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Critical Thinking Skills of a Group of Iranian Dental Students

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Abstract

Background and Aim: This study aimed to assess the critical thinking skills (CTS) of a group of Iranian dental students.

Materials and Methods: This cross-sectional study was conducted on 355 dental students of the Faculty of Dentistry, Tehran Medical Sciences, Islamic Azad University in the clinical training period (academic years 3-6) in 2022-2023. The CTS of students were evaluated by using the valid and reliable Persian version of the California Critical Thinking Skills Test (CCTST). Correlations between the CTS total and domain scores with demographic variables were analyzed by the multiple linear regression and Pearson's correlation tests (alpha=0.05).

Results: A total of 260 questionnaires were filled out and returned, yielding a response rate of 73.2%. The mean age of the participants was 23.90±2.89 years. There were 60.8% females and 39.2% males. Of all, 74.2% were single, and 25.8% were married. Also, 34.2% had an extracurricular clinical dental practice. The mean total CTS score was 10.66±2.83 out of 34, which had a significant correlation with the academic level (P=0.005), such that the mean CTS score was significantly higher in senior dental students. The mean CTS score had no significant correlation with age, gender, marital status, or extracurricular clinical practice (P>0.05).

Conclusion: The mean CTS score of dental students of the Faculty of Dentistry, Tehran Medical Sciences, Islamic Azad University was lower than the standard average, highlighting the need for educational interventions to improve it.

Keywords: Thinking; Students, Dental; Education, Dental

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Introduction

Critical thinking is a vigilant targeted process used for interpretation and processing of information and experiences, and can guarantee the social and individual prosperity of individuals. Those possessing critical thinking skills (CTS) are successful individuals that can contribute to development of their society. Evidence shows that communities with higher number of individuals with CTS are more prosperous [1-3]. CTS enable precise evaluation of negative and positive aspects of a phenomenon through logical and evidence-based reasoning [4]. CTS enable the individuals

to differentiate between correct and incorrect information, and acquire a correct understanding of events [5]. CTS are beyond repeating the taught topics, because thinking and application of the acquired knowledge result in more thorough evaluation of evidence for a precise judgment in different clinical scenarios [6].

The main goal of medical education is to promote professional competency, and decision-making and problem-solving skills of students [7]. Evidence shows that instruction of CTS to students creates motivation for learning and achieving professional competency and problem-solving skills, and improves creativity [8,9]. CTS are highly useful for dental clinicians since patients expect professional and skillful advices, reliable interpretation of findings, and efficient treatment plans from their dental clinician [10]. One-third of the complications and medical errors occur due to misdiagnosis, which can be prevented by CTS [11].

The American Dental Association places CTS at the top of the list when describing the required qualifications for general dentists [12,13]. The traditional educational systems train individuals with a high level of theoretical information, who may not be able to solve even the smallest problems [14,15]. The World Federation for Medical Education considers CTS as one of the main educational standards required for the healthcare providers and also a validation criterion for educational institutes [12].

CTS of healthcare students have been the topic of many investigations. However, information in this regard in dental students is limited, particularly in Iran [16]. Moreover, the COVID-19 pandemic resulted in the cessation of in-person classes in many universities for a long period of time [1,16], which decreased student-mentor communication and might have affected the CTS of students as well, which needs further investigations. Thus, this study aimed to assess the CTS of dental students of the Faculty of Dentistry, Tehran Medical Sciences, Islamic Azad University.

Materials and Methods

This cross-sectional study was conducted on 355 dental students of the Faculty of Dentistry, Tehran Medical Sciences, Islamic Azad University in the clinical training period (academic years 3-6) in 2022-2023. The study protocol was approved by the ethics committee of the university (IR.IAU.DENTAL.REC.1401.121).

Data collection:

CTS of students were evaluated by using the valid and reliable Persian version of the California Critical Thinking Skills Test (CCTST). This questionnaire has two forms of A with 75 multiple choice questions, and B with 34 questions. It evaluates five domains of critical thinking as follows: analysis, evaluation, inference, inductive reasoning, and deductive reasoning. Its content validity has been previously confirmed with a Kuder–Richardson coefficient of 0.68-0.70 [3,17]. The validity (face validity and content validity), reliability, and normality of its Persian version have also been previously confirmed [14]. Moreover, its reliability was confirmed with a Kuder–Richardson coefficient of 0.62 [18]. The Form B was used for data collection in the present study with 34 multiple-choice questions, each with one correct answer. Questions #1-4 and 25-34 are the evaluation questions with the highest achievable score of 14 in this domain. The inference questions include questions #14-24 with the highest attainable score of 11 in this domain. Questions 5-13 are analysis questions with the maximum achievable score of 9. Questions 1, 2, 4, 5, 6, 8, 9, 14, 15, 16, 17, 18, 19, 22, 23, and 27 are inductive reasoning questions with a maximum score of 16, and questions #3, 13, 20, 21, 24-26, and 38-34 are

deductive reasoning questions with the maximum score of 14.

Each item had 4 or 5 answer choices with only one correct answer. Thus, each question was scored 0 (wrong answer) or 1 (correct answer). The total score could range from 0 to 34 [19,20]. The standard average score was determined to be 15.89 for this test, such that lower values would indicate weakness in CTS, and higher scores would indicate optimal competency in CTS [21,22]. The questionnaires were administered among dental students in person, and were collected after being filled out. Participation in the study was voluntarily, and the participants were ensured about the confidentiality of their information [1]. The students were enrolled after signing informed consent forms.

Statistical analysis:

The correlation of the mean CTS total score with different variables was analyzed by multiple linear regression. The correlation of the mean CTS domain scores with different variables was analyzed by the Pearson's correlation test at 0.05 level of significance.

Results

A total of 260 questionnaires were filled out and returned, yielding a response rate of 73.2%. The mean age of the participants was 23.90±2.89 years. The mean grade point average (GPA) score of the students was 16.21±1.24. Of all, 32 (12.3%) were term 5, 32 (12.3%) were term 6, 32 (12.3%) were term 7, 32 (12.3%) were term 8, 33 (12.7%) were term 9, 33 (12.7%) were term 10, 33 (12.7%) were term 11, and 33 (12.7%) were term 12. There were 60.8% (n=158) females and 39.2% (n=102) males; 74.2% (n=193) were single and 25.8% (n=67) were married. Also, 34.2% (n=89) had extracurricular clinical dental practice. Table 1 presents the demographic information of the participants in detail.

The mean CTS score was 10.66±2.83 out of 34, and the mean domain scores based on the academic level of students are presented in Table 2. Table 3 presents the correlation of domain scores with different demographic variables. The mean CTS total score had a significant correlation with the academic level (P=0.005) such that the mean CTS total score was significantly higher in senior dental students than lower-level students. The CTS total score had no significant correlation with age, gender, marital status, or extracurricular clinical practice of students (P>0.05). Male gender had a significant correlation with the analysis domain score, being a senior dental student had a significant correlation with the analysis and evaluation domain scores, GPA had a significant correlation with deductive reasoning, and age had a significant correlation with inductive reasoning (Table 3, P<0.05).

Table 1. Demographic information of the participants in detail

Term	Gender		Age		GPA		Marital status		Extracurricular dental practice	
	Male	Female	Higher than average	Lower than average	Higher than average	Lower than average	Married	Single	Yes	No
5	3(9.37%)	29(90.63%)	2(6.25%)	30(93.75%)	17(53.12%)	15(46.88%)	0(0%)	30(100%)	3 (9.37%)	29(90.63%)
6	17(53.12%)	15(46.88%)	2(6.25%)	30(93.75%)	18(56.25%)	14(43.75%)	2(6.25%)	30(93.75%)	5(15.62%)	27(84.38%)
7	18(56.25%)	14(43.75%)	10(31.25%)	22(68.75%)	17(53.12%)	15(46.88%)	8(25%)	24(75%)	8(25%)	24(75%)
8	8(25%)	24(75%)	13(40.62%)	19(59.38%)	19(59.38%)	13(40.62%)	7(21.87%)	25(78.13%)	14(43.75%)	18(56.25%)
9	17(51.51%)	16(48.49%)	16(48.49%)	17(51.51%)	18(54.54%)	15(45.46%)	10(30.3%)	23(69.7%)	15(45.46%)	18(54.54%)
10	15(45.46%)	18(54.54%)	21(63.63%)	12(36.37%)	14(42.42%)	19(57.58%)	11(33.33%)	22(66.67%)	15(45.46%)	18(54.54%)
11	15(45.46%)	18(54.54%)	33(100%)	0(0%)	17(51.51%)	16(48.49%)	11(33.33%)	22(66.67%)	16(48.49%)	17(51.51%)
12	11(33.33%)	22(66.67%)	33(100%)	0(0%)	25(78.12%)	8(21.88%)	8(21.88%)	25(78.12%)	13(37.5%)	20(62.5%)
			2.89 ± 23.90		1.24 ± 16.21					
Total	102(39.2%)	158(60.8%)	Total mean		Total mean		67(25.8%)	193(74.2%)	89(34.2%)	171(65.8%)

Table 2. Mean domain scores acquired by dental students at different academic levels

Academic term / Domain	5	6	7	8	9	10	11	12	Mean of 8 terms	Maximum score
Analysis	3.96	4.21	3.81	4.28	3.57	3.96	3.75	4.60	4.02	14
Evaluation	3.93	4.00	2.87	4.00	4.21	3.75	3.90	4.12	3.85	11
Inference	2.62	2.68	2.50	2.50	3.00	2.72	3.00	3.21	2.78	9
Inductive reasoning	4.31	4.37	3.65	4.06	3.66	4.30	4.00	4.63	4.12	14
Deductive reasoning	5.21	5.90	4.87	6.25	6.39	5.36	5.90	6.24	5.77	16
Total	10.53±2.55	10.90±2.75	9.18±2.62	10.78±2.37	10.78±3.43	10.45±2.63	10.66±2.89	10.66±2.83	10.66±2.83	34

Table 3. Correlation of domain scores with different demographic variables

		Analysis	Evaluation	Inference	Inductive reasoning	Deductive reasoning	Total score
Gender	Female	4.11	3.77	2.60	4.09	5.70	10.50
	Male	3.88	3.97	3.05	4.17	5.87	10.91
	P value	0.459	0.354	0.008	0.470	0.624	0.198
Marital status	Single	3.98	3.85	2.74	4.12	5.70	10.59
	Married	4.15	3.84	2.91	4.14	6.0	10.91
	P value	0.443	0.812	0.452	0.583	0.401	0.335
Extracurricular activity	Yes	3.84	3.96	2.94	3.97	6.04	10.75
	No	4.11	3.79	2.70	4.20	5.63	10.61
	P value	0.161	0.272	0.388	0.425	0.157	0.822
Academic level	Terms 5-11	3.93	3.81	2.72	4.05	5.70	10.47
	Term 12	4.60	4.12	3.21	4.63	6.24	11.93
	P value	0.026	0.573	0.044	0.060	0.614	0.005
Age	Pearson correlation	0.01	0.04	0.1	0.02-	0.13*	0.08
	P value	0.834	0.946	0.837	0.558	0.039	0.183
GPA	Pearson correlation	0.04	0.14*	0.01	0.06	0.11	0.11
	P value	0.396	0.022	0.717	0.182	0.072	0.847

Discussion

This study assessed the CTS of dental students of the Faculty of Dentistry, Tehran Medical Sciences, Islamic Azad University. The mean CTS score of students was 10.66, which was close to the value reported in previous studies conducted at Mazandaran and Rafsanjan universities [23, 24], and higher than the score acquired by students in Urmia University [25].

The results showed that the mean CTS score acquired by dental students was lower than average. Similarly, many previous studies reported poor CTS of medical and dental students in Iran [14,15,23,26]. Nahvi et al. [1] evaluated the CTS of dental students of the School of Dentistry, Mazandaran University of Medical Sciences during an online instruction period. They used Form B of the CCTST for data collection and reported no significant difference in the mean CTS total score and domain scores between males and females. Their results regarding the CTS total score were in line with the present findings; however, male students acquired a higher score in the analysis domain than females in the present study. Also, term 7 students experienced a significant drop in CTS scores, which may be due to their admission time, which was concomitant with the COVID-19 pandemic and initiation of online instruction. This finding was in agreement with the results of previous studies [23,27]. Naeim et al, [27] in their study on medical students in Ardabil

University of Medical Sciences used the Form B of the CCTST and the Kolb's Learning Styles and showed that the CTS score of students increased with age. This finding was in contrast to the present results. Also, they reported that male gender had a significant correlation with a higher analysis domain score while female gender had a significant correlation with inductive and deductive reasoning domain scores; their results were in line with the present findings. Shirazi et al. [25] evaluated nursing students of Urmia Azad University using the CCTST and the Kolb's Learning Styles. Similar to the present study, they found that senior dental students acquired a significantly higher CTS score than other students; however, the overall level of CTS of nursing students was unacceptably low, highlighting the necessity of strategy planning to improve it. Their results were in agreement with the present findings. Rezaiee et al. [28] evaluated the correlation of CTS and information literacy of medical students attending Ardabil University of Medical Sciences. They used the Form B of the CCTST and an information literacy questionnaire for data collection, and demonstrated that students did not have the required skills in any of the five domains of information literacy or five domains of CTS. The acquired scores by students were significantly lower than the optimal level. Their results were in accordance with the present findings regarding the overall low CTS of students. They also reported that the CTS score did not increase with academic level of students, which was in contrast to the present findings. This difference can be due to differences in educational curricula and field of education. Yasayi et al. [29] assessed the CTS of dental students of Yazd Shahid Sadoughi University using the Form B of the CCTST and found no significant difference in CTS of freshman and senior dental students, which was in contrast to the present results. They found no significant correlation between the demographic factors with the CTS total score or its domain scores. Their results regarding no significant correlation between the demographic factors with the CTS total score were in agreement with the present results. However, their results regarding the domain scores were different from the present findings. Their results regarding no improvement of CTS of students by an increase in their academic level highlights the need for reforming the curriculum or implementation of strategies to improve the CTS of students. Rezaee et al. [30] evaluated the CTS of dental students of Shiraz University of Medical Sciences using the Form B of the CCTST. The students acquired a mean CTS total score of 14.53 out of 34 (versus 10.66 in the present study). The acquired domain scores by students in their study were also higher than the corresponding values in the present study. The CTS total and domain scores of students in their study were moderate, and had no significant correlation with gender or academic level of students; while, the CTS score of students increased with their academic level in the present study. Sheikhmoonesi et al. [11] used the Form B of the CCTST for assessment of CTS of medical students attending Mazandaran University of Medical Sciences, and reported a mean CTS score of 10.91, which was close to the value obtained in the present study. They found no significant correlation between the CTS total or domain scores with gender, marital status, or academic level. Their results regarding no correlation with gender and marital status were similar to the present findings. However, their findings regarding lack of a significant correlation with academic level was in contrast to the present results. Whitney et al. [31] evaluated the CTS of dental students using the CCTST. The response rate was 53%, which was lower than that in the present study (73%). They reported that students with a higher CTS score had higher final

examination scores in their first year of education. Also, higher CTS scores were associated with a higher level of clinical success in diagnosis, professional ethics, greater focus in patient treatment, communication skills, and practical health promotion treatments. It should be noted that the method of instruction of students in their study was problem-based learning and evidence-based dentistry. Partido et al. [32] assessed the correlation of CTS and academic performance of oral hygiene students. The response rate was 71.4%, which was close to the rate in the present study. Consistent with the present results, they showed an improvement in CTS as the academic level of students increased. They found no significant correlation between the CTS score and GPA; however, the CTS score had a significant correlation with the clinical test scores.

Improvement in CTS of students by an increase in their academic level can be due to increased experience and age of students. Nonetheless, it should be noted that intelligence plays an important role in CTS, which is unique and does not depend on age or academic level of students [23]. In total, although dental students have all passed a difficult entrance exam, and are expected to have a higher CTS level than other students, the results show no or insignificant difference in CTS scores of dental students and students of other fields [14,15,25].

Poor cooperation of students in filling out the questionnaire was a limitation of this study. Future studies on dental students of other universities at different academic levels are required.

Conclusion

The mean CTS score of dental students of the Faculty of Dentistry, Tehran Medical Sciences, Islamic Azad University was lower than the standard average, highlighting the need for educational interventions to improve it.

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