

The relationship between learning style, thinking and critical thinking tendency with lifestyle improvement in controlling cardiovascular diseases in medical students of Islamic Azad University, Arsanjan Branch

La relación entre el estilo de aprendizaje, el pensamiento y la tendencia del pensamiento crítico con la mejora del estilo de vida en el control de las enfermedades cardiovasculares en estudiantes de medicina de la Universidad Islámica Azad, sucursal de Arsanjan

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Abstract

Introduction & Background: This study was conducted with the aim of investigating the relationship between learning style and thinking style and tendency to critical thinking in changing lifestyle to control cardiovascular diseases in medical students of Islamic Azad University, Arsanjan branch.

Methods: The present study was an applied and descriptive-correlational research. The statistical population included all medical students of Islamic Azad University, Arsanjan Branch in the academic year of 2019-2020. Based on the number of students and according to the census method, the sample size was determined at 348 people. Students were studying in one of the fields of nursing, midwifery and operating room at the Islamic Azad University, Arsanjan Branch. Willingness to participate in the study was considered as an inclusion criterion of the research. To collect information, the Learning Styles Inventory (1984), the Critical Thinking Disposition Inventory (2003) and the Thinking Styles Inventory-Short Form (1992) were used. Appropriate regression models such as simultaneous multiple regression were used to analyze the data.

Results: The results revealed a significant relationship between learning styles and critical thinking disposition and the most important predictor of critical thinking disposition in students was the learning styles of reflective observation, concrete experience, active experimentation and abstract conceptualization in lifestyle changes to control cardiovascular diseases, respectively. Also, a significant relationship was observed between thinking styles and critical thinking disposition, and the most important predictors of critical thinking disposition in students were legislative, liberal, local, judicial, and anarchic thinking styles, respectively.

Conclusion: Critical thinking and methods of its promotion should be considered by educational planners and the use of new educational methods should be institutionalized in the curriculum for reduce health risks.

Keywords: Learning Style, Thinking Style, Critical thinking disposition, Medical Students, life style, cardiovascular risks

Introducción y antecedentes. Este estudio se realizó con el objetivo de investigar la relación entre el estilo de aprendizaje y el estilo de pensamiento y la tendencia al pensamiento crítico en el cambio de estilo de vida para controlar las enfermedades cardiovasculares en estudiantes de medicina de la Universidad Islámica de Azad, sucursal de Arsanjan.

Métodos. El presente estudio fue una investigación aplicada y descriptiva-correlacional. La población estadística incluyó a todos los estudiantes de medicina de la Universidad Islámica Azad, rama de Arsanjan en el año académico 2019-2020. En base al número de estudiantes y de acuerdo al método censal se determinó el tamaño de la muestra en 348 personas. Los estudiantes estaban estudiando en uno de los campos de enfermería, obstetricia y quirófano en la Universidad Islámica de Azad, sucursal de Arsanjan. La voluntad de participar en el estudio fue considerada como criterio de inclusión de la investigación. Para recolectar información se utilizaron el Inventario de Estilos de Aprendizaje (1984), el Inventario de Disposición de Pensamiento Crítico (2003) y el Inventario de Estilos de Pensamiento-Forma Corta (1992). Se utilizaron modelos de regresión apropiados, como la regresión múltiple simultánea, para analizar los datos.

Resultados. Los resultados revelaron una relación significativa entre los estilos de aprendizaje y la disposición de pensamiento crítico y el predictor más importante de la disposición de pensamiento crítico en los estudiantes fueron los estilos de aprendizaje de observación reflexiva, experiencia concreta, experimentación activa y conceptualización abstracta en cambios de estilo de vida para el control de enfermedades cardiovasculares, respectivamente. Asimismo, se observó una relación significativa entre los estilos de pensamiento y la disposición de pensamiento crítico, y los predictores más importantes de la disposición de pensamiento crítico en los estudiantes fueron los estilos de pensamiento legislativo, liberal, local, judicial y anárquico, respectivamente.

Conclusión. Los planificadores educativos deben considerar el pensamiento crítico y los métodos para su promoción y el uso de nuevos métodos educativos debe institucionalizarse en el plan de estudios para reducir los riesgos para la salud.

Palabras clave: Estilo de aprendizaje, estilo de pensamiento, disposición de pensamiento crítico, estudiantes de medicina, estilo de vida, riesgos cardiovasculares.

Higher education is one of the effective institutions in the comprehensive development of the country, which can provide the conditions for continuation of learning and active presence of students in various social, economic and cultural areas by paving the way for the generating and deepening of knowledge¹. Nowadays, all academic systems consider critical thinking courses necessary, since critical thinking as the basis of higher education is a clear sign of an educated person². The importance of critical thinking is so high that the World Federation for Medical Education (WFME) considers critical thinking as one of the universal standards of medical education, since medical education must adapt to the accelerating developments of the 21st century³. In addition to improving learning methods, this training model can also be effective on people's behavioral changes in accepting healthy behaviors.

Educational methods and strategies based on students' constructivist approaches focus on examining complex conditions and topics of thinking in the learning areas⁴. Cognitive, metacognitive, and constructivist theories support the reinforcement of critical thinking in the teaching process. In constructivist theories of learning, more emphasis is put on thinking processes than on their products⁵. Critical thinking is a method of thinking and problem solving that is the basis of effective decision making and problem solving. It can also be defined as the evaluation and interpretation of available information before making a decision and taking practical action⁶. The development of critical thinking requires a high level of revision of teaching methods. Many teacher-centered teaching methods do not respond to the development of students' critical thinking, and increase their dependence on the teacher and lead to increasing learning problems⁷. Developing thinking power is one of the main goals of education. Thinking is at the heart of critical thinking to improve the thinking process. Teaching medical and paramedical disciplines is one of the areas in which experts make great efforts to improve its quality. Critical thinking skills are necessary for medical disciplines⁸. Critical thinking is one of the most important skills in clinical decision making. Critical thinking is a cognitive activity to understand and evaluate findings and phenomena based on reasoning and analysis⁹. This thinking can also guide people in the thoughtful acceptance of behaviors in choosing the right behavior, such as changing lifestyle, changing behaviors, and changing attitudes towards a specific issue, such as susceptibility to a disease.

The ability to solve problems in the patient's bedside is very valuable for his or her care. A physician or therapist will make the right clinical decision and provide the best services in the care process by strengthening critical think-

ing skills¹⁰. Nowadays, due to the responsibility and scope of jobs related to health and care, making correct and vital decisions requires knowledge and skills and judgement in critical clinical situations and making decisions to save lives in complex problems and thinking in critical situations¹¹. This skill can be enhanced through strengthening cognitive area, motivating, strengthening emotional area, creating a space for interaction, written assignments, essay writing, short analysis, problem-solving practice using mass media, research design, and simulation during theoretical and practical learning processes in medical students¹².

In this study, the relationship between learning style and thinking style and tendency to critical thinking and its effect on behavior change in lifestyle change to control cardiovascular diseases were investigated. Since learning processes vary from one person to another person and due to individual differences, people learn in different ways. The reason for the failure of some students is ignorance of their learning method¹³. Learning styles are a method that people prefer in learning their subjects over other methods¹⁴. In other words, identifying the learning style of students increases the quality of education and makes it more suitable for students¹⁵. Evaluation of students' learning style and the development of teaching methods appropriate to their specific learning style have drawn attention of the experts in education area¹⁶.

As mentioned, humans have differences in various dimensions. Paying attention to these differences will guide people towards a suitable educational and career path. Investigating the learning styles has created a bridge between the study of cognition (processes such as perception, memory, and thinking) and the study of personality. Studies on the psychological, social and physiological dimensions of the educational process have led to research on thinking styles¹⁷. In general, thinking styles refer to a person's preferred ways of using their individual abilities. The concept of thinking styles implies that people use different ways to use their abilities just as there are different ways for management of a society¹⁸. Thirteen styles of thinking, including legislative, judicial, hierarchic, global, liberal, executive, local, monarchic, conservatism, anarchic, oligarchic, internal and external in five dimensions of actions, forms, levels, domains and dispositions have been distinguished¹⁹. Less attention has been paid to thinking styles and more attention has been paid to people performance. The failures and successes attributed to abilities are often due to styles. The poor performance of the student is not always due to incompetence but due to the mismatch between the student's thinking styles and the expectations that the teacher has of him or her. In other words, ability cannot indicate the different performance of individuals²⁰.

Studies have shown that thinking, problem solving and creativity are not metaphysical phenomena, but thinking is a natural fact and phenomenon in which all the laws, systems and principles governing human behavior are true. Behavioral thinking is learnable, so it is possible

teach thinking and creativity for people²¹. Information-based critical classifies, analyzes and applies information and accordingly enhances the process of science production by discovering scientific laws and presenting new theories²². Investigating the individual factors that lead to differences in critical thinking performance is vital, as gaining knowledge about the effective methods to enrich this ability is crucial²³.

Despite extensive educational initiatives and teaching methods designed to enrich critical thinking, little research has been conducted on the relationship between students' learning styles and thinking styles and critical thinking and changes in individual lifestyles and habits. We should help students to develop metacognitive control and other necessary reasoning skills such as critical analysis, thinking style, and learning by overcoming intellectual and one-dimensional habits and creating efficient and structured critical thinking framework. For this reason, identifying learning styles and factors related to it necessary for development of thinking skills, especially critical thinking development²⁴. In other words, to promote critical thinking pedagogy and enhance critical thinking abilities of learners, teachers should have a clear definition of the nature of critical thinking and factors affecting it²⁵. Considering the consequences of critical thinking and the effect it has on students' performance, paying attention to this important structure in the process of teaching, learning and discovering variables such as thinking style is necessity in education.

Materials and methods

Sample:

The present study method was descriptive-correlational. The statistical population included all medical students of the Islamic Azad University, Arsanjan Branch in 2018-2019 (students entered university from 2015 to 2018 in fields of midwifery=154, operating room =60, and nursing=134 people). According to the number of students, census method was used and the sample size was determined to be equivalent to the population. The studied students were studying in one of the fields of nursing, midwifery and operating room at the Islamic Azad University, Arsanjan Branch, and have willing to participate in the study was considered as an inclusion criterion. Research tools included:

Instruments:

Learning Styles Inventory (LSI): This inventory was developed by Kolb (1984) with the aim of assessing individuals' learning styles. It has 12 items. This questionnaire assesses people's learning styles in two dimensions of concrete experience, abstract conceptualization, reflective observation, active experimentation, and by combining these dimensions, four learning styles of converging, diverging, assimilating, and accommodating are obtained. It is scored on a 4-point Likert scale. Kolb (2005) reported va-

lidity coefficients of subscales of the Learning Styles Inventory for concrete experience, reflective observation, abstract conceptualization, active experimentation at 0.75, 0.66, 0.72, and 0.62, respectively and reported reliability coefficients for concrete experience, reflective observation, abstract conceptualization, and active experimentation at 0.80, 0.75, 0.79, and 0.70, respectively²⁶. Also, the Persian version of this inventory was used in this study, the validity and reliability of which were reported in Izadi and Mohammadzadeh Amlaei (2007) at 0.65, 0.64, 0.67, and 0.74 for active experimentation reported at concrete experience, reflective observation, abstract conceptualization, active experimentation, respectively²⁷.

Critical Thinking Disposition Inventory (CTDI): It was developed by Ricketts (2003) with the aim of assessing the critical thinking disposition using 33 items and three subscales of creativity (7 items) that assesses inquisitiveness disposition and willingness to know the facts, maturity (5 items), that assesses disposition to be aware of real and complex issues and problems, to be intelligent about different opinions and views, and to be aware of the prejudices and desires and commitment disposition (12 items) that assesses predisposition to seek opportunities to reason and anticipate situations that require reasoning, as well as to have self-confidence in the reasoning process. The inventory is scored on a 5-point Likert scale.

Ricketts (2003) reported the reliability coefficient of the inquisitiveness, maturity, and commitment subscales at 0.75, 0.57, and 0.86, respectively²⁸. The Persian version of this tool was used in this research. In Iran, Hatefi et al. (2016) used internal consistency method (Cronbach's alpha calculation) to calculate the reliability coefficient. The highest validity coefficient belonged to the commitment factor (0.81) and the lowest coefficient belonged to the maturity factor (0.38). Also, the correlation between the score of critical thinking skills and inquisitiveness was not significant, but the correlation between the score of critical thinking skills and maturity factors was significant at the level of 0.03 and the correlation between the score of critical thinking skills and commitment was significant at the level of 0.01. The correlation between the commitment factor in the preliminary test and the commitment factor in the test-retest was 0.682, the creativity factor in the test-retests was 0.546, the maturity factor in the test-retest was 0.372²⁹.

Thinking Style Inventory (TSI) (Short Form): It was developed by Sternberg and Wagner (1992)³⁰. It has 65 questions and its aim is to examine different thinking styles in individuals. It consists of 13 subtests. Each subtest consists of 5 questions that measure one thinking style (legislative, executive, judicial, monarchic, hierarchic, oligarchic, anarchic, global, local, internal, external, liberal, and conservative). This questionnaire is scored based on a five-point Likert scale. Zhang (2004) reported the reliability coefficient of this inventory between 0.40 and 0.80³¹. The internal validity of this inventory was obtained through analysis of variance and Pearson correlation coefficient, which ac-

count for about %0.80 of variance of data. Cronbach's alpha coefficient for each of the thinking styles of legislative, executive, judicial, global, oligarchic, liberal, conservative, hierarchic, anarchic, monarchic, oligarchic, internal, and external was reported at 0.74, 0.65, 0.74, 0.65, 0.67, 0.83, 0.76, 0.75, 0.51, 0.65, 0.70, 0.73, and 0.78, respectively. To confirm the reliability of the Persian version of this tool, Pouratashi and Zamani (2016) reported its Cronbach's alpha in the thinking styles of legislative, executive, judicial, global, oligarchic, liberal, conservative, hierarchic, anarchic, monarchic, internal, and external at 0.75, 0.77, 0.77, 0.91, 0.81, 0.87, 0.78, 0.76, 0.62, 0.92, 0.79, and 0.86, respectively¹⁷.

The desired variable in this study, which is expected to change under the influence of education and learning programs, is the change in people's lifestyle in reducing the risk of cardiovascular diseases.

Results

Table 1. Descriptive indices of research variables

Variable	Mean	SD	Min	Max
concrete experience learning style	5.94	2.03	0	12
reflective observation learning style	6	2.16	1	12
abstract conceptualization learning style	5.85	1.97	0	11
active experimentation learning style	5.99	1.97	1	12
Legislative thinking style	17.21	3.43	7	29
executive thinking style	16.6	3.10	8	25
Judicial thinking style	17.49	3.65	6	25
monarchic thinking style	17.95	3.63	8	25
hierarchic thinking style	17.47	3.33	8	26
Oligarchic thinking style	16.96	3.56	5	25
anarchic thinking style	17.51	3.55	5	25
global thinking style	16.66	3.24	9	25
local thinking style	16.01	2.95	9	29
internal thinking style	19.10	3.87	6	25
External thinking style	16.63	3.23	8	25
Liberal thinking style	17.74	3.80	6	26
Conservative thinking style	17.29	3.62	5	25
Critical thinking style	113.09	17.65	70	159

Hypothesis 1: Learning styles (concrete experience, reflective observation, abstract conceptualization, and active experimentation) predict the critical thinking disposition of students.

(Table 1), Data analysis shows that the Pearson test correlation coefficient between concrete experience, reflective observation, abstract conceptualization and active experimentation with students' critical thinking disposition is 0.324, 0.512, 0.256 and 0.282, respectively, with p-value (Significance) of 0.001 which are less than the significance level of $\alpha = 0.05$.

Thus, there is a positive and significant relationship between concrete experience, reflective observation, abstract conceptualization and active experimentation and students' critical thinking disposition (Table 2).

Simultaneous multiple regression was used to investigate the linear relationship between the dimensions of the predictor variable (independent variable) and the criterion variable (dependent variable). Before performing regression, the correlation between predictor and criterion variables was obtained by correlation in the previous step to test the significance of regression in the next step. Since the statistic value of Durbin-Watson is in the range of 1.5 and 2.5, it can be stated that the errors are uncorrelated. Also, the results obtained from the analysis of variance table show that the regression model is significant (significance level less than 0.05). The results of regression analysis are presented in (Table 3).

Considering that the p-value calculated from the test (0.001) is less than the significant level of 0.05, the linear regression model is significant. It means that there is a significant relationship between concrete experience, reflective observation, abstract conceptualization and active experimentation and critical thinking disposition of students. Multiple correlation coefficient value was obtained at 0.597, which indicates the level of simultaneous relationships between concrete experience, reflective observation, abstract conceptualization and active experimen-

tation and students' critical thinking disposition. Therefore, this relationship is meaningful. Since the significance level was 0.001 and is smaller than the level of $\alpha = 0.05$, this relationship is significant. The R^2_{adj} value was 0.349, so concrete experience, reflective observation, abstract conceptualization and active experimentation simultaneously explain 0.349 of variance of students' critical thinking disposition (Table 4).

Also, according to p-value calculated in the regression model coefficient test, H_0^1 , H_0^2 , H_0^3 H_0^4 is rejected at the level of 0.05 and t-value of concrete experience, reflective observation, abstract conceptualization and active experimentation are 4.681, 9.617, 2.227, and 3.121, respectively, with significance of less than 0.05. Thus, the critical thinking disposition in students varies according to the level of concrete experience, reflective observation, abstract conceptualization and active experimentation. Also, the β value for concrete experience, reflective observation, abstract conceptualization and active experimentation is 0.213, 0.434, 0.101 and 0.14, respectively. Hence, learning styles of students can be predicted using concrete experience, reflective observation, abstract conceptualization and active experimentation. The most important predictors of students' critical thinking disposition are reflective observation learning style, concrete experience, active experimentation, and abstract conceptualization, respectively (Table 5).

Table 2. Pearson correlation test statistics between learning styles (concrete experience, reflective observation, abstract conceptualization and active experimentation) with students' critical thinking disposition

Variable	critical thinking disposition			
	Correlation coefficient	sig	Presence of relationship	Type of relationship
concrete experience learning style	0.324	0.001	yes	direct
reflective observation learning style	0.512	0.001	yes	direct
abstract conceptualization learning style	0.256	0.001	yes	direct
active experimentation learning style	0.282	0.001	yes	direct

Table 3. Summary of the multiple correlation model of the correlation between students' learning styles and critical thinking disposition

Durbin-Watson	$R^2_{(adj)}$	R^2	R
1.99	0.349	0.357	0.597

Predictor variables: concrete experience, reflective observation, abstract conceptualization, and active experimentation

Criterion variable: critical thinking disposition

Table 4. Analysis of variance of correlation between concrete experience, reflective observation, abstract conceptualization and active experimentation and students' critical thinking disposition

Model	Sum of squares	df	Mean of squares	Statistic F	sig
regression	38590.185	4	9647.546	47.60	*0.001>
Residual	69520.873	343	202.685		
Total	108111.057	347	-		

Criterion variable: Critical thinking disposition

* Significant at the level of 0.01

Hypothesis 2: Thinking styles (legislative, executive, judicial, monarchic, hierarchic, oligarchic, anarchic, global, local, internal, external, liberal, and conservative) predict students' critical thinking disposition.

Data analysis shows that the correlation coefficient of Pearson test of thinking styles of legislative, executive, judicial, monarchic, hierarchic, oligarchic, anarchic, global, local, internal, external, liberal, and conservative is 0.283, 0.102, 0.256, 0.204, 0.246, 0.139, 0.263, 0.098, 0.253, 0.171, 0.141, 0.286, and 0.219, respectively. Except for executive and global thinking styles, the significance level of other styles is less than $\alpha = 0.05$, so there is a positive and significant relationship between the thinking styles of legislator, judicial, monarchic, hierarchic, oligarchic, anarchic, local, internal, external, liberal, conservative and students' critical thinking disposition. However, there is no significant relationship between executive and global thinking styles and students' critical thinking disposition because their significance is more than 0.05 (Table 6).

Simultaneous multiple regression was used to investigate the linear relationship between the dimensions of the predictor variable (independent variable) and the criterion variable (dependent variable). Before performing regression, the correlation between predictor and criterion variables was obtained by correlation in the previous step to test the significance of regression in the next step. Since the Durbin-Watson value is in the range of 1.5 and 2.5, it can be said that the errors are uncorrelated. Also, the results obtained from the analysis of variance table show that the regression model is significant (significance level less than 0.05). The results of regression analysis are presented in (Table 7).

Since the p-value calculated from the test (0.001) is less than the significant level of 0.05, the linear regression model is significant. It means that there is a significant linear relationship between legislative, executive, judicial, monarchic, hierarchic, oligarchic, anarchic, global, local, external, internal, liberal, and conservative thinking styles and students' critical thinking disposition. Multiple correlation coefficient is $r = 0.475$, which indicates the simultaneous relationship between legislative, executive, judicial, monarchic, hierarchic, oligarchic, anarchic, global, local, internal, external, liberal, and conservative thinking styles and critical thinking disposition of students. Since the level of significance is 0.001 and less than the level of $\alpha = 0.05$, this relationship is significant. Since the R^2_{adj} value (adjusted R^2) is 0.196, thinking styles simultaneously explain 0.196 of variance of students' critical thinking disposition (Table 8).

Also, based on the p-value calculated in the regression model coefficient test, H_0^1 , H_0^3 , H_0^7 , H_0^9 , H_0^{12} are rejected at the level of 0.05. The t-value of the thinking styles of legislative, judicial, anarchist, local, and liberal is 2.18, 2.10, 3.80 and 2.70, respectively, with a significance level of less than 0.05, so the critical thinking disposition in students varies according to the thinking styles of the legislative, judicial, anarchist, local, and liberal. Also, β value for the legislative, judicial, anarchic, local and liberal thinking styles is 0.166, 0.118, 0.114, 0.145 and 0.149, respectively. Thus, students' critical thinking of students can be predicted using legislative, judicial, anarchic, local, and liberal and the most important predictors of critical thinking in students are legislative, liberal, local, judicial, and anarchic, respectively (Table 9).

Table 5. Regression coefficients of correlation between concrete experience, reflective observation, abstract conceptualization and active experimentation and students' critical thinking disposition

Predictor variables	Non-standardized coefficients		Standardized coefficients	t	P
	B coefficient	Standard error	Beta		
Constant	67.97	3.689	-	18.426	0.001
concrete experience learning style	1.85	0.395	0.213	4.681	0.001
reflective observation learning style	3.55	0.369	0.434	9.617	0.001
abstract conceptualization learning style	0.903	0.406	0.101	2.227	0.027
active experimentation learning style	1.257	0.403	0.14	3.121	0.001

Criterion variable: Critical thinking disposition

Table 6. Pearson correlation test statistics between thinking styles (legislative, executive, judicial, monarchic, hierarchic, oligarchic, anarchic, global, local, internal, external, liberal, and conservative) and students' critical thinking disposition

Variable	critical thinking disposition			
	Correlation coefficient	sig	Presence of relationship	Type of relationship
Legislative thinking style	0.283	0.001	yes	direct
Executive thinking style	0.102	0.058	no	-
Judicial thinking style	0.256	0.001	yes	direct
Monarchic thinking style	0.204	0.001	yes	direct
Hierarchic thinking style	0.246	0.001	yes	direct
Oligarchic thinking style	0.139	0.001	yes	direct
Anarchic thinking style	0.263	0.001	yes	direct
global thinking style	0.098	0.067	no	-
local thinking style	0.253	0.001	yes	direct
Internal thinking style	0.171	0.001	yes	direct
External thinking style	0.141	0.009	yes	direct
liberal style	0.286	0.001	yes	direct
Conservative thinking style	0.219	0.001	yes	direct

Table 7. Summary of Multiple correlation model of the correlation between students' thinking styles and critical thinking disposition

Durbin-Watson	R ² _(adj)	R ²	R
1.91	0.196	0.226	0.475

Predictor variables: Legislative, Executive, Judicial, Monarchic, Hierarchic, Oligarchic, Anarchic, Global, Local, Internal, External, Liberal, and Conservative thinking styles
 Criterion variable: Critical thinking disposition

Table 8. Analysis of variance of correlation between thinking styles and students' critical thinking disposition

Model	Sum of squares	df	Mean of squares	Statistic F	sig
regression	24415.703	13	1878.131	7.49	*0.001
residual	83695.355	334	250.585		
Total	108111.057	347	-		

Criterion variable: critical thinking disposition

Table 9. Regression coefficients of correlation between thinking styles and students' critical thinking disposition

Predictor variables	non-standardized coefficient		Standardized coefficient	t	P
	B coefficient	Standard error	Beta		
Constant	39.70	8..95	-	4.436	0.001
Legislative thinking style	0.852	0.27	0.166	3.156	0.002
Executive thinking style	0.412	0.299	0.025	0.474	0.636
Judicial thinking style	0.569	0.26	0.118	2.18	0.03
Monarchic thinking style	0.49	0.265	0.101	0.185	0.065
Hierarchic thinking style	0.404	0.293	0.076	1.38	0.169
Oligarchic thinking style	0.118	0.272	0.024	0.43	0.665
Anarchic thinking style	0.566	0.27	0.114	2.10	0.036
global thinking style	0.137	0.294	0.025	0.467	0.641
local thinking style	0.868	0.31	0.145	2.80	0.005
Internal thinking style	0.213	0.245	0.047	0.868	0.386
External thinking style	0.11	0.301	0.02	0.365	0.715
liberal style	0.693	0.257	0.149	2.70	0.007
Conservative thinking style	0.071	0.28	0.015	0.253	0.80

Criterion variable: Critical thinking disposition

Discussion

Based on the results of the data, both hypotheses of the present study were confirmed. These results are consistent with the results of previous studies³².

Hypothesis 1: Learning styles (objective experience, reflective observation, abstract conceptualization, and active experimentation) predict students' critical thinking tendency towards behavior change.

Data analysis of the correlation coefficient in the Pearson test showed a positive and significant correlation coefficient between concrete experience, reflective observation, abstract conceptualization and active experimentation and students' critical thinking disposition. In explaining these results, it can be said that in the model presented by Kolb, learners with abstract conceptualization learning

style show a logical and scientific approach to problem solving and other learning situations. They are intellectual / deductive-inductive learners rather than emotional learners. These learners make judgement based on reason and the laws of logic. These people have critical thinking dispositions such as truth-seeking, analytical, systematic, self-confidence and cognitive maturity dispositions.

Also, in the Kolb learning model, learners with the method of reflective observation have a reflective approach to learning. These people are able to see ideas and situations from different and multidimensional angles. They form their opinions based on thought and feeling, and often judge very thoughtfully. Learners with an active experimentation style place great emphasis on the practical and experimental application of concepts. Instead of having reflective understanding of the absolute truth of the matter, they prefer to find a solution to the problem by experimenting. They are also at high risk and can influence behavior change in controlling the occurrence of disorders such as the occurrence of cardiovascular disease. However, learners with a high score on concrete experience

have experimental approach to learning and rely heavily on emotion-based judgments.

Hypothesis 2: Thinking styles (legislative, executive, judicial, monarchic, hierarchic, oligarchic, anarchic, global, local, internal, external, liberal, and conservative thinking styles) predict the students' critical thinking disposition.

Data analysis of the correlation coefficient in the Pearson test showed a positive and significant between legislative, executive, judicial, monarchic, hierarchic, oligarchic, anarchic, global, local, internal, external, liberal, and conservative thinking style and students' critical thinking disposition. However, there was no significant relationship between executive and global thinking styles and students' critical thinking disposition. Studying and identifying thinking styles in individuals is important since it is a valuable step in predicting critical thinking in different societies, especially students, in the process of academic achievement. There are situations in which students' academic and critical behaviors are directly derived from their thinking styles. Critical thinking is important in clinical judgments and decisions and traditional education system needs to be transformed and revised to achieve the goals of education to educate medical students. Hence, extensive studies have been conducted in this area³².

A study conducted by Zare and Nahravanian (2017) examined critical thinking training on problem-solving and self-directed learning styles. The results showed that critical thinking involves combining the student's ability and maximizing it, which in turn leads to the promotion of self-directed learning and problem solving³³. Elahi Frad, Fathi Azar, and Hashemi (2018) showed a positive and significant relationship between critical thinking skills and academic achievement of medical students and the methods of receiving and processing information as well as between critical thinking skills and learning styles³⁴. Ghadmapour et al. (2013) showed that there was no significant difference between students' critical thinking disposition based on learning style³⁵. In a study conducted by Thorlton J, Catlin AC. (2019), active learning methods led to a high level of participation and satisfaction of medical and nursing students³⁶. Also, in research conducted by Knoll AR, Otani H, Skeel RL, Van Horn KR. (2017), no correlation was found between the scores of learning verbal and visual information and the recall or accuracy of learning judgments. The subjective aspects of learning predicted learning styles, but the objective aspects of learning did not predict learning style³⁷. In a qualitative study on nursing students in Taiwan Lin CC, Han CY, Pan IJ, Chen LC. (2015), the method of teaching and learning and critical thinking was examined. The results of the research were based on participants' views on becoming a critical thinker, becoming an active learner, and ultimately gaining self-confidence³⁸.

Based on the research results, it can be concluded that critical thinking can be predicted through learning styles and thinking styles. Since students' problems in learning skills and thinking style are often directly related to their critical thinking disposition, critical thinking and methods of promoting it should be considered by educational planners and the use of new teaching methods should be institutionalized in the curriculum. There is also a need for more research to identify the causes for non-development of critical thinking in the medical education system.

Recommendations

The data of the present study were obtained using self-report tools. It is recommended that qualitative and mixed methods be used for critical thinking in future research. Also, the present study was conducted among Arsanjan medical students, so we should treat with caution in generalizing of these results to other fields of study and more studies are needed in this area.

References

1. Sadri Damirchi E, Jafari Kafash K, Kiani A, Balakhani Tulegilani A. Prediction of Critical Thinking Based on Autonomous Learning and Epistemological Beliefs in Dentistry Students. *Jmed*. 2018; 13 (2):101-113.
2. Tashi S, Mortazavi F, Yazdani S, Motaghypour Y. The Study of Critical Thinking Skills in Medical Students of Isfahan University of Medical Sciences. *Developmental steps in medical education*, 2012; 9(2):170-178. [Persian]
3. Duane B, Satre ME. Utilizing constructivism learning theory in collaborative testing as a creative strategy to promote essential nursing skills. *Nurse Education Today*, 2014; 34(1):31-34.
4. Kalhor M, Mehran G. The effect of concept map strategy on students' critical thinking skills. *Quarterly of Educational Psychology*, 2017; 13(44):153-172.
5. AlperAy F, Karakaya A, Yilmaz K. Relations between Self-Leadership and Critical Thinking Skills. *Procedia- Social and Behavioral Sciences*, 2015; 207:29-41.
6. Lee A, Boyle P. Quality Assurance for learning and teaching: A systemic perspective. *Ideas on Teaching*, 2012. Accessed 12/09/2012, URL: <http://www.cdte.nus.edu.sg/ideas/iot536.htm>.
7. Matroudi L. An Analytical Study of Factors Influencing Critical Thinking in Elementary School Children. M.Sc. thesis, Shahid Chamran University of Ahvaz, 2010.
8. Mohammadipour M. A Look at Critical Thinking in Medical Sciences Education, *Journal of Forensic Medicine Faculty of the Islamic Republic of Iran*, 2014; 9(1):38-42. [Persian]
9. Windish DM. Teaching Medical students reasoning Skills. *Acad med*. 2000; 75: 90.
10. Simpson E, Courtney M. Critical thinking in nursing education: litera-

- ture review. *Int J Nurs Pract.* 2002;8:89-98
11. Khalili H, Soleimani M. [Determination of reliability, validity and norm of California critical thinking skills test, form B]. *Journal of Babol University of Medical Sciences*, 2003; 5(2):84-90. [Persian]
 12. Billings Diane M, Hulsted Judith A. *Teaching in nursing a guide for faculty.* St Luis: Saunders Co, 2009.
 13. Sharifi M, Nadi M. Structural Modeling of the Relationship between Self-directed Learning and Learning Styles and Learning Strategies with Academic Achievement in Isfahan Public Schools Preschool Students. *Curriculum research*, 2016; 13(22): 48-60. [Persian]
 14. Al Hamdani, D. Exploring students' learning style at a Gulf university: a contributing factor to effective instruction. *procedia-social and behavioral sciences*, 2015; 176: 124-128
 15. Rogowsky BA, Calhoun BM, Tallal P. Matching learning style to instructional method: effects on comprehension. *Journal of educational psychology*, 2015; 107(1): 64-78.
 16. Martin S. Teachers using learning styles: Torn between research and accountability? *Teaching and Teacher Education*, 2010; 26:1583-1591.
 17. Pouratashi M, Zamani A. Validity and Reliability of the Thinking Styles Questionnaire among Agricultural Students. *Journal of Educational Measurement*, 2016, 6(24):103-121. [Persian]
 18. Pirmohammadi G, Khodai E, Yousefi H, Shariati F, Dasta M. The Relationship between Thinking Styles and Learning Approaches with Academic Achievement in Male and Female Students. *Teaching and learning studies*, 2010, 2(1):69-94. [Persian]
 19. Sadeghi J, Eghei J, Gholamali Lavasani M, Abbaszadeh N. Predicting the academic achievement of students of Imam Ali University of Medical Sciences on the basis of thinking styles. *Military Management Quarterly*, 2015; 17(1):1-28. [Persian]
 20. Gravand H, Sabziyan S, Kamkar P, Karami. The role of thinking style functions on self-directed learning and tendency to critical thinking. *Cognitive Strategies in Learning*, 2014; 1(2):17-30. [Persian]
 21. Darezereshki N, barzegarbafoee K, zandvanian A. Examining the Effectiveness of Teaching Philosophy on the way community of inquiry on critical thinking and its dimensions of female students in fifth grade in Yazd. *JCP.* 2017; 5(2):61-70. [Persian]
 22. Stupple EJN, Maratos FA, Elander J, Hunt TE, Cheung KYF, Aubeeluck AV. Development of the Critical Thinking Toolkit (CriTT): A measure of student attitudes and beliefs about critical thinking. *Thinking Skills and Creativity*, 2017; 23:91-100.
 23. Kelly YL, Ku A, Irene T. Dispositional factors predicting Chinese students' critical thinking performance. *Personality and Individual Differences*, 2010; 48:54- 58.
 24. Gholamrezai S, Yousefvand L, Radmehr P. The predictive role of Self-Efficacy and Meta-Cognitive on students tendency to Critical Thinking. *Rme*, 2017; 9(1):45-37. [Persian]
 25. Marin LM, Halpern DF. Pedagogy for developing critical thinking in adolescents: Explicit instruction produces greatest gains. *Think Skill Creat*, 2011; 6(1):1-13.
 26. Kolb D. *Experiential learning: Experience as the source of learning and development.* Englewood Cliffs, NJ: Prentice-Hall, 1984.
 27. Izadi S, Mohammadzadeh Edmolae R. A Study of Relationship between Learning Styles, Personality Characteristics and Academic Performance. *TLR.* 2008; 1 (27):15-28. [Persian]
 28. Ricketts JC. The efficacy of leadership development, critical thinking dispositions, and student academic performance on the critical thinking skills of selected youth leaders. Doctoral dissertation, University of Florida, 2003.
 29. Hatefi S, Arkan A, Heidari M. Investigating the Psychometric Properties of Critical Thinking Tendency Inventory among Students of Tehran Universities. *Journal of Cognitive Psychology*, 2016; 4(4):1-10. [Persian]
 30. Sternberg RJ, Wagner RK. *Thinking styles Inventory.* Unpublished test, Yale University, 1992.
 31. Zhang LF. Revisiting the predictive power of thinking styles for academic performance. *The Journal of Psychology*, 2004; 138:370-351.
 32. Kerman Saravi F, Navabi Rigi S D, Ebrahimi Tabas E. Critical thinking skills in Zahedan University of Medical Sciences freshman nursing students and graduated in 2009-2011. *J Qual Res Health Sci.* 2011; 11 (1 and 2):7-17.
 33. Ramezanpour A, Bakhtiyari A, Sheykhi S, Farhadi F. The Relationship between Learning Style and Thinking Style of Students of Faculty of Engineering-Psychology-Educational Sciences of Tehran University. *Journal of Iranian Higher Education Association*, 2013; 7(2):193-219. [Persian]
 34. Elahifard, L. Fathi Azar, A. Hashemi, T. The Relationship between Critical Thinking Skills and Academic Achievement with Mediating the Learning Styles of Medical Students of Tabriz University of Medical Sciences. Master's Degree in Educational Psychology, Faculty of Educational Sciences and Psychology. Tabriz University. 2018. [Persian]
 35. Ghadampour, A. Kashtiaray, N Nasserian, H. Mohammadzadeh, A. Gravand, H. On the subject of learning priorities and its relation to why it is possible to create more literacy and midwifery students. *Iranian Journal of Medical Education*, 2013, 13(8):652-662. [Persian]
 36. Thorlton J, Catlin AC. Data Mining for Adverse Drug Events: Impact on Six Learning Styles. *Comput Inform Nurs*, 2019; 37(5):250-259.
 37. Knoll AR, Otani H, Skeel RL, Van Horn KR. Learning style, judgements of learning, and learning of verbal and visual information. *Br J Psychol*, 2017; 108(3):544-563
 38. Lin CC, Han CY, Pan IJ, Chen LC. The teaching-learning approach and critical thinking development: a qualitative exploration of Taiwanese nursing students. *J Prof Nurs*, 2015; 31(2):149-57.