

Identifying lateral thinkers amongst dental undergraduates through questions based on oral pathologies

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Abstract

Context: Lateral thinking implies utilizing existing knowledge to generate new ideas by restructuring existing information by using one's own creative and logical thinking capabilities. Development of novel solutions to existing dilemmas in the field of medical and dental sciences is need of the hour in which individuals with lateral thinking capability can play a major role. Thus, it is imperative to identify and motivate lateral thinkers in any field of work, which is even more so applicable in the medical and dental fields.

Materials and Methods: A self-constructed questionnaire having 5 open ended questions based on oral pathologies was prepared via Google Forms and circulated through online social media platforms to third year undergraduate dental students. The responses were scored and a scale was devised based on which the participant's capability was categorized. The data was then subjected to statistical analysis by means of Chi square test and Student t-test.

Results: 24.44% respondents potentially exhibited LT capability at least to some extent. Although statistically insignificant, there was an evident higher percentage of male lateral thinkers in all categories except for moderate level which had greater number of females.

Conclusion: Every field has potential lateral thinkers but without proper nurturing, motivation and encouragement of ideas, they may encounter stagnation in the monotonous education system. Lateral thinkers are the light bearers of innovation and research. The continuously evolving fields of dentistry and medicine warrant the integration of policies and activities that inculcate the habit of lateral thinking in students.

Keywords: Creativity, Dentistry, Research, Innovation, Theories

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I. INTRODUCTION

Lateral thinking is an uncommon psychological or mental trait related to insight, creativity and humor. Despite the fact that all these processes have a similar basis, lateral thinking (LT) is a deliberate process of ignoring the straightforward solution and finding the hidden innovation. The concept was first introduced by Edward de Bono in 1967 [1]. LT is a skill firmly related to insight, creativity, and humor which can be learned through practice. It depends upon restructuring and rebuilding already known information through insight to develop a solution that may not necessarily be perfect but has a creative approach. Such an approach is imperative for research and reformative purposes [2]. Even in the past lateral thinking has proved to be the light bearer of innovations and discoveries. For instance, Geocentric theory which was

challenged and subsequently proven false by Galileo Galilei or discovery of Penicillin by Alexander Fleming whose curiosity was piqued by observation of laboratory apparatus [3,4].

The education system present in most of the schools focuses on reinforcement of existing knowledge and leads to subsequent development of vertical thinking in the students [5]. However, for any field to advance it requires innovation and research for developing solutions to existing modern-day problems. This is particularly applicable to the medical and dental fields, wherein not only novel treatment modalities overcoming limitations of the conventional ones are desired but also not much is understood about the pathogenesis of various diseases even with high end technologies.

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The essence of medical field is its continuously updating knowledge and technology, and therefore, creativity should be considered in the early years of teaching process [6]. In this context, lateral thinking is essential to identify and develop novel devices and theories to resolve existing scientific dilemmas which would otherwise not be possible solely by vertical thinking.

The field of pathology has always perplexed researchers as well as practitioners wherein despite thousands of known diseases, a precise understanding of their true nature and pathogenesis is lacking [7]. The oral cavity which involves numerous complex intercellular interactions houses lesions of extensively varied nature and etiologies which are equally difficult to comprehend. For instance, controversies on whether Odontogenic keratocyst is a cyst or a cystic neoplasm, its behavior and management still exist [8]. The dynamic nature of dentistry is reflected in various instances, like the focal infection theory, theories on the etiology of dental caries where rejected theories were accepted and accepted ones were later rejected [9,10]. Therefore, it constantly stimulates minds of pathologists and researchers to seek for means or theories to understand these complex processes which essentially lies in the domain of Lateral thinking.

To adapt to the rapidly changing world, patterns and competition we must liberate our minds from old ideas and perceive things from a newer perspective using the twin aspects of lateral thinking, provocative use of information, and challenge to the accepted concepts [11]. To cope up with this continuously evolving subject it is imperative to identify lateral thinkers and motivate them into brainstorming theories, research and develop innovative solutions for overcoming present day diagnostic and treatment hurdles and work miracles in the field of dentistry. This could even help in inculcating the habit of lateral thinking in other students as well, ultimately benefiting the entire field of dentistry in general. The present study was conducted to identify percentage of lateral thinkers amongst dental undergraduates by means of a questionnaire based on suggestion of alternatives in the field of Oral Pathology.

II. MATERIALS AND METHOD-

The present cross-sectional study was conducted by a team of six members including two experts in Oral Pathology and an expert in Public Health. The research protocol utilized e-questionnaire method and was approved by institutional ethical review board. A questionnaire was constructed, comprising of five open-ended questions pertaining to suggestion of alternative solutions for existing quandaries in pathological conditions of the oral cavity. The questions were prepared after a detailed search of published data available with respect to existing dilemmas in dentistry that demand novel answers. The questions and their expected corresponding answers based on vertical and lateral thinking are enlisted in [Table 1].

Table 1: The questions and their expected corresponding answers based on vertical and lateral thinking.

QUESTIONS	Answers based on Vertical Thinking	Examples of answers based on Lateral Thinking
Q1) Can you think of an alternative solution for restoration of a carious tooth? (other than extraction or replacement by a prosthesis)	1. Dental amalgam restoration 2. Composite restoration 3. Porcelain crowns 4. Extraction of grossly decayed tooth 5. Root canal treatment	1. Synthetically growing lost tooth structure in lab by genetic engineering 2. Using inert materials like diamonds 3. A smart setting cement, which could dissolve caries as well as set there. 4. Using stem cells 5. Remineralization of dentin up to the point that it fills the entire cavity.
Q2) Can you think of a permanent solution for missing teeth other than fixed partial denture (FPD) and implants?	1. Removable partial denture 2. Removable complete denture 3. Fixed bridge 4. Dental implant 5. Resin retained bridge	1. Implantation of a new tooth bud developed from stem cells 2. Grafting impacted teeth 3. Closing the space orthodontically 4. Induce odontogenesis 5. Clone cells from odontogenic tumors
Q3) Can you think of mechanisms by which a periapical cyst expands?	1. Osmosis of fluid inwards 2. Pressure exerted outside 3. Continued epithelial proliferation	1. Inflammatory chemotaxis 2. Release of cytokines 3. Differentiation of cell rests 4. Bone resorption 5. Changes in connective tissue stroma
Q4) Why does caries in a pit remain as it is for a long time?	1. Pit is not easily accessible to cleansing aids 2. Pattern of caries spread 3. Reparative dentin formation	1. Remineralization by saliva or toothpastes 2. Direction and concentration of enamel rods 3. Insufficient nutrients for the carious bacteria to survive 4. A safe house that protects bacteria
Q5) Why do our teeth feel hypersensitive? Enumerate all possible reasons.	1. Hydrodynamic theory 2. Wearing of the tooth due to attrition, abrasion, erosion and abfraction 3. Gingival recession	1. Mobility of tooth causes pressure on nerves apically 2. Sinusitis 3. Gap in the cemento-enamel junction 4. Crack in tooth 5. Removal of external protection analogous to fur from an animal that would feel cold

The participants were strictly instructed not to refer any available online or offline text and formulate an answer based on their inherent thinking capability in order to avoid bias in answering as well as in the subsequent scoring.

The scoring was carried out by three different investigators. A score of 0-3 was given for each answer based on the number of solutions provided, the clarity of idea, novelty, practicality and elaboration of various aspects such as techniques or limitations of their solutions. After scoring all the answers, an average score (total/5) was calculated for each participant. In order to eliminate bias in assessment, each investigator scored all the responses independently and final scoring was considered as an average of all three investigators. Depending upon the final average score, the participants were designated as those having High (>2), Moderate (1.50 to 1.99), Low (1 to 1.49) and Borderline (0.70 to 0.99) LT capability respectively.

The questionnaire was pilot-tested on 10 participants and reliability was evaluated by means of Cronbach's alpha analysis. Certain questions were modified owing to their unsuitability in determining LT capability of the respondents. A final Cronbach's alpha value of greater than 0.8 indicated that no further modifications were required in the questionnaire. Upon validation, the questionnaire was circulated amongst third year undergraduate students of the dental institute via online platforms. Further, the identity of the participants was kept anonymous to the investigators.

A final sample size of $n=90$ was achieved by means of deliberate sampling method [Figure 1]. Data was recorded in the form of excel sheets and subjected to statistical analysis.

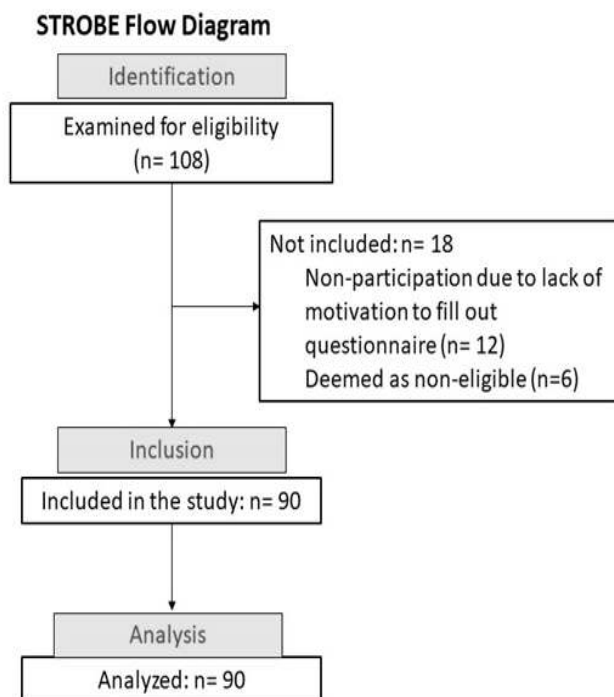


Figure 1: STROBE Flow Diagram indicating inclusion process of the respondents

Statistical Analysis: Statistical software IBM SPSS statistics 20.0 (IBM Corporation, Armonk, NY, USA) was used for the analysis of the data. Descriptive and inferential statistical analyses were carried out in the present study. Results on continuous measurements were presented as Mean and SD. Results on categorical measurement were presented in numbers or percentages. The level of significance was fixed at $p=0.05$ and any value less than or equal to 0.05 was considered to be statistically significant. Chi square analysis was used to find the significance of study parameters on a categorical scale. Student t-test (two tailed, unpaired) was used to find the significance of t-test parameters on continuous scale between two groups.

III. RESULTS

The total of 90 respondents comprised of 22 males and 68 females. A highly skewed male: female ratio is generally expected in undergraduates of medical and dental institutes similar to findings in similar previous studies [12]. The age of respondents ranged from 20 to 23 years with a mean age of 21.12 years ($S.D = \pm 0.805$). About 24.44% ($n=22$) respondents potentially exhibited LT capability at least to some extent. The distribution of LT capability according to assigned grades after scoring is detailed in [Table 2]. The gender-specific results restricted to the identified lateral thinkers is depicted in [Figure 2]. Subsequent analysis of data was carried out by means of Chi-square test. The Chi square value was found to be 1.833 with a p value of 0.608.

Table 2: Number of respondents of each gender exhibiting various respective levels of LT capability

Level of lateral thinking exhibited	Females	Males
High	1.11% of total respondents 1.47% of female respondents (n=1)	1.11% of total respondents 4.55% of male respondents (n=1)
Moderate	3.33% of total respondents 4.41% of female respondents (n=3)	None
Low	6.67% of total respondents 9.23% of female respondents (n=6)	3.33% of total respondents 13.63% of male respondents (n=3)
Borderline	5.56% of total respondents 7.35% of female respondents (n=5)	3.33% of total respondents 13.63% of male respondents (n=3)
Total	16.67% of total respondents 22.06% of female respondents (n=15)	7.78% of total respondents 31.81% of male respondents (n=7)

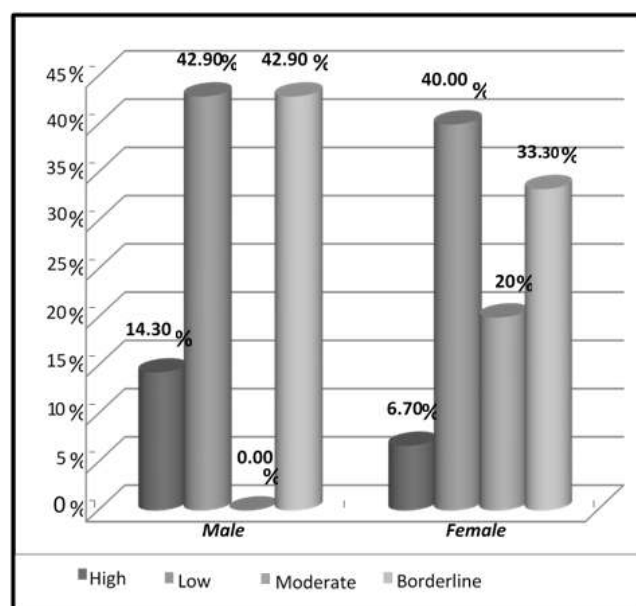


Figure 2: Gender-based percentage distribution of individuals exhibiting lateral thinking

Although statistically not significant, there was an evident higher percentage of male lateral thinkers in all the categories except for moderate level which had greater number of females. There was also no statistical significance found when correlating lateral thinking capability with age [Table 3] possibly because all the respondents were of identical academic qualification in a similar setting although their prior backgrounds may vary.

Table 3: Comparison of Scoring Among Different Age Groups Using Chi Square Test

Age (years)		Scoring				Total
			High	Low	Moderate	Borderline
20	Count	1	4	1	1	7
	% within groups	14.3%	57.1%	14.3%	14.3%	100.0%
21	Count	1	4	1	5	11
	% within groups	9.1%	36.4%	9.1%	45.5%	100.0%
22	Count	0	1	1	2	4
	% within groups	0.0%	25.0%	25.0%	50.0%	100.0%
Total	Count	2	9	3	8	22
	% within groups	9.1%	40.9%	13.6%	36.4%	100.0%
Chisquare value: 3.266 P value: 0.775						

IV. DISCUSSION

Drastic increase in the population of a country obviously warrants an increased number of health care workers in every field owing to a corresponding rise in morbidity. As a result, medical and dental universities in India are presently emphasizing on increasing their intake capacity. About 562 medical colleges and 300 dental colleges in India serve to accommodate nearly 85,000 and 30,000 students respectively per year [13]. The current Indian dentist to population ratio of 1:5000 satisfies the minimal ratio recommended by WHO of 1:7500 [14].

Teaching in these institutes is predominantly in the form of teacher-centered classrooms wherein knowledge is readily transmitted by the teachers to the students [15]. Such systems tend to lack concepts of independent learning, problem solving, and development of critical thinking skills which constitute the essence of education in developed countries [16]. Undoubtedly, the vertical thinking developed through conventional logical processes is required for professionalism. Yet the convergent and analytical vertical thinking in unison with divergent and generative lateral thinking can improve the quality of education by leaps and bounds [17].

A common inference led through multiple researches is that majority of humans have the left hemisphere which is concerned with logical, analytical, and verbal functions as their dominant hemisphere [18]. This could be attributed to

the nature of present-day education systems and lifestyles which is majorly career-oriented. The right hemisphere, which is concerned with intuition, visual and lateral thinking tends to get suppressed as a result of overwhelming focus on 'unidirectional' thought process [19]. Emphasis should be laid on expanding the 'multidirectional' or 'collateral' reasoning process which constitutes the essence of lateral thinking [20].

The multidirectional thought process can serve to generate new ideas and perceptions relevant to the present concepts by identifying loopholes and suggesting alternatives with an objective to improve them and develop novel solutions. LT may often be considered synonymous to 'creativity' owing to the broad overlap between the scopes of both the entities. However, while creativity refers to final value judgement of a result, LT refers to viewing a problem from various perceptions and thus, extending its coverage from problem-solving process to multiple possible end-results [19].

The applicability of LT in problem-solving can be attributed to its five dimensions, comprising of – analogies, fractionation, generation of alternatives, brainstorming and dominant ideas [21]. By using these dimensions, an individual is able to recognize the dominant ideas underlying a problem, proceed beyond the rigidity of vertical thought process, look at the problem through multiple perceptions and ultimately generate new ideas as possible solutions for the problem [22]. The present study utilized intriguing questions based on pathological conditions of oral cavity to stimulate and test the capability of respondents to provide alternative solutions to the existing dilemmas.

Therefore, there is a need for dental and medical education systems to emphasize their curriculum around the development of LT in students [23]. Firstly, they need to identify the students with LT capability and attempt to extend the attitude to other students as well. Well-maintained portfolios and their thorough scrutiny could help in identification of students having high LT capability [24]. Encouraging those identified can help in motivating other students to explore certain existing questions, brainstorm, and develop novel perspectives on the problems [25]. Active participation in brainstorming activities would further boost self-confidence in communication and empathy, which is crucial for patient interactions in the clinic [26].

Introduction of LT in research methodology can also significantly improve the quality of research. With the present-day expansion of scientific literature available through umpteen databases, retrieving relevant information on a complete scale seems to be an arduous task. Development of precise search strategies would require a certain amount of LT capability on the part of investigators. Incorporation of LT into search engines or AI-based software can further cover an extended document landscape [17,27].

In this manner, incorporation of exercises focusing on development of LT ability into routine academic curriculum could transform scientific research. Similarly, a clinicopathologic conference approach has proven useful in inculcating superior diagnostic skills wherein the students were able to better recognize and identify patterns in clinical cases [26]. Overall, LT could bring about improvement in both, clinical as well as academic aspects of dentistry.

The present study lacks in comparison of LT capability amongst students with varying academic qualifications. Research to understand association of LT capability of students with academic qualification is warranted to establish a definite correlation. Policies to incorporate teaching methods in medical and dental curriculum emphasizing on development of creative thinking in students need to be revised. Overall, these could largely benefit the academic research quality as well as clinical practice of both the fields. Further planning to identify suitable methods that would promote creative thinking in students and incorporate them in academic curriculum is warranted.

V. CONCLUSION

There are potential lateral thinkers in every field. In order to promote growth and innovations, in a world filled with unprecedented challenges and uncertainties, where time is always limited, it is necessary to identify, motivate and guide these lateral thinkers. Encouraging students to think divergently could bring about new insights in understanding complex pathogenesis of various diseases. As inferred from this study, the number of lateral thinkers in a given population is relatively low. Therefore, it is necessary to nurture the quality and motivate those displaying the capability. Education systems should also strive to inculcate creative thinking in the students who would be the torch-bearers of growing research and technology. Integration of policies and activities that promote LT capability in teaching and learning strategies would definitely improve academic as well as clinical aspects of medical field by leaps and bounds.

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