



Designing a model for critical thinking development in AJA University of Medical Sciences

MAHYAR MAFAKHERI LALEH¹, MOJGAN MOHAMMADIMEHR^{2*}, SANAZ ZARGAR BALAYE JAME³

¹Educational Development Center, AJA University of Medical Sciences, Tehran, Iran; ²Department of Microbiology, Educational Development Center, AJA University of Medical Sciences, Tehran, Iran; ³Department of Public Health, School of Medicine, AJA University of Medical Sciences, Tehran, Iran

Abstract

Introduction: In the new concept of medical education, creativity development is an important goal. The aim of this research was to identify a model for developing critical thinking among students with the special focus on learning environment and learning style.

Methods: This applied and cross-sectional study was conducted among all students studying in undergraduate and professional doctorate programs in Fall Semester 2013-2014 in AJA University of Medical Sciences (N=777). The sample consisted of 257 students selected based on the proportional stratified random sampling method. To collect data, three questionnaires including Critical Thinking, Perception of Learning Environment and Learning Style were employed. The data were analyzed using Pearson's correlation statistical test, and one-sample t-test. The Structural Equation Model (SEM) was used to test the research model. SPSS software, version 14 and the LISREL software were used for data analysis.

Results: The results showed that students had significantly assessed the teaching-learning environment and two components of "perception of teachers" and "perception of emotional-psychological climate" at the desirable level ($p < 0.05$). Also learning style and two components of "the study method" and "motivation for studying" were considered significantly desirable ($p < 0.05$). The level of critical thinking among students in terms of components of "commitment", "creativity" and "cognitive maturity" was at the relatively desirable level ($p < 0.05$). In addition, perception of the learning environment can impact the critical thinking through learning style.

Conclusion: One of the factors which can significantly impact the quality improvement of the teaching and learning process in AJA University of Medical Sciences is to develop critical thinking among learners. This issue requires providing the proper situation for teaching and learning critical thinking in the educational environment.

Keywords: Critical thinking; Learning; Teaching; Teaching environment; Learning environment

*Corresponding author:

Mojgan Mohammadimehr,
Department of Microbiology,
Educational Development
Center, AJA University of
Medical Sciences, Tehran,
Iran

Tel: +98 21 88337914

Email:

m.mohammadimehr@
ajaums.ac.ir

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Introduction

Being aware of self-behavior and having thinking ability are fundamental features of human being. In other words, a human being can be aware of his/her behavior and use his/her thinking power in dealing with various issues and affairs (1). Critical thinking is a thinking skill which consists of mental processes of discernment, analysis and evaluation (2). Critical thinking is one dimension of thinking. The tendency in developing critical thinking abilities in educational communities is not a new phenomenon and the origin of such tendency can be traced back to Plato's school of philosophy (3). The explosion of information and amazing increased human knowledge, globalization and the acceleration of the rate of changes make the necessity of fundamental evolution in educating people about critical thinking more obvious (4), because approximately 3 million new articles in medical knowledge are published annually and also more than 17 thousands new books in the field of medical sciences are released per year (5). Also, measures should be adopted to meet new needs in the field of health and medicine and in this regard, change in medical education is the most important measure. Thus, medical education in its new concept is an environment in which the development of creativity and training innovative student are important goals. The UNESCO Universal Declaration on Higher Education titled "Higher Education in the Twenty-First Century" in 2009 states that training on creativity and innovation are the main tasks of the higher education (6). Hence, the development of creativity for educating critical thinking is considered as the most important task of medical education. All universities should be appropriately prepared to consider structural components required for such a process. Also, using appropriate educational methods and teaching efficient learning and studying methods in this field are matters of great importance (7, 8).

The review of studies conducted in this field indicates that most studies have investigated the relationship between critical thinking and demographic variables, educational progress, teaching methods and so on (3). Results of some studies have also shown that graduate programs are considered as a strong predictor of critical thinking (9, 10). Faciune & Giancarlo concluded that educational and professional progress requires fostering intrinsic motivation for thinking and also for critical thinking skills (11). Most studies show that age, sex and educational path have an effect on critical thinking (12, 13). Behrens found that there is a

direct relationship between critical thinking and creative and judgmental thinking style, while there is a negative relationship between critical thinking and conservative thinking style; in fact, creative thinking and critical thinking are related to each other (14). Alivandi Vafa, Bigdeli and Shabaniconcluded that there is a statistically significant relationship between the level of critical thinking and educational progress (15-17). The results of a study conducted by Borjalilou showed that analytical and curiosity components related to critical thinking contribute significantly in predicting educational self-efficacy (1). The results of a study conducted by Pishegar showed that there is no statistically significant relationship between learning style (converging-diverging and accommodating) and critical thinking skills (analytical-evaluative and deductive). However, there is a statistically significant relationship between critical thinking skills and the students' field of study (18). A study conducted by Jones, Rotliff & Glick identified little but significant relationship between skills and critical thinking tendencies (19).

On the other hand, attention to the sensitive and significant role of medical schools in preparing students as future physicians facing 21st century challenges, in turn, indicates the necessity of conducting a study on the field of critical thinking. Teaching critical thinking at a high level, especially in medical schools, may facilitate learners to face various challenges that they will probably experience in their personal, professional and social life. The outcome will be physicians trained to be able to logically deal with changes.

The present study aimed to design a model for critical thinking development for students in AJA University of Medical Sciences. To do so, the identification of dimensions and components for growth and development in critical thinking, such as personal factors or teaching-learning environment, was necessary. According to the results of studies conducted in this field, personal and organizational factors were selected as factors to be studied in this research. Among the organizational factors, teaching-learning environment and among the personal factors, learning style is great importance (12).

Methods

This cross sectional study was conducted among all students studying in undergraduate and professional doctorate programs in Fall Semester 2013-2014 in AJA University of Medical Sciences (N=777). Due to the probable difference in attitudes towards the studied variables among

the two groups of students on two programs, the sample was selected from both students in undergraduate and professional doctorate programs using proportional stratified random sampling method. Based on Krejcie and Morgan's table, the sample size of 257 students was determined and there were 158 undergraduate students and 99 students in professional doctorate program. In each stratum, students were selected randomly based on the university education department list.

To gather data, three questionnaires were used including Ricketts' critical thinking dispositions questionnaire (consisting of 18 items) (20), Roff's perception of teaching-learning environment questionnaire (consisting of 37 items) (21) and John Biggs' two-factor study process questionnaire (consisting of 14 items) (22). The questions were close-ended and responses to them were based on a five-point scale (5 strongly agree, 4 agree, 3 neither agree nor disagree, 2 disagree and 1 strongly disagree). The validity of the questionnaires was assessed using experts' and academicians' opinions and the reliability of the questionnaires was measured using Cronbach's alpha coefficient test. To do so, the questionnaires were administered to 30 students in AJA University of Medical Sciences and Cronbach's alpha coefficient was calculated. The results of Cronbach's alpha coefficient test for critical thinking dispositions questionnaire was 0.805, for perception of teaching-learning environment questionnaire 0.914 and for learning style questionnaire 0.930. After making future amendments, we administered the questionnaires to 257 students.

Administrative approval was granted for conducting the study in the university. Verbal consent was obtained from participants after providing adequate information about the significance and aim of the study. The participants were assured that their participation was voluntary and their responses would be treated with confidentiality.

The critical thinking questionnaire consists of three subscales including "creativity" and "cognitive maturity" and "commitment". Also, the perception of teaching-learning environment questionnaire consists of two components including "perception of emotional -psychological climate" and "perception of teachers"; and the two-factor study process questionnaire involves subscales including "deep motive", "deep strategy" and "surface motive" and "surface strategy".

It should be noted that in this study, based on experts' opinion and for adaptation to the subjects' situation, some items were omitted. In other

words, we decreased the number of questions in the two-factor study process questionnaire from 20 to 14 and questions in the critical thinking dispositions questionnaire from 33 to 18. The questionnaires were translated into Persian, and an expert accurately matched the content of the translated questionnaires with the originals ones and finally they were administered.

For the ease, efficiency and more accuracy in distributing and collecting the questionnaires, after obtaining required permission, the questionnaires were distributed at the final test sessions in cooperation with authorities responsible for holding exams in AJA University of Medical Sciences. The students were given enough time to accurately answer the questions of the questionnaires and finally the questionnaires were collected. Given the method of distribution and collection of the questionnaires, the response rate was 100%.

The data were analyzed, using Pearson's correlation statistical test and one-sample t-test in SPSS software, version 14. To determine the utility of any variable or component, the score for each one, based on the Nanly scale (1967), was put in a range of four domains with four values: desirable (4-5), relatively desirable (3-3.99), relatively undesirable (2-2.99) and undesirable (1-1.99). Finally, Structural Equation Model (SEM) was used to test the research model. The Structural Equation Model is a very powerful multivariate analysis from multi-variables regression family. More precisely, it is an extension of General linear model (GLM) which enables researchers to examine some set of regression equations simultaneously. For development of this model, the LISREL software was used. The LISREL approach whilst estimates unknown coefficients of structural linear equations, it is also designed to embed structural models including latent variables, measurement errors in every dependent and independent variables, bidirectional causality, simultaneity and codependency.

Results

Out of 257 studied students, 91.7% (235 students) were male and 8.3% (22 students) were female.

Table 1 shows frequency and one sample t-test of variables and components. According to the results, it can be said that based on the Nanly scale (1967), the students' perceptions of the teaching-learning environment in AJA University of Medical Sciences are in the relatively desirable range. In other words, the students have significantly assessed the teaching-learning environment at the desirable level ($p < 0.05$). As

Table 1: Frequency table and one sample t-test of variables and components

Variables and components		Frequency	Mean±SD	Mean	Sig.
Students' perception of teaching-learning environment	Perceptions of the teaching-learning environment	257	3.335±0.910	3	<0.001
	Perception of teachers	257	3.175±0.695	3	<0.001
	Perception of emotional-psychological climate	257	3.263±0.750	3	<0.001
Students' learning style	Learning style	257	3.201±0.788	3	<0.001
	Study method	257	3.122±0.692	3	0.001
	Motivation	257	3.281±0.932	3	<0.001
Students' critical thinking	Critical thinking	257	3.197±0.730	3	<0.001
	Commitment	257	3.185±0.789	3	<0.001
	Creativity	257	3.084±0.747	3	0.026
	Cognitive maturity	257	3.323±0.819	3	<0.001

the two components, “*perception of teachers*” and “*perception of emotional-psychological climate*”, were considered as dimensions of perception of teaching-learning environment, it can be said that the students’ perceptions of the teaching-learning environment in these two dimensions have been significantly higher than the average level. In other words, based on the Nanly scale, the students assessed the features of teachers and also emotional-psychological climate in AJA University of Medical Sciences as relatively desirable ($p < 0.05$).

According to the results shown in Table 1, it can be said that based on the Nanly scale, the level of critical thinking among students in AJA University of Medical Sciences is in the relatively desirable range ($p < 0.05$). Since the status of critical thinking has been measured within three components including commitment, creativity and cognitive maturity, it can be said that based on the Nanly scale, the level of critical thinking among students in AJA University of Medical Sciences in terms of components of commitment, creativity and cognitive maturity has been at the relatively desirable level ($p < 0.05$).

Pearson correlation test was used to evaluate the research hypotheses and the results are shown in Table 2.

First hypothesis) There is a statistically

significant relationship between the perception of teaching-learning environment and its components and critical thinking and its components. Based on the results, there was a statistically significant direct relationship between the variable of the perception of teaching-learning environment and critical thinking by a correlation coefficient of 0.311 at an error level of less than 0.05.

Second hypothesis) There is a statistically significant relationship between learning style and its components and critical thinking and its components. Based on the results, there was a statistically significant direct relationship between the variable of learning style and critical thinking behavior by a correlation coefficient of 0.695 at an error level of less than 0.05.

Third hypothesis) There is a statistically significant relationship between the perception of teaching-learning environment and its components and learning style and its components. Based on the results, there was a statistically significant direct relationship between the variable of the perception of teaching-learning environment and learning style by a correlation coefficient of 0.345 at an error level of less than 0.05.

Forth hypothesis) The perception of teaching-learning environment directly and through learning style influences critical thinking. Structural equation modeling was used in order

Table 2: Correlation matrix of variables and their components

Variables and components	Commitment	Creativity	Cognitive maturity	Critical thinking	Study method	Motivation	Learning style
Emotional-psychological climate	0.373**	0.311**	0.305**	0.350**	0.350**	0.378**	0.373**
Perception of teachers	0.422**	0.353**	0.358**	0.401**	0.402**	0.401**	0.413**
Teaching-learning environment	0.337**	0.285**	0.257**	0.311**	0.371**	0.308**	0.345**
Study method	0.675**	0.615**	0.588**	0.664**			
Motivation	0.698**	0.628**	0.605**	0.683**			
Learning style	0.709**	0.641**	0.616**	0.695**			

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

to test the fourth hypothesis of the study. To do so, we, first, designed the conceptual model shown in Figure 1 based on the history and theoretical foundations.

Based on the conceptual model, the perception of teaching-learning environment either directly or through learning style affects the level of critical thinking. Thus, according to the model, the following three detailed hypotheses were introduced.

A. The perception of teaching-learning environment influences the students' critical thinking.

B. The perception of teaching-learning environment influences the students' learning style.

C. Learning style influences the students' critical thinking.

To test the above-mentioned research hypotheses, the research conceptual model was entered into the LISREL software and its fitness was tested. The results of the first order confirmatory factor analysis indicated that based on factor model statistics, loadings for all items were over 0.33. This shows that the observed items (questions in the questionnaire) measuring latent variables loaded significantly on them (latent variables). Latent variables include perception of teaching-learning environment (PoE), learning style (LS) and critical thinking (CT).

Goodness of Fit Indices (GFI) of the research model shows that χ^2 value (15835.04) with a p value less than 0.001 is significant. The value of Root Mean Squared Error of Approximation (RMSEA) was found to be equal to 0.0789 and less than 0.1 and the value of GFI (assessment of variance and covariance relative values) is more than 0.9 and equal to 0.92; and adjusted goodness-of-fit index (AGFI) is also 0.893 and near to 0.9.

These results indicate that the fitness of the Structural Equation Model is relatively good and the value of RMR which is equal to 0.08 indicates the weakness of residuals in the model. Also, all studied structural relations were statistically significant with a 95% confidence level. The results of the second order confirmatory factor analysis of the variables have been presented in Figure 2. The results showed that loadings for all items are over 0.33; hence, it is clear that the observed items loaded significantly on research main variables. Furthermore, since the Chi-square value (93.70) was significant with a 95% confidence level and the Root Mean Square Error of Approximation (RMSEA) was less than 0.1 (0.045), it can be concluded that the fitness of the model is good.

Given that the results of the first and second order confirmatory factor analyses were significant, the studied detailed hypotheses were addressed as below:

A. The perception of teaching-learning environment influences critical thinking as the value of t with a p-value < 0.05 was significant. Therefore, it is clear that the research hypothesis on direct and significant impact of perception of teaching-learning environment on critical thinking is proved. The coefficient of this correlation and the t-value are equal to 0.41 and 5.11 respectively. The correlation coefficient obtained in the first hypothesis of the research is consistent with this finding.

B. The perception of teaching-learning environment influences the learning style as the value of t with a p < 0.05 was significant. Therefore, it is clear that the research hypothesis on direct and significant impact of perception of teaching-learning environment on learning style is proved.

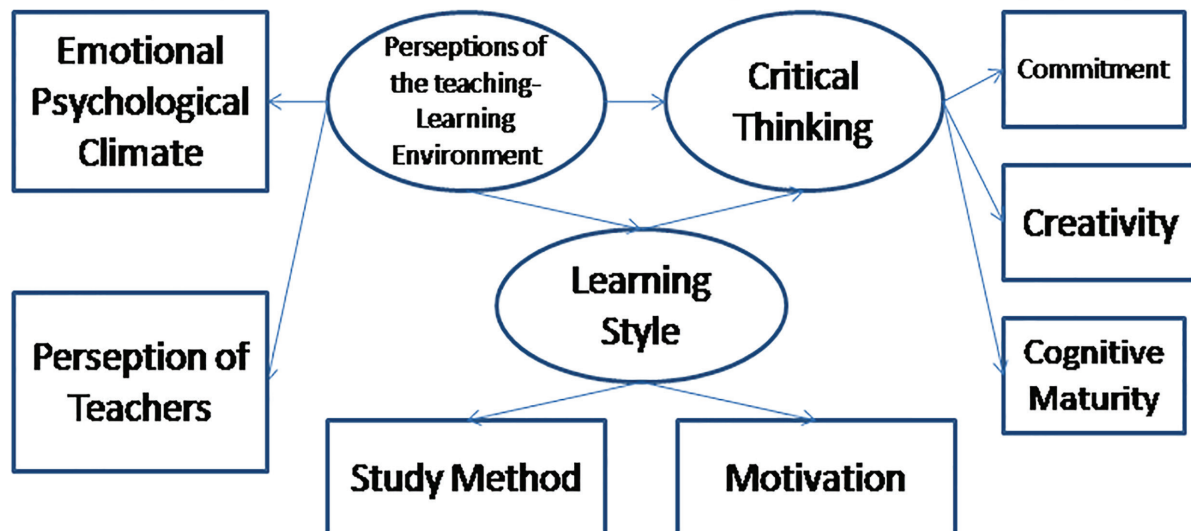


Figure1. The conceptual model of research

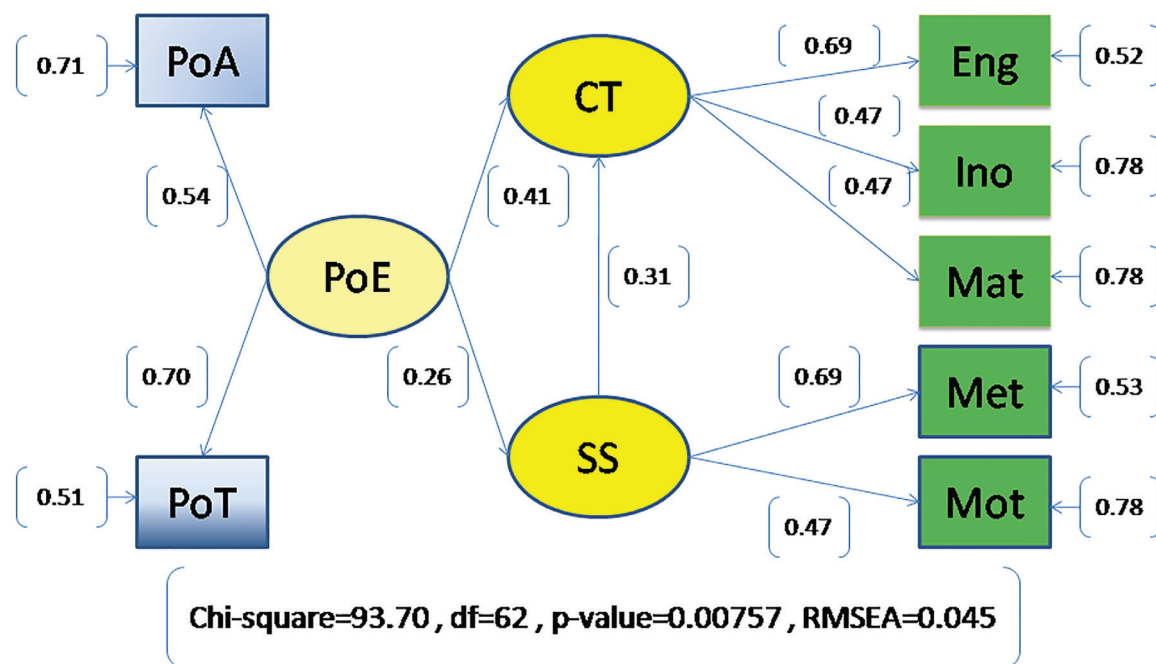


Figure 2. Second order confirmatory factor analysis

The coefficient of this correlation and the t-value are equal to 0.26 and 3.23 respectively. The correlation coefficient obtained in the second hypothesis of the research is consistent with this finding.

C. The students' learning style influences their critical thinking as the value of t with a p-value<0.05 was significant. Therefore, it is clear that the research hypothesis on direct and significant impact of learning style on critical thinking is proved. The coefficient of this correlation and the t-value are equal to 0.31 and 4.07 respectively. The correlation coefficient obtained in the third hypothesis of the research is consistent with this finding.

Based on those three hypotheses, a fourth hypothesis was also formulated. The fourth research hypothesis was about the impact of perception of teaching-learning environment on critical thinking either directly or through learning style. According to the results from Structural Equation Modeling and also coefficients presented above and given that all the detailed hypotheses were proved, it can be said that the main research hypothesis on the impact of perception of teaching-learning environment on critical thinking either directly or through learning style was proved.

Discussion

The results of this study showed that the students' perceptions of teaching-learning environment including perception of teachers and

perception of emotional-psychological climate may have an impact on their critical thinking directly. These findings are consistent with those of Renzuli's study suggesting that a positive climate in learning environment and teaching style be very effective in improving creativity and critical thinking among learners (23). In order to clarify these results, it can be said that a teaching-learning environment based on training critical thinking definitely has different features compared with a formal teaching environment so that the provision of these features causes more engagement and freedom among learners to express their points of view and perspectives. In addition, based on the results, the students' learning style is considered as a significant factor in developing their critical thinking, i.e. as much as their learning style and method are deeper, they may have more motivation for studying, and most probably, get more involved in critical thinking. These findings are directly consistent with those of a study conducted by Yamazaki. He concluded that learning style is a significant variable for developing critical thinking (24). Other studies have come more or less to the same result. For instance, studies conducted by Kurubacak, Li and Hejazi suggested that there is a relationship between learning and studying styles and types of thinking (25-27). To explain the results of this hypothesis, it can be said that critical thinking about any issue and especially about issues provided in higher education courses

requires deep and broad views related to the issues, relative proficiency in them and familiarity with views of experts and theorists in the field. This issue does not happen unless through deep studying with aims at levels of analysis and synthesis. The results of the third hypothesis on the relationship between perception of teaching-learning environment and its components and learning style and its components are similar with those of a study conducted by Wafika, Suliman and Halabi, suggesting relationships between classroom environment and depth of learning (28). To explore the results of the study, it can be said that the students' perceptions of teaching-learning environment i.e. climate and teachers have an impact on the type and quality of study. If students consider emotional-psychological climate of a class as a competitive environment in which achieving the goals requires attempt and effort, then they find out that a cursory reading and transient learning cannot meet their needs and try to seek for more in-depth study methods. So from the students' view, if teachers have characteristics such as interest in teaching and learning, the ability to manage class democratically, positive views towards class discussion, proficiency on contents, higher expectations from students, then most probably students are more motivated for study and try to deepen their study style and method. Also, Mangena & Chabli also suggested that teachers, rather than organization of educational centers, play a key role in the success of learners (29). As the results showed, the obtained experimental pattern has a good fitness and is completely consistent with the research conceptual model. It was therefore recognized that the perception

of teaching-learning environment indirectly through learning style has an impact on critical thinking among students. A study conducted by Chan suggested 3 courses to improve abilities and attitudes that critical thinkers should have; it also emphasizes the effective role of learning environment and teaching style in improving creativity and critical thinking among learners (30).

Finally, based on the results of the study, the model shown in Figure 3, for developing critical thinking among students is provided.

This study was conducted using a quantitative method, though using qualitative methods such as interview and observation may suggest different results. This issue can be mentioned as one of the limitation of this study. Also, self-report questionnaires have their own limitation. It should also be mentioned that in this study, the researcher inevitably selected unequal percentages of male and female, due to the necessity of proportional gender composition in the selected sample. However, some studies indicate the impact of sex on critical thinking. Hence, conducting similar studies considering equal numbers of both sexes would be useful.

According to the results of the study indicating the impact of perceptions of teaching-learning environment on critical thinking, it is suggested that managers and authorities of AJA University of Medical Sciences plan for a richer academic environment in which the innovation and diversity can be considered as quality assurance criteria. In addition, in regard to training, faculty members and staff do the best in order to realize positive performances in the evolution of teaching and learning systems. Also, it is recommended that courses for various faculty members be held

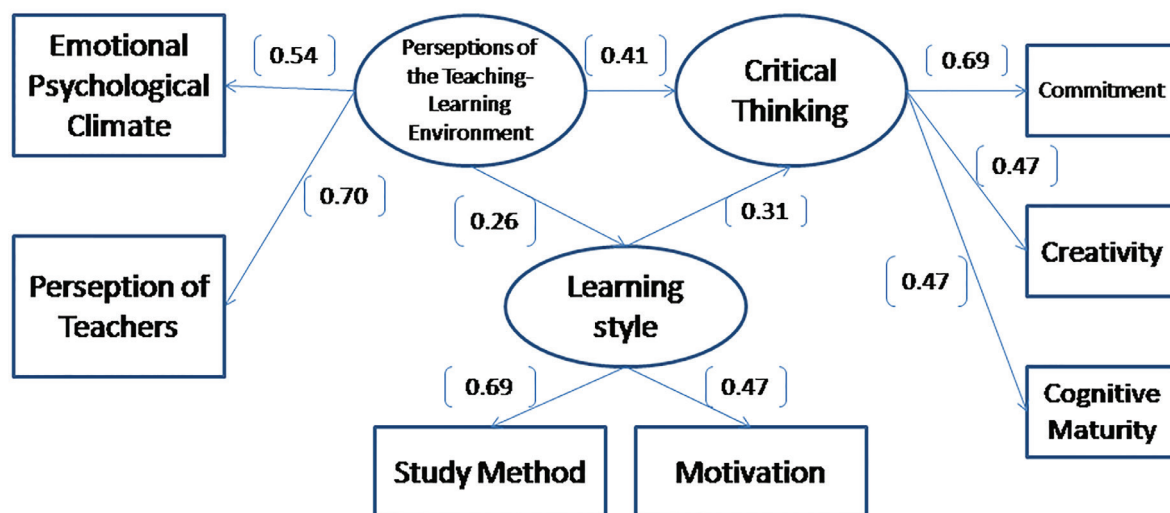


Figure 3. The final model of research for critical thinking development of students

which include the following features:

Teachers should encourage students to engage in class discussion and teach subjects in a way to concentrate mind on study and improve proficiencies and self confidence among students; clarify learning objectives of various subjects for students; focus on more activity of learners when teaching and evaluating them; select challenging and motivating topics to teach in order to improve thinking and problem solving skills among students; focus on students' reasoning and analytical ability rather than their knowledge when evaluating them; encourage students to ask question and share their ideas and knowledge with others; strengthen their communication skills and give proper feedback to students; use constructive criticism in providing issues and welcome constructive criticism from students; establish a context for arousing curiosity; stimulate ideas in class and welcome new ideas and opinions; and provide opportunities for students to improve interpersonal skills through creating an intimate and comfortable atmosphere in the classroom.

According to the results of the study on the impact of learning style on critical thinking, it is suggested that in order to determine curricula after conducting needs analysis of the students and also considering social health status in society and the situation of labor market and medical community, subjects based on students' needs and interests should be selected for teaching and learning. The students should be justified that learning is the goal but not just passing exams. The system for evaluating students should be based on analysis, deduction and even innovation and not solely focus on memorizing. Teaching and learning methods should be taught to students through some courses and workshops.

Conclusion

The results of the study found that one of the factors which can significantly impact the quality improvement of teaching and learning process in AJA University of Medical Sciences is to develop critical thinking among learners. This issue requires providing a situation needed for teaching and learning critical thinking in an educational environment. An intimate atmosphere should have some specific feature to be effective. For example, a favorable environment has open and receptive atmosphere; encourages thinking; old and new ideas and opinions are challenged, investigated and explored; awareness is valuable; attractive, modern and practical issues are created and introduced and the students' mind is used to respond them. Also, teachers have been trained and prepared for teaching and working in such an environment so

that their teaching method is not only challenging, but also learner-based, causing higher activity by students. Such teachers focus more on deep and long term learning rather than obtaining excellent scores and passing exams. They discuss various theories in classroom and compare them and focus on problem solving skills among students and try to strengthen them. In such a situation, the evaluation method for students should be changed, i.e. the students' reasoning and analytical ability, rather than their knowledge, should be more focused in assessments. It is recommended that this important issue be also examined in other universities. Such a teaching/learning environment may influence learners' learning style and move it towards more in-depth learning.

Conflict of Interest: None declared.

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