Original Article

Evaluation of the Relationship between Learning Style and Academic Achievement of Dental Students at Alborz University of Medical Sciences

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Abstract

Background & Objective: Several factors affect the flow of learning, including the learning style. In general, learning style is a method preferred by learners over other styles in learning lessons. Therefore, knowledge of students' learning styles is crucial for educational programs. This study aimed to evaluate the relationship between learning style and academic achievement of dental students at Alborz University of Medical Sciences.

Materials & Methods: This cross-sectional research was performed on all dental students in the second semester of 2019-2020. Data were collected using Kolb's Learning Style Questionnaire. In addition, students' GPA was an indicator of their academic achievement. Data analysis was performed in SPSS version 24 using descriptive and inferential statistics such as Chi-square and one-way ANOVA.

Results: In this research, 205 out of 360 dental students completed the questionnaire. Most participants used a converging learning style (32.7%), and the rest of the subjects applied an assimilating (31.7%), diverging (31.7%) and accommodating (9.3%) learning style. There was no significant difference in students' learning styles based on gender, year of admission, age and place of residence (P>0.05). However, a significant correlation was reported between learning style and academic achievement (P=0.04), in a way that convergers achieved higher GPAs, compared to divergers.

Conclusion: According to the results of the present study, most students applied converging and assimilating learning styles. Therefore, it is recommended that educational methods that match these styles (e.g., visual content presentation, diagrams, teacher's handouts, lectures and self-study) be applied in this regard. It is notable that students with a converging learning style obtained higher GPAs, compared to those with a diverging learning style.

Introduction

Education and learning have always been bilateral processes. Learning is a continuous process in humans' life and starts from the complicated process of talking at the beginning of life and continues to learning complex scientific theories and solving difficult problems (1). However, the process is not carried out similarly in all states, and not all learners learn at an equal pace and amount. Multiple factors can affect the flow of learning, including the learning style (2). Learning style is defined as a combination of cognitive, emotional and physiological methods used by the learner to collect, organize, interpret, process and recall information. In fact, it is one of the factors affecting learning (3-6). According to Kolb, learning modes are developed based on one's genetic makeup, particular life experiences, and the demands of the present environment and are rooted in the nervous structures and personality of individuals. Despite the relative stability of learning styles, they might undergo qualitative changes due to evolution and maturity and environmental stimuli (7). In other words, the preference for learning styles changes over time (8).

Students' academic achievement is one of the important factors for higher education evaluation used for the prediction of learners' future academic

status. Therefore, the education system dedicates all efforts to achieve this significant matter. Various factors affect the academic achievement of a person, including their ability. In this regard, one of the personal factors affecting people's academic achievement is the learning and study style chosen for comprehending different content (9). Students' academic achievement can be measured by using different methods such as problem-solving abilities, clinical performance in fieldwork, grade point average (GPA) and finishing an academic course (10). Each student has a specific learning style (9), and matching their styles with the learning framework could improve their GPAs. On the other hand, the mismatch between learning styles and curriculum can result in low academic achievement (10, 11). Lack of consistency between a students' learning style and their field of study and educational methods in that area could dissuade students from pursuing their discipline or lead to dissatisfaction with that field of study (12). One of the causes of these problems is overlooking students' learning styles. Therefore, determining students' learning styles in the education system and using relevant techniques for a student education can facilitate the learning process.

Researchers believe in the crucial role of attention of teachers and planners of different levels of education to the learning styles of students and its ability to facilitate learning and training processes. When teachers have knowledge of students' information processing methods, they can change their educational methods from lectures to techniques that would increase comprehension, which could improve students' learning (10, 13). Understanding each student's learning style can help teachers use effective educational media and methods. Moreover, better knowledge of students' learning styles can reduce students' feeling of disappointment and enhance education provision techniques (10, 14). In 1984, Kolb proposed the most useful descriptive model of the adult learning process, inspired by the works of Kurt Lewin, entitled Experiential Learning Style (15). This theory involves four principal stages of concrete experiences (CEs), reflective observation (RO) (observation of and reflection on the experiences), abstract conceptualization (AC) (the formation of a hypothesis or a theory about it), and active experimentation (AE) (testing the hypothesis or theory in practical situations) (16).

By combining these four methods, Kolb introduced four learning styles, as shown below:

Diverging (a combination of CE/RO)

Assimilating (a combination of AC/RO)

Converging (a combination of AC/AE)

Accommodating (a combination of CE/AE)

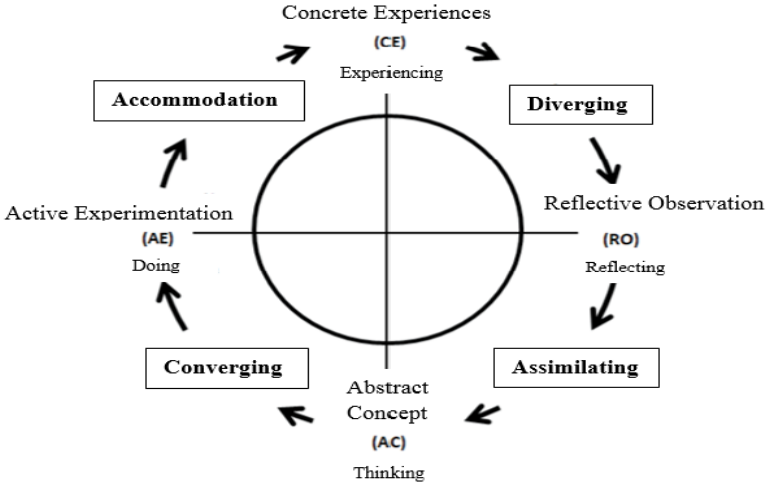

Diagram 1. Kolb's cycle

According to Kolb, learning is based on understanding information and transforming it through active reflection or experimentation and practice (16). Kolb's Learning Style Questionnaire encompasses 12 items and evaluates people's learning style in two dimensions of CE-AC and RO-AE and four learning styles of diverging, converging, assimilating and accommodating. In the first dimension, perceiving (the vertical axis of the diagram) of AC is against CE, whereas OR is against AE in the second dimension known as processing (the horizontal axis of the diagram). In fact, a diverging learning style is processing a CE, which leads to RO (experiencing and observing). On the other hand, the assimilating learning style involves the development of abstract theories from findings and observed reflections (watching and thinking). Meanwhile, the converging learning styles include turning a theoretical abstract or concept into an active experiment (doing and thinking). Finally, the accommodating learning style is active experimentation that leads to specific experiences (doing and feeling) (15, 17) (Diagram 1).

In a research by Reynolds et al. (2020) in the United States, most medical students adopted converging and assimilating learning styles (84.1%). In addition, no significant difference was observed in the learning styles of students, with the exception of the cardiovascular score, which is one of the scores related to the final exams of the National Assembly (18). In another study, Ebrahimi Fakhar et al. (2019) evaluated the learning styles of final-year medical students and their relationship with scores of comprehensive basic sciences and pre-internship exams and results of clinical competency exam at the end of the general practitioner course in the Islamic Azad University, Tehran Branch. In the end, the results were indicative of a positive relationship between the variables of AC and RO and CE and the comprehensive basic sciences and pre-internship exams (19). Conducting a study in King Saud University in Riyadh (2015), Almigbal concluded that students would gain academic achievement if teachers were able to understand the factors related to their learning styles. Accordingly, teaching based on learning styles can increase students' academic achievement and contribute to training more professional people in addition to increasing the job satisfaction of teachers (10).

Recognition of educational factors is a necessity for preparing the most favorable learning conditions. These factors can be divided into two general groups of learner characteristics and social aspects of learning (20). Learning styles are identified as the most important learning factor that could assist the education system to determine the curriculum and provide appropriate learning opportunities (21). Therefore, identification of students' learning styles and creating compatibility and adaptation between teaching patterns with students' learning styles play a fundamental role in the effectiveness of teaching and learning processes in the education system. On the other hand, students can learn more in less time if they become aware of the priority of their learning style (3, 22). Some domestic and foreign studies have proposed a significant relationship between learning style and academic achievement (23-25). Meanwhile, other studies have not reported such an association (9, 10, 26).

Given the interventions of medical sciences fields, including medicine and dentistry, and their direct effect on the health of people, education quality is of paramount importance in these areas (27). Moreover, the field of dentistry is a combination of theoretical and practical education. Given the significant importance of understanding the relationship between learning styles and factors affecting these techniques, especially in fields of medical sciences that requires students to have extensive and deep knowledge as well as high skill levels (10, 28), the present study aimed to determine the learning styles of medical students of Alborz University of Medical Sciences. In the current research, attempts were made to answer this question: is there a relationship between the learning style and academic achievement of students? It is hoped that the results of the present

study be able to lay the proper foundation for planning the improvement of educational quality in future interventions and studies. In addition, our findings can be used by educational designers and teachers to facilitate students' learning by adopting appropriate educational methods.

Materials and Methods

This was a cross-sectional study performed on dental students in the second semester of 2019-2020 at Alborz University of Medical Sciences. First, the number of dental students was determined (n=360) based on the census of 2020. Afterwards, the sample size was estimated at 186 based on Cochran's formula and Morgan table, and the participants were selected by convenience sampling. The research questionnaire was developed in porseline.ir following receiving a code of ethics from the ethical committee of Alborz University of Medical Sciences (IR.ABZUMS.REC.1399.093).

In the next stage, the link of the electronic instrument was sent to all groups of dental students. It is notable that the research objectives were explained to the subjects and they were ensured of the confidentiality terms regarding their personal information. In addition, participation was voluntary, and a two-week interval was considered for questionnaire completion and delivery. All students studying in the second semester of 2019-2020, who were willing to participate in the research, were completed the questionnaire. The exclusion criteria were lack of willingness to cooperate with the researcher, elimination of items with joint IPs, spending less than 30 seconds for completing the questionnaire and incomplete questionnaires.

Data were collected using Kolb's Learning Style Questionnaire (16), validity and reliability of which were previously approved by Seif and Hoseini Lorgani (29). According to these scholars, the mentioned tool was able to properly assess the learning styles of students. In addition, different sections of AE (0.81), AC (0.83), RO (0.81) and CE (0.82) had acceptable Cronbach's alphas (29). We also collected the demographic characteristics of the subjects, including gender, age, admission year, place of residence and GPA. Notably, the total GPA of students was used in the current research to assess their academic achievement.

The multiple-choice items of Kolb's questionnaire were scored based on a four-point scale, from the most correspondence with participants' learning style (score=4) to moderate correspondence (score=3), weak correspondence (score=2) and lack of correspondence (score=1). In each item, the first-fourth options are related to learning through CE, learning through RO, learning through AC, and learning through AE, respectively. To determine the individual's learning style, the scores of option 1 are added together in every 12 questions, and the process is repeated for the other options. Accordingly, four scores are obtained, and the total score of the first option is related to learning through CE, whereas the total scores of the other three options are related to learning through RO, AC, and AE, respectively. Two scores are obtained from the paired difference of these techniques (i.e., the difference in the scores of AC and CE and the difference in the scores of AE and RO). These two scores are placed on the two coordinate axes (depending on their positivity and negativity). The vertical axis includes CE at the top of the axis and AC at the bottom of the axis while the RO and AE are the right and left sides of the horizontal axis, respectively. These two axes make up four quadrants of a square, each quarter of which represents one of the learning styles.

Data analysis was performed in SPSS version 24 using descriptive statistics, mean, frequency and percentage (to evaluate the research variables) and inferential statistics, including Chi-square and one-way ANOVA to assess the relationship between the demographic characteristics and the GPA of the students. Notably, a P-value of below 0.05 was considered statistically significant.

Results

In total, 207 questionnaires were received during a two-week interval in August 2020, two of which were excluded due to completion errors. In this research, 120 subjects (58.5%) were female and the rest (n=85, 41.5%) were male. The mean age of the students was reported to be 23.3±3.4 years. In addition, the lowest and highest age of the students was 18 and 37 years, respectively, and most of the participants (n=131, 63.9%) were in the age range of 20-25 years. Most students entered the university in the year 2018 (n=49, 23.9%) while the least of them were admitted in the year 2014 (n=27, 13.2%). Regarding the place of residence, 181 subjects (88.3%) were residing at a personal home, whereas 24 students (11.7%) were living in dormitories. The highest frequency of GPA of students participating in the study was in the range of 14-17 (n=167, 81.5%). In addition, the lowest and highest GPAs were respectively 12 and 19 with a mean and standard deviation of 16±1.2. The demographic characteristics and GPAs of students are presented in Table 1.

Regarding the type of learning styles, 67 students (32.7%) had converging learning styles, whereas 65 (31.7%), 54 (26.3%), and 19 (9.3%) had assimilating, diverging and accommodating learning styles, respectively. Table 2 presents the distribution of students' learning styles while Figure 1 depicts their dispersion. According to the results, there was no significant difference between the students regarding their type of learning style based on gender, year of admission, and place of residence (by using Chi-square) and age (by using ANOVA) (P>0.05). In addition, there was a significant difference between GPA groups regarding learning style (P=0.04). In this respect, students with a converging learning style received higher GPAs, compared to those with a diverging learning style. Table 3 shows the distribution of learning styles based on demographic characteristics and GPA.

Table 1: Distribution of demographic characteristics and total grade point average of dental students at Alborz University of Medical Sciences in 1399 (N=205)

Variable		n	%
Gender	Female	120	58.5
	Male	85	41.5
Age groups	<20	38	18.5
	20-25	131	63.9
	25-30	25	12.2
	>30	11	5.4
Year of entrance	2014	27	13.2
	2015	29	14.1
	2016	30	14.6
	2017	28	13.7
	2018	49	23.9
	2019	42	20.5
the place of residence	Personal home	181	88.3
	Dormitories	24	11.7
Grade Point Average	<14	21	10.2
	14-17	167	81.5
	>17	17	8.3

Table 2: Distribution of learning styles of dental students at Alborz University of Medical Sciences in 1399 (N=205)

Learning styles	n	%
Diverging	54	26.3
Accommodating	19	9.3
Converging	67	32.7
Assimilating	65	31.7

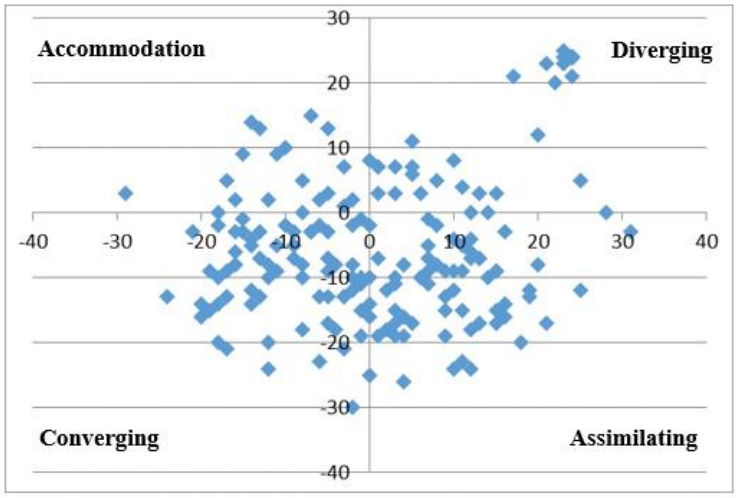

Figure 1: Dispersion of learning styles of dental students at Alborz University of Medical Sciences in 1399

Table 3: Distribution of learning styles according to demographic characteristics and grade point average of dental students at Alborz University of Medical Sciences in 1399 (N=205)

Learning style / Variable	Diverging	Accommodating	Converging	Assimilating	p-Value
		Gender N (%)			
Female	37 (30.8)	12 (10)	40 (33.4)	31 (25.8)	A 0.13
Male	17 (20)	7 (8.2)	27 (31.8)	34 (40)	
		Year of entrance			
2014	8 (29.6)	4 (4.8)	7 (25.9)	8 (29.8)	A 0.94
2015	8 (27.6)	2 (6.9)	11 (37.9)	8 (27.6)	
2016	8 (26.7)	1 (3.3)	13 (43.3)	8 (26.7)	
2017	6 (21.4)	4 (14.3)	9 (32.1)	9 (32.1)	
2018	15 (30.6)	5 (10.2)	13 (26.5)	16 (32.7)	
2019	9 (21.4)	3 (7.1)	14 (33.3)	16 (38.1)	
		the place of residence			
Personal home	48 (26.6)	18 (9.9)	56 (30.9)	59 (32.6)	A 0.45
Dormitories	6 (25)	1 (45.8)	11 (45.8)	6 (25)	
		Age (Mean ± SD)			
Age	24.2 ± 3.78	23.7 ± 3.37	22.79 ± 2.56	23 ± 3.72	B 0.1
		Grade Point Average			
GPA	15.62 ± 1.4	16.15 ± 0.95	16.26 ± 1.12	16 ± 1.15	*B 0.04

[A] Chi-2 analysis; [B] ANOVA analysis; * significant; The level of statistically significant was considered below 0.05

Discussion

With regard to the importance of education in the field of medical sciences, the present study was performed on 205 dental students at Alborz University of Medical Sciences to evaluate the relationship between students' learning style and academic achievement. In a way that their learning level could be improved and appropriate solutions could be proposed in this regard. According to the results of the present study, most students adopted converging learning styles, and assimilating learning styles were applied by about two-thirds of the participants. In addition, the diverging and accommodating learning styles were third and fourth, respectively. On the other hand, there was no significant relationship between students' learning styles and the variables of age, gender, year of admission and place of residence.

Meanwhile, a correlation was observed between learning style and academic achievement, in a way that students with a converging learning style gained higher GPAs, compared to those with a diverging learning style. In similar domestic studies, Sayadi et al. (2020) (3), Nasirzadeh et al. (2014) (1), Khayam et al. (2019) (31), and Mirzaei et al. (32), the converging learning style was introduced as the dominant method used by dental students. However, the assimilating learning style had the most use among the participants evaluated by Hosseini et al. (2015) (33) and Farhang et al. (2020) (27). In foreign studies by Wang et al. (2019) in China (34) and Kim et al. (2018) in South Korea (35), the majority of dental students used a converging learning style. Meanwhile, dental students of Saudi Arabia used a diverging learning style in the research by Al-Gahatani et al. (2014) (36). This lack of consistency in results might be due to cultural and educational differences of students in different areas.

Moreover, most students studying nursing and midwifery, which are similar to dentistry practically and theoretically, used converging and assimilating learning styles (1, 37-39). In a review research on 13 domestic studies, Imani et al. (2015) concluded that the converging and assimilating learning styles were dominantly applied by midwifery and nursing students (2). Studies related to the medical field have also reported using of converging and assimilating learning styles by the majority of students (40, 41). In foreign studies, most medical students used the converging and assimilating learning styles (17, 18, 42). Convergers and assimilators are similar in terms of learning through AC. In fact, convergers are interested in the practical use of thoughts and theories and have a higher performance in exams that measure the application of theories in practice. In contrast, assimilators are more interested in theories without focusing on their practical use. These people can properly communicate with others while convergers have a poor performance in this area. In other words, convergers are less willing to focus on subjects that require cooperation with others. Therefore, it is recommended that students' abilities be strengthened for future educational and work environments by their academic teachers through various educational methods. Moreover, it is suggested that the accommodating learning style be improved in students of medical sciences to increase their communication abilities (43).

Studies show that divergers prefer group discussion and brainstorming, whereas convergers are more inclined towards diagrams and handouts of teachers. On the other hand, assimilators prefer self-study content and lectures while accommodators choose role-playing and computer simulation. Furthermore, convergers are more willing to work individually and as an assistant of the instructor and do not enjoy participating in group discussions. Therefore, practical learning methods and problem-solving techniques seem to be more practical and useful in the medical education of convergers, compared to lectures and group discussions (43).

In the present study, we found no significant difference among the learning styles of students based on gender, age, year of admission (academic semester) and place of residence. Other studies have also found no association between learning style and

demographic characteristics of participants, which is in line with our findings (30, 31). However, a difference was observed in the learning styles of male and female students in a research by Almigbal (10). According to Akhlaghi et al., factors such as age, gender and marital status had no impact on the preferred learning style of students (3). This could be justified by the fact that students experience a similar educational situation regardless of their social, cultural and demographic features.

Regarding the relationship between learning style and academic achievement, our findings were indicative of a significantly higher GPA obtained by convergers, compared to divergers, which is inconsistent with the results of some studies (30-33, 43). Consistent with our findings, Geranmayeh et al. (2011) (45) found a significant correlation between learning style and scores of basic credits following the assessment of nursing-midwifery students' learning styles. According to Kolb's theory, the consistency between the learning style and teaching style determines learners' success, which can contribute to their increased educational efficiency. Kolb believes that physicians mostly use the converging learning style, and divergers generally have cultural interests and are attracted to the humanities and arts (16). Therefore, divergers could be assumed to achieve lower GPAs due to less compliance with the field of dentistry. However, a research in South Korea reported higher academic achievement for dental students using a diverging learning style, compared to other students with different learning styles. This inconsistency in the results could be due to the use of flipped classes for these students, which maximized the teacher-student and student-student interaction through group learning activities such as discussion and course presentations by students. Therefore, the higher compliance of divergers, who learn from interacting with others, with the type of education in class leads to their higher academic achievement (35). Nonetheless, as mentioned by Kolb, none of the learning styles were superior to each other, and a complete learner is someone who can use various styles in different learning situations. According to Fry and Kolb (1979), since each learning style has its own weaknesses and strengths, a learner who uses only a specific style is not a complete learner (46).

Conclusion

According to the results of the present study, most dental students at Alborz University of Medical Sciences used converging and assimilating learning styles, and convergers achieved higher GPAs, compared to divergers. Therefore, it is recommended that different learning environments such as observing problems from different angles, simulations, tests that measure a person's knowledge about a subject, laboratory activities, emphasizing the practical applications of materials and getting students to think and analyze problems be used to improve learning and strengthen students' abilities required in the future educational and work environments.

On the other hand, given the possible effect of teachers' learning styles on their methods of presenting educational concepts, teachers' understanding of their own learning styles is of utmost importance. In other words, teachers learning style preferences affect their teaching method. Teachers should heed attention to individual differences of students and their different learning styles and dedicate efforts to providing content in a way that matches various learning styles in order to improve this aspect of students. In this area, studies have shown the importance of using up-to-date educational methods and aids by teachers to maximize students' participation in learning. In this regard, both the learning style of teachers and students determine the teaching and learning process (43). Therefore, it is suggested that further studies be conducted to determine teachers' learning styles. In addition, evaluation of the relationship between teachers' teaching style and students' learning style can greatly contribute to this area.

There were some limitations in the present study, which means that the results should be interpreted with caution. One of the major drawbacks was the mere use of questionnaires, in which information bias can play a confounding role in the validity of results. We used a standard tool, the validity and reliability of which have been repeatedly approved inside and outside the country. In addition, several studies have applied this instrument, which could be one of the strengths of the present research. In addition, we used electronic tools due to the COVID-19 pandemic. Nevertheless, attempts were made to minimize bias by persuading students to provide candid responses. Another limitation of the current research was its cross-sectional nature, which disrupted the proper interpretation of causal relations. Designing experimental studies might be useful in recognizing factors affecting different learning styles. In addition, the present study was performed on the students of only one school, and it seems that covering several schools and comparing their results could yield a more comprehensive result in terms of understanding students' learning styles and related factors.

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Conflicts of Interest

The authors declare that there are no conflicts of interest.

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