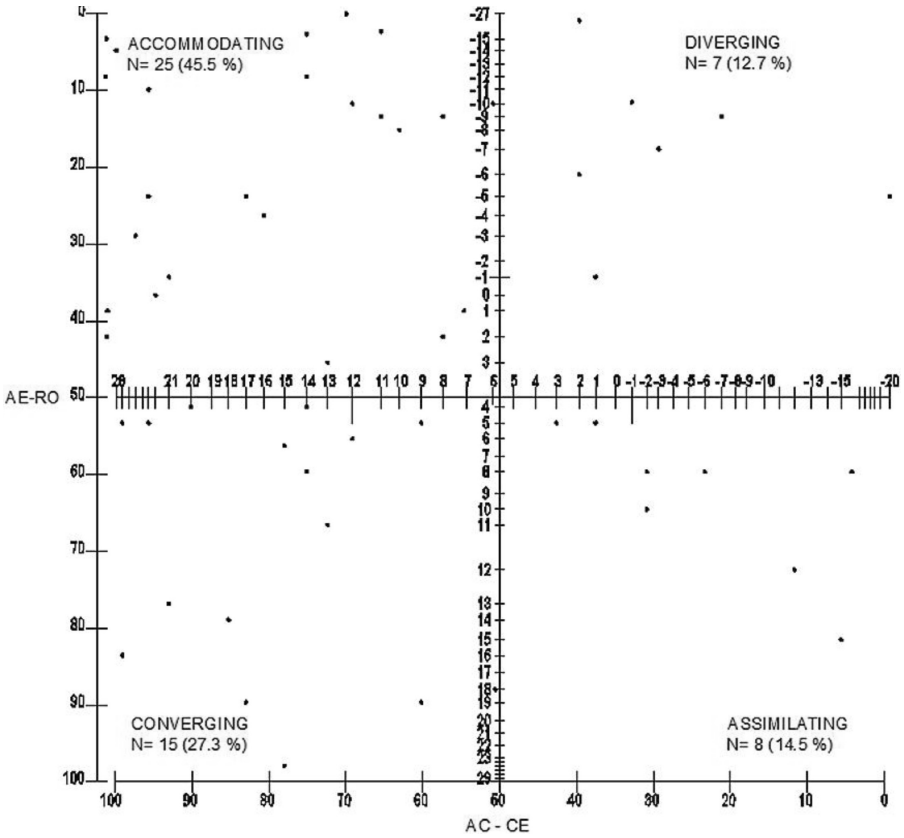


**Fig. 6.** The distribution of third year students' learning styles.

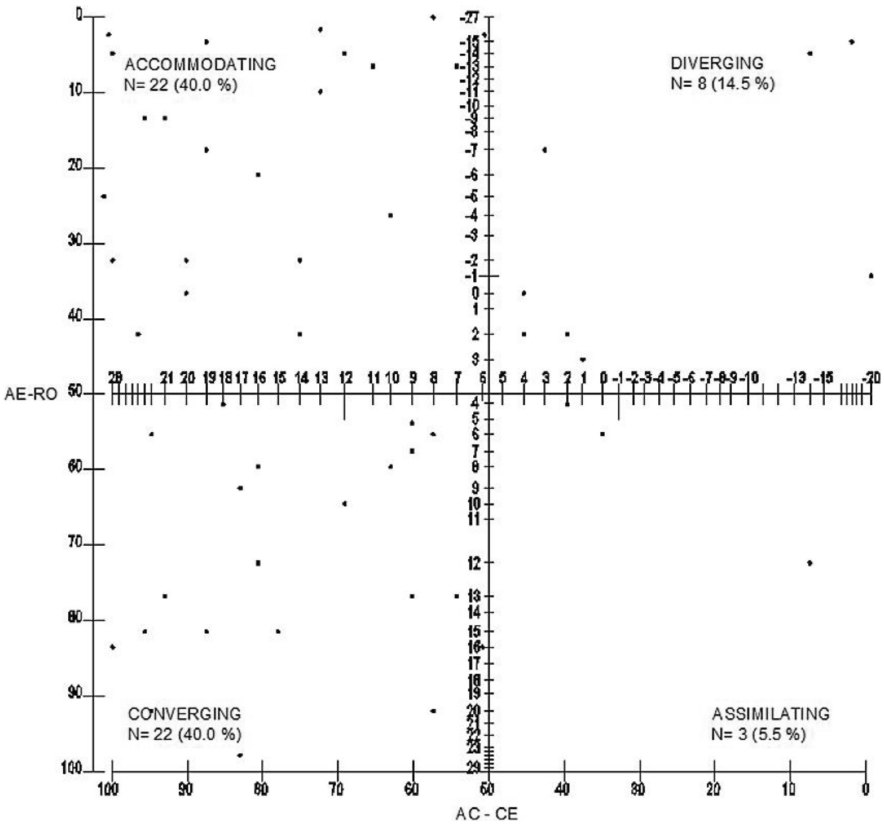


**Fig. 7.** The distribution of fourth year students' learning styles.

away from the center of the grid. The closer a data point is to the center of the grid, the more balanced the learning style is. If a data point falls near any of the far corners of the grid, a particular learning style is heavily relied upon.

According to the distribution of the data points in Figs. 4–7, accommodating and converging students fell near the far corners of the grid, and they clarified their learning styles during the second and third years of their architecture education. However, the assimilating and diverging students' data points were placed near the center of the grid and balanced the learning style in the same year. The number of assimilating and diverging students decreased significantly and were finally positioned near the center of the learning style grid in the fourth education year. In contrast, the accommodating students moved farther from the center of the grid and clarified their learning styles more in the last year of architectural education (Figs. 4–7).

### *5.3 Learning style characteristics according to gender*

In this research, the chi-square tests showed that learning style and gender were independent except in the second year (Table 2). The relationship between learning style and gender was investigated by using an independent sample t-test. There was only a statistically significant relationship (Sig. $0.017 < 0.005$) between gender and learning style for second-year students (Table 2).

The output of a crosstab analysis on the gender and learning style relationship revealed that the female students always preferred the accommodating learning style in comparison with the male students, whereas the male students preferred the assimilating and converging learning styles more than the female students over the four years (Table 2).

### *5.4 Analysis of variance (ANOVA) of construction management performance score*

The performance scores of the students in the three courses, Construction Management and Economics (Cons. Man. Eco.), Occupational Health and Safety (OHS), and Professional Practice, were considered separately as dependent variables. All three of these courses are technology based.

#### *5.4.1 Relationship of construction management courses performance scores to gender*

The performance scores of students in the construction management courses according to gender were determined, as shown in Table 3.

The performance scores of the architecture students in all the construction management-related courses (Professional Practice, OHS, Cons. Man. Eco.) were treated as dependent variables. Statistically significant mean differences were found across all the construction management-related courses ($p = 0.004$; $p = 0.045$; $p = 0.002$; $p = 0.038$). This finding is remarkable because all the construction management performance score means of the female students were higher than those of the male students in the Professional Practice ($M = 3.42 > 2.65$), OHS ($M = 4.03 > 3.25$) and Construction Management and Economics ($M = 3.43 > 2.95$) courses (Table 3).

**Table 2.** The distribution of learning styles according to gender and the relationship between learning styles and gender

| | 1st year | | Sig. | 2nd year | | Sig. | 3rd year | | Sig. | 4th year | | Sig. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Learning Styles** | ***F*** | ***M*** | **(p)** | ***F*** | ***M*** | **(p)** | ***F*** | ***M*** | **(p)** | ***F*** | ***M*** | **(p)** |
| Accommodating | 17 | 8 | | 16 | 6 | | 17 | 8 | | 15 | 7 | |
| Diverging | 4 | 4 | | 8 | 5 | | 4 | 3 | | 3 | 5 | |
| Converging | 8 | 9 | 0.123 | 6 | 11 | **0.017*** | 7 | 8 | 0.084 | 12 | 10 | 0.242 |
| Assimilating | 2 | 3 | | 1 | 2 | | 3 | 5 | | 1 | 2 | |
| Total | 31 | 24 | | 31 | 24 | | 31 | 24 | | 31 | 24 | |

Note: $p \leq 0.05$. *F: Female, M: Male.*

**Table 3.** Relationship of construction management scores to gender

| | Female | | | Male | | | | |
|---|---|---|---|---|---|---|---|---|
| **Construction Management Courses** | **Mean ($\bar{x}$)** | **Std. (S)** | **Dv.** | **Mean ($\bar{x}$)** | **Std. (S)** | **Dv.** | **Sig. (p)** | **Mean Comparison** |
| Professional Practice | 3.42 | 1.11 | | 2.65 | 0.57 | | 0.004* | F > M |
| OHS | 4.03 | 0.94 | | 3.25 | 0.71 | | 0.002* | F > M |
| Cons. Man. Eco. | 3.43 | 0.89 | | 2.95 | 0.72 | | 0.038* | F > M |

$p \leq 0.05$, F: Female, M: Male.

**Table 4.** Relationship of construction management scores to learning styles

| Construction Management Courses | Accommodating | | Diverging | | Converging | | Assimilating | | Sig. (p) | Mean Comparison |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{x}$ | S | $\bar{x}$ | S | $\bar{x}$ | S | $\bar{x}$ | S | | |
| Professional Practice | 3.08 | 1.07 | 2.75 | 0.46 | 3.57 | 0.82 | 3,07 | 0.46 | 0.000* | C > AC > AS > D |
| OHS | 3.83 | 0.92 | 3.00 | 0.57 | 3.90 | 0.99 | 3.33 | 0.57 | 0.000* | C > AC > AS > D |
| Cons. Man. Eco. | 3.14 | 0.85 | 3.29 | 0.75 | 3.33 | 0.91 | 3.00 | 1.00 | 0.000* | C > D > AC > AS |

$p \leq 0.05$, C: Converger, AC: Accommodator, AS: Assimiliator, D: Diverger.

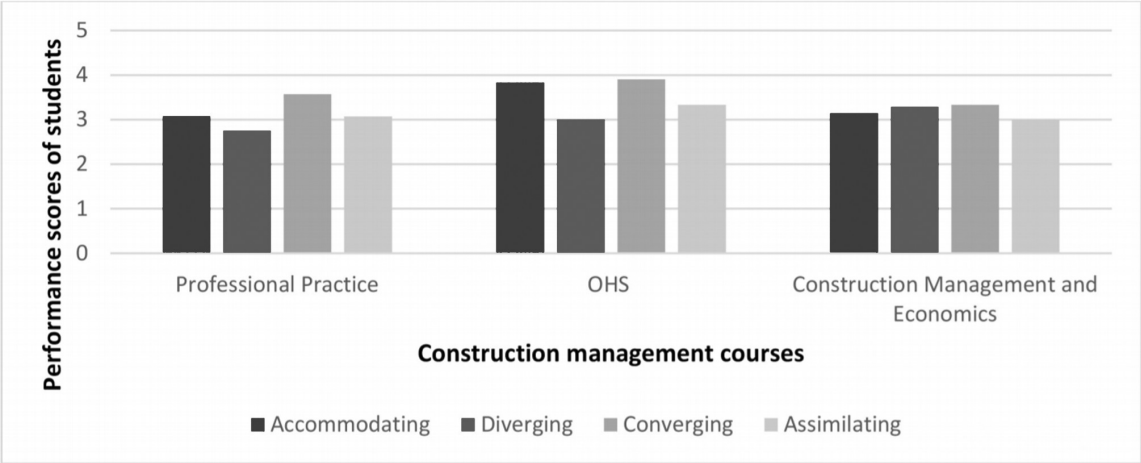


**Fig. 8.** The mean distribution of performance scores at construction management courses across learning styles.

*5.4.2 Relationship of performance scores to learning style*

The performance scores of the students in all the construction management-related courses according to learning style are shown in Table 4.

The performance scores of the students in the Professional Practice course were treated as dependent variables, and there were statistically significant mean differences across the learning styles. The performance scores of the converging students and diverging students differed significantly ($p = 0.000$) with a 95% confidence level in favor of the converging students (Mconverging = 3.57, Mdiverging = 2.75).

The performance scores of the students in the Occupational Health and Safety course were treated as dependent variables, and there were statistically significant mean differences across the learning styles. The performance scores of the converging students and diverging students differed importantly ($p = 0.000$) with a 95% confidence level in favor of the converging students (Mconverging = 3.90, Mdiverging = 3.00).

The performance scores of the students in the Construction Management and Economics course were treated as dependent variables, and there were statistically significant mean differences across the learning styles. The performance scores of the converging students and assimilating students differed remarkably ($p = 0.000$) with a 95% confidence level in favor of the converging students (Mconverging = 3.33, Massimilating = 3.25).

These results clearly indicate that students with particular learning styles are more successful in certain courses.

The distribution of the performance scores in the construction management-related courses according to learning style is presented in Fig. 8.

It is clearly seen that the converging students are the most successful in the construction management-related courses, whereas the diverging students are the least successful in these courses (Fig. 8). When these findings were identified with the characteristic properties of the learning styles, the success of the converging students in construction management courses is an expected result since these are students who have the ability to use theories and actualize and implement them for practical uses and to make decisions. In contrast, as a characteristic of the diverging learning style, the learners with this style learn by viewing and feeling concrete situations from different points of view, but this is not a successful strategy for these courses.

## 6. Discussion

*6.1 The distribution of the learning styles*

By repeating the application of the LSI survey, it

was found that there was a specific distribution of learning styles for the architecture students. The architecture students were found to be more concentrated in the accommodating style across the four years. It is assumed that this finding is a valuable and reliable contribution to the literature by following the same 55 students with the same questionnaire over four years.

This finding is similar to that in Kolb's [22] study in which he stated that the dominant learning style of architects is accommodating. However, this result is contrary to that of Newland et al.'s [28], Kvan and Yunyan's [13], and Demirbaş and Demirkan's [12] studies, which are pioneering studies in architecture that considered the learning styles of design students, especially interior architecture students. Newland et al. [28] found that the architecture students favored reflective observation and abstract conceptualization, and these kinds of students were called assimilating learners. In both the Demirbaş and Demirkan [12] and Kvan and Yunyan's [13] studies, which were related to design students, the accommodating learners were in the minority of the four learning styles, which is contrary to the findings in this study. The difference in the distribution can be explained by Kolb's [22] statements that learning styles are shaped gradually by individual experience since Demirbaş and Demirkan's [12] sample group consisted of only freshman students and Kvan and Yunyan's [13] sample group consisted of freshman and third year architecture students. In other words, these studies focused on the learning styles of students in different years of study with composite subject groups. In this research, the fifty-five students were monitored by the same questionnaire throughout the four years, which is distinct from the other studies. Another reason for the difference between this study and Kvan and Yunyan's [13] study can be seen by considering the cultural differences. Although Demirbaş and Demirkan's [12] study focused on Turkish design students, there is a significant difference in the distribution of the learning styles. It is assumed that this difference originates from the characteristics of design students. Demirbaş and Demirkan's [12] sample group is comprised of interior architecture students, whereas architecture students are the research subjects of this study.

The distribution of the learning styles according to the specific education year demonstrated that a student's learning style changes. Due to the effect of the architectural education, more students are characterized as accommodating students, and this learning style is concentrated at the end of the education program. When the characteristics of architectural education are reviewed, the obtained results show that the learning style with the most coherence with the education type is the accommodating learning style. Students who have assimilating and diverging learning styles that are incompatible with the architecture education curriculum in this study were inclined to change or balance their styles due to the impact of the education.

### *6.2 Gender and learning style*

Former studies related to learning inventory tests [24] showed that the male students were more abstract (AC) than the female students on the perceiving dimensions (AC–CE), which was confirmed in this study. In our research, the male students were more concentrated in the learning by thinking (AC) style than female students, and the female students' learning styles were mostly described as accommodators, and there were many significant gender differences in the processing dimension (AE–RO).

Demirbaş and Demirkan [11] found that the gender and learning style of design students were independent variables. In this research, it was found that there is no significant relationship between the gender and learning style of architecture students except for in the second year of study. The reason for this variation was because most of the second-year female students' learning styles were accommodating, whereas the large majority of second-year male students preferred the converging learning style. In addition, the female students always preferred the accommodating learning style more that the male students, whereas male students preferred the assimilating learning style more than female students. Considering the overall results, it is remarkable that the female architecture students were more inclined than the male students to alter their learning style year by year.

### *6.3 The academic performance scores and gender*

There is consistency throughout all the years, and the results indicate that there are significant differences in the means in all the performance scores in terms of gender for the construction management courses that are classified as technology-based courses. The performance scores of the female students were higher than those of the male students in all the construction management and related courses. When it is considered that most of the female students have an accommodator learning style, this may be explained because accommodating learners, who perceive through experience and process by active experimentation, have a successful strategy for the construction management courses (Table 3).

This finding is contrary to Demirbaş and Demirkan's [11] study in which they stated that the male

design students' performance scores in the technology-based courses were higher than those of the female students. This difference can be explained by the content of the courses, which in this study were classified as technology-based courses. Several courses in the architectural programs can be considered to be technology-based; construction, structures, materials, control of physical environments, building physics and construction management are some examples. Although they are technology-based courses, the content and the characteristics are different. In this study, there is a focus on only the construction management and related courses; however, in Demirbaş and Demirkan's [11] research, they analyzed other technology-based courses that are different from those in construction management.

### *6.4 The academic performance scores and learning styles*

The performance scores of the converging and diverging students in the Professional Practice, Occupational Health and Safety, Construction Management and Economics courses were found to differ significantly in favor of the converging students. These courses require students to relate theoretical information for practice and application. Students who are converger learners are best at finding practical uses for ideas and theories [25]. Smith and Kolb [24] state that they have the ability to solve problems and are good at making decisions and finding solutions to problems. Diverger learners are interested in gathering information [25], and although these learners are more creative than others, they are not systematic in problem solving. This may explain the success of converging students. Since construction management is considered to be a problem-solving activity, converger learners are successful in the management process. This result also supports the findings of two studies that were conducted among engineering [29] and management students [30]. In addition, this finding is completely consistent with Ayalp's [18] research, which was conducted with civil engineering students. In that study, researcher explored the relationship between the learning styles of civil engineering students and their construction management academic performance. According to the research results, converger civil engineering students are the most successful compared to students with other learning styles. When the context and nature of architecture and civil engineering are analyzed, it can be seen that these two disciplines are different from each other but actually complement each other and have several common areas. Therefore, this finding points out that there are valuable parallels with the research results for civil engineering students [18].

## 7. Conclusion

From the findings of the research reported in this paper, we conclude that; there was a specific distribution of learning styles for architecture students. Architecture students were found to be more concentrated in the accommodating and converging domain throughout the four years of architectural education.

Female architecture students were more successful than the male architecture students in the construction management courses.

Most of the first-year, second-year and third-year students were accommodating learners, while the fourth-year students were accommodating and converging learners. This finding reveals that learning styles can change according to the year of education. In other words, architectural education shapes and changes the learning styles of students.

The converging architecture students are the most successful in the construction management courses.

It was also found that the number of accommodating and converging architecture students is much more than that of the other categories. This result is important for architecture instructors who need to be aware of the learning style preferences of their students to organize course materials that are comprehensible and learnable for all.

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