

Assessing critical thinking in medical sciences students in two sequential semesters: Does it improve?

Zeinab-Sadat Athari, Sayyed-Mostafa Sharif, Ahmad Reza Nasr, Mehdi Nematbakhsh¹

Department of Educational Sciences, University of Isfahan, Isfahan, ¹Water and Electrolytes Resaerch Center, Department of Physiology, Isfahan University of Medical Sciences, Isfahan, Iran

ABSTRACT

Objectives: Critical thinking is an important outcome criterion of higher education in any discipline. Medical and paramedical students always encounter with many new problems in clinical settings and medicinal laboratory, and critical thinking is an essential skill in obtaining a better approach for problem solving. We performed a pre-and post-test to evaluate the change of critical thinking skills in medical sciences students who enrolled in Isfahan University of Medical Sciences in Iran during the academic years 2008-2010. **Methods:** In a longitudinal design study, the critical thinking skills were compared in medical sciences students in two sequential semesters using the California Critical Thinking Skills Test. The test is divided into two parts (parts 1 and 2), including 17 items in each part. Based on proportional stratified sampling, a groups of students (group 1, $n=159$) were selected from the university population, who enrolled in medicine, pharmacy, nursing, and rehabilitation colleges. The students in group 1 were asked to complete the part 1 of the test (phase I). After one semester, another group (group 2, $n=138$) from the same population was randomly selected, and they were asked to complete the part two (phase II). The students' demographic data also were recorded. The California critical thinking skills test was translated and it validity and reliability were approved before. **Results:** No significant difference was observed between the two groups in the demographic data. The students critical thinking scores in phase II significantly reduced in comparison with phase 1 ($p<0.05$). The phase II scores in subdivisions of analysis, inference, inductive reasoning, and deductive reasoning also failed to demonstrate improvement. **Conclusion:** It seems curriculum reform is necessary to improve the students' critical thinking.

Keywords: Critical thinking, curriculum, higher education, medical sciences

INTRODUCTION

Critical thinking (CT) is considered a fundamental cognitive

Address for correspondence: Prof. Mehdi Nematbakhsh, Water and Electrolytes Resaerch Center, Department of Physiology, Isfahan University of Medical Sciences, Isfahan, Iran. E-mail: nematbakhsh@med.mui.ac.ir

process for knowledge development and utilization. CT plays an applicable role for problem solving and decision making in any context, whether it is social, clinical, ethical, managerial, or political.^[1] CT is useful in analyzing complex data, evaluating situations and actions, and implementing the most appropriate actions. Therefore, it is required for effective problem solving and decision-making.^[2] Accordingly, enhancement of CT is regarded as a valuable outcome for any program in higher education,^[3-8] and most academic departments in higher education expect their faculty to incorporate teaching and learning and assessment strategies that promote CT skills.^[2]

There have been many definitions of CT over the years.^[9,10] However, an important consensus known as "the Delphi Report" that was announced in 1990 by the theoreticians of the USA and Canada defined CT as a cognitive

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process, a purposeful self-regulatory judgment that has two components of cognitive skills (interpretation, analysis, inference, evaluation, explanation, and self-regulation) and a motivational component (the disposition toward CT).^[11]

Traditionally, higher education is thought to produce career thinkers equipped with the knowledge and intellectual abilities. However, there is a growing awareness that many students do not have expected professional abilities. Therefore, the higher education system needs development of these thinking abilities in curriculum. It is expected that the higher education students be able to learn and memorize educational materials, but they often experience considerable problems in thinking critically about what they are learning. Furthermore, the most common complaints by faculties are that students cannot effectively think. Therefore, in recent years special attentions have been paid to the concept of CT, and it is improving.^[12-27]

Although CT is influenced by many educational and sociological parameters, curriculum is the most important parameter every student must deal with during academic studies. If a curriculum is based on CT skills, it directs learners toward disposition to CT.^[28] Then; curricula should develop such dispositions and skills.

Several studies reported that the CT is changed from one semester to another semester^[29-31] in higher education. Actually it is expected that suitable curriculum must enhance the ability to think critically. However, most of the curriculums for medical sciences student were not designed based on new and developed medical sciences education technology and methods. So these curriculums may not develop the ability of CT in students. Therefore, this study was designed to determine the CT of medical sciences students for two sequential semesters (beginning of one semester and end of next semester) in Isfahan University of Medical Sciences (IUMS), Isfahan, Iran.

METHODS

Instrument

The instrument used in the study to determine the CT skills of the students was a standard test, called California CT Skills Test (CCTST). The test is a standardized, norm referenced test that assesses CT skills in authentic problem solving situations. The skills this test examines are based on an interdisciplinary definition of CT by the Delphi research project. These skills are analysis, evaluation, inference, inductive reasoning, and deductive reasoning. Two forms of the test are available, and the second form (Form B) in paper and pencil format was used in this study. It contains 34 multiple choice items. The items ranged from basic analysis of the meaning of sentences to more complex integration of CT skills. No discipline-specific college level knowledge is presumed on the CCTST. Each correct answer received one point; therefore, the total score can range from 0 to 34, with higher scores reflecting stronger CT skills.^[32] This test was divided into two parts (CCTST1 and CCTST2), including

17 items in each part. The maximum score for each part was 17. The test for each part includes all five mentioned skills. The language of the original questionnaire was English, however the questionnaire was translated and its validity and reliability were approved before.^[33]

A demographic questionnaire related to those factors that may influence CT skills was also designed. This questionnaire included 35 items on sex, age, GPA, marriage status, parents' education level, social activities, and economic status. It was completed by all students.

Study Design and Participants

A descriptive longitudinal design was applied in this study. The study population comprised IUMS freshman, sophomore and junior students. A group of students (group 1, $n=159$) were randomly (by student identification number) selected from the IUMS student population who enrolled in medicine, pharmacy, nursing (nursing major students), and rehabilitation (rehabilitation major students) colleges. At the beginning of the fall semester (first semester for freshman, third semester for sophomore and fifth semester for junior), the students in group 1 were asked to complete part 1, CCTST1, of the standard test (phase I) to determine the CT level. All students from each college had the same curriculum during the study. On the end of next (spring) semester (second semester for freshman, fourth semester for sophomore and sixth semester for junior), another group (group 2, $n=138$) from the same population was randomly selected, and they were asked to complete part 2, CCTST2, of the standard test (phase II). Therefore the time between phase I and phase II was about seven months. A demographic survey also designed by the investigators was used to collect the demographic data, and it was completed by all students in two groups.

Data analysis

Both descriptive statistics and inferential statistical tests were applied using SPSS version 16. Descriptive statistics include means and standard deviations. Inferential statistical test of t-independent test was applied to compare the score of CT between the groups. ANOVA accompanied with post-hoc analysis; LSD was used to test the mean differences among colleges. To compare the demographic data between the groups, Mann-Whitney test was used. The p-values of <0.05 were considered statistically significant.

RESULTS

The demographic data (including GPA, marriage status, parents' education level, social activities, and economic status) in both phases were compared with non-parametric test and no significant differences were observed between the two phases. The study sample of group 1 included 68 male and 91 female students with the age of 20.1 ± 2.2 . The age of group 2 was 20 ± 1.1 . No significant difference was observed between the two groups with regard to age.

The CT scores of all freshman students in the first and in

the second semester was compared in each college, and no improvement between two sequential semesters were observed. Similar results were obtained for sophomore (or junior) students when the CT score in the third (or fifth) and fourth (or sixth) semesters were compared. However, to compare the CT score between phase I and phase II (two sequential semesters) for all students in each college are provided in Table 1. The maximum scores are as follows: CT: 17; analysis skill: 5, evaluation skill: 7, inference skill: 5, inductive reasoning skill: 7 and deductive reasoning skill: 8. since some items evaluate more than one skill simultaneously, therefore, the summation of the first three skills (analysis, evaluation, and inference) is equal to the maximum score of 17.

The CT scores in phase II (group 2) were significantly less than the score in phase I (group I) in all colleges ($P < 0.05$) [Table 1]. The CT score in medical students also was significantly greater than the score from other colleges students ($P < 0.05$) [Table 1].

DISCUSSION

The main objective of this study was to seek the change of CT skills in IUMS students during two sequential semesters. Although the data indicate that the students in college of medicine had a higher score in CT skills in comparison with students of other colleges, the CT score obtained from phase II (group 2) reduced significantly when compared with phase I (group 1) in all colleges students. The findings of the current study showed this important fact that CT skills of medical sciences students according to CCTST were decreased during two sequential semesters. The validity and reliability of this test (CCTST) were approved by other.^[33] We found that the student' CT score significantly reduced after one semester. Also, no improvement was observed in subdivisions of analysis, inference, inductive reasoning, and deductive reasoning skills. CT skills are influenced by different social and educational factors. In academic society, it is naturally expected that curriculum plays an important and objective role in improvement of CT skills. However, the curriculums in universities or colleges are sometimes not sufficient for such improvement.

Kawashima and Petrini determined the CT score in three different groups including generic students (freshmen and junior), transfer students at selected baccalaureate nursing program, and registered nurses at selected general hospital, and their results indicated that registered nurses scores was lower than the other two groups, and curriculum review for Japanese nursing education was suggested.^[34] Shin compared CT ability in Korean senior nursing students enrolled in associate degree and baccalaureate programs, and the baccalaureate group score was significantly higher than that in the associate degree group.^[35] Similar result was found in nursing students in the USA.^[36] Colucciello found significant relationship between CT skills and CT dispositions, and found a significant difference in the total CT disposition scores

Table 1: Scores of critical thinking (CT) skills in medical sciences students from different colleges in two sequential semesters (phase I and II). The maximum scores are as CT: 17; analysis skill: 5, evaluation skill: 7, inference skill: 5, inductive reasoning skill: 7, and deductive reasoning skill: 8

College group	n	Analysis		Evaluation		Inference		Inductive Reasoning		Deductive Reasoning		Critical Thinking								
		1	2	1	2	1	2	1	2	1	2	1	2	p						
Medicine	65	43	2.46 ±1.09*	1.72 ±1.11	<0.01	2.72 ±1.25*	3.07 ±1.30†	0.17	3.10 ±1.10†	1.87 ±0.95*	<0.001	2.75 ±1.33	3.09 ±1.23†¶	0.19	4.87 ±1.53*	2.70 ±1.35#	<0.001	8.29 ±2.20*	6.65 ±2.22*	<0.001
Pharmacy	39	51	1.97 ±1.15	1.62 ±1.15	0.15	2.20 ±1.24	2.72 ±1.06	<0.05	2.92 ±1.04	1.14 ±0.94	<0.001	2.44 ±1.27	2.64 ±1.11	0.41	4.20 ±1.28	1.90 ±1.12	<0.001	7.10 ±2.11	5.43 ±2.07	<0.001
Nursing	36	28	1.97 ±1.15	1.58 ±1.14	0.19	2.05 ±1.07	2.35 ±1.25	0.31	2.55 ±1.10	0.89 ±0.87	<0.001	2.28 ±1.16	1.89 ±1.10	0.18	3.75 ±1.44	2.43 ±1.26	<0.001	6.58 ±1.92	4.71 ±1.63	<0.001
Rehabilitation	19	16	1.79 ±1.08	1.37 ±1.15	0.28	2.10 ±0.93	2.43 ±1.03	0.32	2.74 ±1.19	0.98 ±0.51	<0.001	2.31 ±1.29	2.06 ±0.99	0.53	3.74 ±1.59	2.06 ±1.12	<0.01	6.63 ±1.98	4.81 ±1.60	<0.01
Total	159	138	2.15 ±1.14	1.61 ±1.13	<0.001	2.37 ±1.20	2.72 ±1.19	<0.05	2.89 ±1.11	1.30 ±0.96	<0.001	2.51 ±1.28	2.56 ±1.21	0.73	4.32 ±1.53	2.27 ±1.26	<0.001	7.41 ±2.20	5.60 ±2.11	<0.001
P (between colleges)	-	-	0.03	0.78	-	0.02	0.06	-	0.10	0.00	-	0.25	0.00	-	0.001	0.02	-	0.00	0.00	-

*Significantly different from other colleges, †from nursing college, ‡from rehabilitation college, or §from pharmacy college ($p < 0.05$)

between students at different levels.^[37] It was also reported that the CT skill scores of the fourth year students were significantly higher than those of the second year students,^[38] and CT skills of students enrolled in a 4-year baccalaureate program at a University in Western Canada increased from years 1 to 4.^[39] Miller and Philipset *al.* reported significant increases in CCTST total scores in their studies, when the same cohorts of students were followed from admission to graduation.^[31,40] It is expected that CT skills must be improved during staying at colleges or universities, and most of these findings are in agreement with the expectation. However, on the contrary, Vaughan-Wroblet *al.* evaluated the CT skills in nursing student, and no significant difference in CT score was reported from beginning to the end of junior and senior years.^[41] The students' disposition toward CT was also examined and negative disposition towards CT was shown.^[42] Based on CCTST, the change of CT skills over one academic year in pharmacy students was assessed and no significant changes in students' scores were detected.^[43] Unfortunately, in our result, decrease of the scores of CT skills was observed in medical sciences students during one academic semester. One reason for this unexpected result may be the time duration. A better picture of CT changes might be seen if the duration of study includes from admission until graduation. However, the main important parameter is curriculum. From suitable curriculum, we expect CT improvement even in short period of time. The curriculum is accompanied with many other educational factors in the higher education society, and it could potentially increase the CT skills in students.^[28,44] Therefore, according to our findings, the curriculum for medical sciences students need to be reconsidered.

CONCLUSION

It is necessary for policymakers, planners, and managers to provide appropriate facilities and a suitable education environment to strengthen students' CT skill. The findings revealed that the mean score of CT in medical sciences students is low and curriculum revision seems to be necessary.

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