

Evaluation of development of clinical reasoning skills in dental students through diagnostic thinking inventory

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Abstract

Objective: To assess the clinical reasoning skills among dental students, and to compare the diagnostic thinking ability of male and female students.

Method: The cross-sectional study was conducted from May to July 2021 at a public-sector dental school in Karachi, and comprised students of both genders from across all the four years of dental school. Data was collected using the diagnostic thinking inventory which also assessed flexibility in thinking and knowledge structure in memory. Data was analysed using SPSS 18.

Results: Of the 111 forms distributed, 108(98.2%) were received duly filled; 32(29.35%) from male students and 76(69.72) from female students. Participants from the first year were 24(22%), second year 23(21%), third year 33(30.27%) and the fourth year 29(26.6%). The reliability of diagnostic thinking inventory was 0.906, for knowledge structure in memory 0.661, and flexibility in thinking 0.573. The correlation was significant for students in their 2nd, 3rd and 4th years of studies ($p=0.01$). The overall mean score was <150 which was poor. Both the knowledge structure in memory, and flexibility in thinking scores were higher for females compared to males (Significant at the level of 0.01).

Conclusion: The clinical reasoning skills of students were low, and the diagnostic thinking ability of female students was better than that of their male counterparts.

Keywords: Students, Dental, Schools, Dental, Problem-based learning, Clinical competence, Clinical reasoning.

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Introduction

One of the key qualities of medical or dental professionals dealing with patient diagnosis and treatment is the ability to use clinical reasoning.¹⁻³ The improvements brought about by medical education have revolutionised the curriculum globally, converting it to a competency-based model that is more effective, affordable and relevant to students' lives.⁴ The dentist may apply their knowledge to pinpointing and resolving clinical issues encountered in real-world application by being proficient in clinical reasoning abilities and diagnostic thinking capacity. It takes professionalism, ethics and communication and critical thinking prowess to deal with patients.¹

In medicine, to test the clinical reasoning skills across the curriculum, diagnostic thinking inventory (DTI) was developed as an aid. It was designed to check the flexibility in thinking (FT) and knowledge structure in memory (SM).⁵ Initial study for its validation found positive results in students in different phases of medical education and clinicians in the United Kingdom. The overall reliability was 0.83; 0.72 and 0.74 for FT ($k=21$) and SM ($k=20$), respectively.⁵ Similar results were reported in physiotherapy students with positive correlation plots

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($r=0.779$, $p<0.001$) and good consistency with an overall alpha value of 0.846.⁶⁻⁹

The emphasis on how to teach clinical reasoning started in medical education and to assess the results, diagnostic thinking inventory (DTI) was used for rating Standardized patients (SP).^{10,12} In dentistry, a few studies exist on clinical reasoning skills demonstrating them through clinical scenarios, but none shows a definite pattern/ definite tool to assess.^{13,14}

In medical sciences, the learning and developing of clinical reasoning skills is a topic on which a lot of work has been done. Moving from the hypothetico-deductive model to the knowledge-driven model, the understanding of the development of clinical reasoning skills has evolved.¹⁵⁻¹⁷ According to the knowledge-driven model, recognition of meaningful information, definition of clinical data, and access to SM contribute to the diagnostic ability of clinicians.⁵

There is a dearth of information available about the learning environment, student learning styles, and teaching methods used to foster diagnostic thinking in dental students in Pakistan. The current study was planned to fill the gap by assessing the clinical reasoning skills among dental students, and to compare the diagnostic thinking ability of male and female students.

Subjects and Methods

The cross-sectional study was conducted from May to July 2021 at the Sindh Institute of Oral Health Sciences (SIOHS), a public-sector dental school in Karachi. After approval from the institutional ethics review board, the sample size was calculated using OpenEpi with 95% confidence interval (CI) and 5% margin of error in line with literature.¹⁸

The sample was raised using multistage sampling technique. Primarily, 132 subjects were divided equally across 4 years of dental school through quota sampling, and then those 33 students were selected through convenience sampling from the class of each of the 4 academic years. Those included were fresh students from both genders from each academic year, while year-back students were excluded. Also excluded were students not willing to participate.

After taking informed consent from the subjects, data was collected using the DTI.⁵ Permission from the developer was taken to use the instrument. The instrument was primarily designed for medical students, but it was also used in physiotherapy subjects and the correlation plots indicated a significant positive relationship between scores on test and retest ($r=0.779, p<0.001$), while it had internal consistency with an overall alpha value of 0.846.⁷

The inventory has 41 questions following a scenario. These questions require the most suitable answer to be marked on a 6-point, semantic differential scale. These questions are designed to check the two components of diagnostic thinking which are the degree of FT and the degree of SM.⁵

To make a blueprint of the topics to cover in the scenarios, data from the Oral diagnosis and Medicine departments was checked for the highest frequency of complaints received during the preceding 3 years. Topics included pulpitis, oral ulcers, burning mouth syndrome and road traffic accident (RTA) cases.

Four cases/scenarios were developed by the content expert on basis of the semantic qualities, patient’s sign and symptoms, clinician’s possible set of diagnosis and organisation of findings and diagnosis, and was reviewed by 2 oral and maxillofacial surgeons for content before pilot-testing (Annexure). Then the inventory was pilot-tested on 10 dental students; 2 each from 1st and 2nd years and 3 each from 3rd and 4th years of dental school. Data of these students was not used in the final analysis. After the pilot-testing, the questionnaire was used as the survey form.

The subjects were given oral instructions advised by the original developers, and they were asked to respond as spontaneously as possible by indicating how they diagnose, and not how they think they should diagnose

Annexure Scenarios

1. A 15-year-old came to OPD with complaint of severe, sharp, continuous pain in left mandibular posterior tooth for 3 days. Pain started during chewing which radiates towards left ear. Aggravates on hot water and sweets consumption and relieved temporarily on taking painkillers. Patient was unable to sleep during the night due to pain.
2. A 60-year-old female patient came to OPD with complaint of an unpleasant sensation in mouth on consuming spicy food. She complains of constant metallic taste. She appears in anxiety and gives history of sleeplessness due to change in taste.
3. A 38-year-old woman came to OPD with complaint of mouth ulcers which has recently exacerbated in their occurrence in last 1 month. She has suffered from occasional mouth ulcers, usually small, one at a time, for more than 15 years. However, recently they have become worse, and she now has multiple ulcers. Normally, she ignored them but, now they have become painful. The patient is otherwise fit and well.
4. A 12-year-old boy reported with complaints of laceration on chin after road traffic accident 2 hours back. Patient appears oriented and fit otherwise with history of bleeding from mouth and right ear. He has pain in jaw. When he opens his mouth, it deviates towards right side, and he is unable to close the mouth properly.

even if they had little or no clinical experience. Data was analysed using SPSS 18.

Results

Of the 111 forms distributed, 108(98.2%) were received duly filled; 32(29.35%) from male students and 76(69.72) from female students. Participants from the first year were 24(22%), second year 23(21%), third year 33(30.27%) and the fourth year 29(26.6%). Thus, the quota sample of 33 was only achieved for the third year batch.

The reliability of DTI was 0.906; for SM 0.661, and for FT 0.573. The correlation was significant for students in their 2nd, 3rd and 4th years of studies ($p=0.01$) The overall mean score was <150 which was poor.

The FT and SM scores of first year and third year students was slightly lower than the available reference scores, while no reference range was available for scores of second year and fourth year students (Table 1).

The highest overall DTI score was highest for third year dental students, followed by fourth year, first year and second year students (Table 2).

Table-1: Scores of students across academic years compared to the reference scores.

Class	n	Structure (Mean score)	Reference Score	Thinking (Mean score)	Reference Score
First Year	24	70.2917±7.24	74.7	74.5208±8.02	79.2
Second Year	23	71.2500±15.78	-	75.0227±16.42	-
Third Year	33	74.4453±12.03	76.7	74.5766±10.04	81.6
Final Year	29	71.2054±9.26	-	75.7679±10.76	-

Table-2: Descriptive statistics across academic years of dental school.

Class	n	Minimum Score	Maximum Score	Mean±SD
First Year	24	125	189	144±11.65
Second Year	23	00	181	146.3±30.98
Third Year	33	24	202	149.02±19.45
Final Year	29	41	195	146.97±17.34

SD: Standard Deviation.

Table-3: Diagnostic thinking inventory (DTI) scores between genders.

Gender	n	Structure (Mean score)	Thinking (Mean score)
Male	32	70.7578±6.62	73.5781±8.42
Female	76	72.5738±12.98	75.5443±12.42

Both the knowledge structure in memory, and flexibility in thinking scores were higher for females compared to males (Significant at the level of 0.01) (Table 3).

Discussion

DTI is a valid and reliable tool used in medicine, physiotherapy and nursing for the development of diagnostic thinking ability of students during academic years and so on in their clinical careers.^{6-9,15-17,19}

The current study showed that the highest score for SM was for third year dental students, while the FT score was highest for final year students. On comparing these to the reference score,⁵ the maximum scores for FT and SM were in the third year, while the 2nd and final year batches had no reference scores to compare with. Though, as shown by the global reference range, both SM and FT scores gradually increased with gradual seniority of each academic year. This is supported by the knowledge-driven theory proposed for the diagnostic thinking ability of clinicians.⁵ Over the clinical years, students learn to find relevant points and link the theoretical knowledge to this information. This improves the clinical reasoning skills and the time required for provisional diagnosis. Previous studies held on medical and physiotherapist students showed similar results.^{6-9,15-17}

Comparing the scores of the male and female participants, it was concluded that the females had slightly higher scores than male counterparts in both FT and SM terms, which is similar to an earlier study on dental students in Iran though FT score was higher in male students.¹⁶

The overall reliability score were for DTI 0.906, SM 0.661 and FT 0.573. While Cronbach's alpha value was very poor for first year students (0.197) compared to 2nd, 3rd and 4th year students (0.906, 0.729 and 0.671, respectively) which was overall good. Compared to references given in literature,^{6-9,15-17,19-22} the current findings were found to be in concordance.

It was interesting to see that the overall DTI score did not increase with each academic year in the current sample. The mean score in all the academic years was <150, showing poor development of diagnostic thinking ability in students.¹⁹ DTI was used previously in a single study conducted in Iran on students belonging to one academic year.¹⁶ The current study was the first in which the questionnaire was utilised to study the development of diagnostic thinking in the students from all the four academic years. The overall reliability of the questionnaire was good (>0.7), and the validity was also good across the years. Usually, second year students go on community trips, and this provides them exposure partly to the clinical environment. But owing to the coronavirus disease-2019 (COVID-19) pandemic in the recent past, frequent lockdowns affected not only the community trips to schools, but also the clinical exposure of third and final year students. This may have affected the scores of the students.

Recent changes in medical education have resulted in certain competencies required of a dental graduate. They are expected to be health advocates and professionals having the desired expertise in terms of clinical skills and knowledge.^{1-3,23} Most of the work in dentistry is dependent on the diagnosis of the problem, and, hence, different teaching strategies or changes in the curriculum should be utilised to support the development of diagnostic thinking skills.²⁴

It is suggested that diagnostic thinking in students should be checked throughout the academic year with valid and reliable tools that cover all the aspects that could affect the diagnostic thinking so that any shortcoming may be timely picked up, and measures should be taken to solve the problem.

The current study has its limitations as it was done at a single dental school. Though the curriculum followed by all the dental schools in Karachi is a traditional one, different teaching strategies are practised in different schools which could alter their scores. Hence, a more comprehensive study to include samples from all dental colleges and along with the teaching strategies utilised should be conducted, and, since dentistry is more skill-based, a questionnaire designed specifically to explore the effect of experience on the diagnostic thinking skill should be explored.

Conclusion

The clinical reasoning skills of students were low, and the diagnostic thinking ability of female students was better than that of their male counterparts.

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