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Case-based learning: Modern teaching tool meant for present curriculum: A behavioral analysis from faculties' perspective

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Abstract:

BACKGROUND: Case-based learning (CBL) is an established bidirectional active learning approach where students learn concepts by solving cases or problems under the guidance of a facilitator. In the present study, the awareness and acceptance level of faculties to implement this method of teaching were assessed by behavioral analysis.

MATERIALS AND METHODS: This cross-sectional study was done through two workshops organized at NDRI Karnal on December 16 and 17, 2019, and BHU Varanasi on March 1, 2020. Fifty-four faculties from different applied sciences participated. The participants were given an insight into this teaching tool through didactic lecture and hands-on training session about implementation of this method. Pre and post-session responses were compared through a set of questionnaires and the behavioral change was analyzed by using SPSS version 22. $P \leq 0.05$ was considered as statistically significant.

RESULTS: Only 31.5% faculties were aware of the active learning methods though 83% agreed that active learning is better than conventional teaching. 96% agreed that CBL is a better way to develop concepts and nearly 81% agreed that more learning could be done with lesser efforts. The clinical decision-making improve significantly. Pre and post-session mean scores of effectiveness of CBL as a teaching tool were 2.44 ± 0.63 and 2.72 ± 0.53 , respectively.

CONCLUSION: CBL originally is a mode of imparting knowledge in a student-centric bimodal learning. Acceptance to the mode is increasing among faculties despite of many deterrents.

Keywords:

Behavioral analysis, case-based learning, faculty, modern teaching tool

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Introduction

The current scenario of professional medical teaching is mostly through didactic lectures and demonstrations which have been criticized in the recent past due to monotonous nature and one-way communication. Scientific data have shown that the attention of the students does not last more than 20 min.^[1] Hybrid model of teaching which includes a short discussion of a case or framing a quiz etc., is more effective than conventional one-way teaching as

these are active learning methods.^[2] In the active learning model, students learn through professional discussion and solving a problem or completing a project based on a concept and this not only results in gain of knowledge but also develops critical thinking toward the real-life professional cases.^[3]

Case-based learning (CBL) is one of the active teaching methods in this series of advancement. CBL is an established approach used across disciplines where students apply their knowledge to

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real-world scenarios, promoting higher levels of cognition. This model of teaching involves collaborative efforts by the faculty and students where the learning is student centric. In CBL classrooms, the instructor frames a case in the form of a problem, based on the real clinical scenario and the students typically work in groups to devise solutions under the guidance of the instructor. This method implicitly uses the capability of human beings to explicate and interpret better from the stories. It is difficult to learn the fragmented concepts and retain those as long-term memory to execute in practical life. However, if the fragmented concepts are integrated to a single event form, then it is easy to understand the concept and to retain for execution.^[4] CBL is an educational paradigm closely related to the more common PBL. It also follows the same seven jumps or steps described by Maastricht University, i.e., clarify the unknown terms, identify the problem statement, brainstorming session, set the learning objectives, a self-study session period, share and discuss the result, and evaluate the outcome.^[5]

Although many educationists researched on the students' acceptance to CBL, literature, so far available, is remarkably deficient of faculties' perspectives in this regard. This article aims to derive the faculties' acceptance of this method in their scheduled curriculum.

Materials and Methods

Study design and setting

This cross-sectional study was conducted through two workshops organized at two different places, i.e., NDRI Karnal on December 16 and 17, 2019, and BHU Varanasi on March 1, 2020.

Study participants and sampling

A total of 54 candidates participated in the workshops, 17 at NDRI Karnal and 37 at BHU Varanasi.

The sample size corresponds to the confidence level of 90% with a 10% margin of error of the study, as calculated by software calculator.net based on Lawshe (1975) formula.^[6] The age group varied from 31 to 59 years. All these participants were from different scientific streams such as medical, veterinary, dairy science, and horticulture. All were newly recruited faculties, apart from three, who were guest lecturers and participated in the workshop as delegates.

Data collection tool and technique

Workshop started with an ice-breaking session to make all the participants comfortable. Participants were given a predesigned questionnaire including close-ended and open-ended questions about CBL. Afterward, a theory lecture of two hours was conducted in didactic

lecture form. In this lecture, the concepts and benefits of active learning methodology and the importance of CBL as one of the active learning methods were explained to the participants. They were given a brief insight into the procedure of how to implement the same in the classroom among students in the Indian scenario. Then, they were shown an animated video regarding the implementation of the method. A hands-on training session was conducted post lunch in which all the participants were distributed in four small groups. The strength of group members varied from group to group. The smallest group included six members and the largest group included ten members. Each group was given a case based on a real clinical scenario [Appendix 1]. All the groups were encouraged to follow the steps of the CBL procedure described in the theory session. Finally, all the groups presented their case and the session was concluded after a brief discussion. Then, all the candidates were asked to fill the same questionnaire to reflect their views. Following parameters/close-ended questions were included in the questionnaire:

1. Do you think active teaching methods are better teaching tools than conventional teaching?
2. Do you agree that CBL is a better way for development of concepts than traditional teaching?
3. Do you agree that CBL is more helpful in understanding the content with lesser efforts?
4. Do you agree that CBL will introduce better clinical skills in students?
5. Do you think that CBL demands more resources than traditional teaching?
6. Do you consider CBL as an effective teaching tool in the current scenario?
7. Will you implement the CBL module in your teaching curriculum?

The validity of the questionnaire was determined by discussion in the department of physiology in presence of five faculties. The content validity index calculated was 0.791.

All the participants were asked to respond to the above-mentioned close-ended questions on a Likert scale of no = 1, not sure = 2, and yes = 3. Participants were asked to write in brief in response to an open-ended question about potential limits in the implementation of CBL. Overall grading of the workshop was done by the participants on a 5-point Likert scale of excellent = 5, very good = 4, good = 3, satisfactory = 2, and poor = 1. Response sheets were kept anonymous. The pre session and the post session responses were compared. Data analysis was performed by SPSS version 22 (IBM Corporation, Armonk, NY, USA) using descriptive statistics and paired *t*-test. $P \leq 0.05$ was considered as statistically significant.

Ethical considerations

Since the study was based on the data obtained from the workshop delegates who participated voluntarily, ethical committee approval was not required.

Results

Out of 54 faculties, only 17 (31.5%) were aware of the active learning methods before the session. The rest of the faculties (68.5%) were only exposed to the traditional modes of teaching, for example, didactic lectures and laboratory demonstrations during their training and they were not aware of any scientific active teaching module. Even without much awareness, 83% of them before the session agreed that active teaching methodology was better than the passive mode of teaching, which is just one way of the information flow and it increased to 96% post session.

Table 1 summarizes the perception of faculty members about CBL before and after the session. The results clearly indicated that faculties were quite receptive towards CBL, but due to lack of awareness and patronage, they were using the traditional mode of teaching which was not appealing to them also. It was observed post-session that 96% of the faculties agreed that CBL was a better way to develop concepts among students and nearly 81% of them agreed that more learning could be done with lesser efforts by using this module due to division of the labor in small groups and sharing the knowledge on a student-centric platform. Since the professional course requires clinical acumen along with scientific knowledge, 58% of the participants agreed after the session that CBL would introduce better clinical skills among students. The demand of human and logistic resources for implementing this method was assessed and almost 78% of faculties were found to be apprehensive about the scarcity of resources as CBL requires lots of skilled faculties, enough space/seminar rooms, and ample time in the curriculum. At the end of the session, 76% of the participants agreed that CBL is an effective teaching tool to be included in the professional education as a mode of teaching, but only 56% agreed to implement it in the present curriculum.

Responses of participants to close-ended questions before and after sessions were compared. Mean scores of all the parameters/questions used to assess the effectiveness of CBL increased after the session [Table 2].

Paired *t*-test and significant two-tailed test were applied and it was observed that there was a statistically significant difference between pre and post mean scores of perception of faculties toward various aspects of CBL except for the clinical skills introduced by CBL [Table 3]. Faculties mentioned various potential limits to the implementation of CBL in the present scenario [Table 4].

The overall grading of the workshop was 3.50 ± 0.90 [Figure 1].

Discussion

Active mode of teaching is not new to the present century. Its history though is unclear but can be traced to the early 20th century, wherein Dr. James Lorrain Smith being the professor, Department of Pathology in the University of Edinburgh, used the investigation of clinical cases as the basis for a series of exercises in clinicopathological correlation to teach pathology.^[7] Active teaching models were introduced by many educators in various ways in their teaching curriculum. Rajasekaran described a hybrid model in which he introduced a short case in

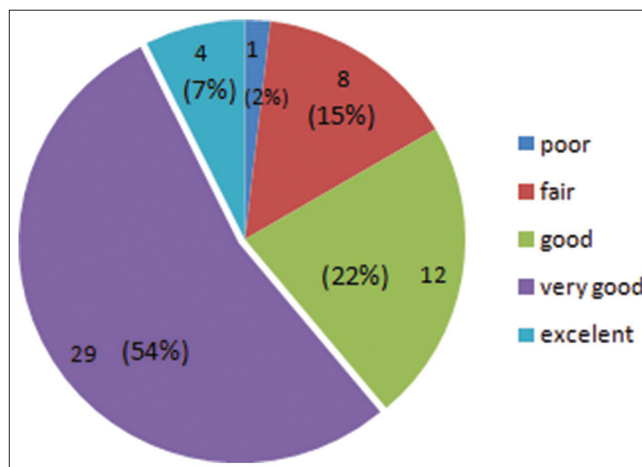


Figure 1: Overall grading of workshop sessions on case-based learning

Table 1: Faculties' perception about case-based learning pre and post session (n=54)

Questionnaire serial number*	Pre session			Post session		
	Yes, n (%)	No, n (%)	Not sure, n (%)	Yes, n (%)	No, n (%)	Not sure, n (%)
1	45 (83.3)	4 (7.4)	5 (9.3)	52 (96.3)	2 (3.7)	0
2	17 (31.5)	4 (7.4)	33 (61.1)	52 (96.3)	2 (3.7)	0
3	15 (27.8)	4 (7.4)	35 (64.8)	44 (81.5)	2 (3.7)	8 (14.8)
4	25 (46.3)	6 (11.1)	23 (42.6)	31 (57.4)	5 (9.3)	18 (33.3)
5	33 (61.1)	4 (7.4)	17 (31.5)	42 (77.8)	2 (3.7)	10 (18.5)
6	28 (51.9)	4 (7.4)	22 (40.7)	41 (75.9)	2 (3.7)	11 (20.4)
7	10 (18.5)	4 (7.4)	40 (74.1)	30 (55.6)	2 (3.7)	22 (40.7)

*Questions 1-7 refer to those mentioned in methodology

between the class for discussion, relevant to the same pharmacological concepts, and noticed that it was better compliant to the students. He also observed that even asking a question to an individual student wakes up the attention of the whole class.^[2] In the same line, Axita *et al.* focused on students' perspectives about CBL wherein students' feedbacks reflected that the method was more relevant. Study concluded that not only the information but its application was highly necessary to develop the affective skills so that the students can tackle the professional life problems.^[8] This type of teaching in medical profession is even more essential as it not only develops the problem-solving skills but also the skills of multidisciplinary approach by group discussion and accepting the ideas of the others to solve a case. It also develops the self-directed learning approach and creates an attitude of research among the students.

All these kinds of active teaching methods are based on the Malcolm Knowles concept of andragogy, which states that the adult learning (andragogy) is quite different from the pedagogy, meant for preadolescent students. In the andragogy model, students are involved in planning of teaching curriculum. Students also know about the requirement of the teaching material in their future professional life and they are free to build up their knowledge from their previous experiences.^[9] Every professional graduate is expected to take quick professional decisions which should be based on the sound scientific concepts. However in the recent past, it has been realized that the professionals in their career

lack the scientific knowledge learned in their graduation period. In this context, Harris *et al.* stated that knowledge cannot be retained for long if not practically implemented simultaneously.^[10] Therefore, the teaching methods should aim for the integration of scientific knowledge with its practical application. CBL is one of such methods. This method involves guided inquiry and is grounded in constructive aspects whereby students form new concepts by interacting with peer groups with their knowledge.^[11] CBL not only enhances the critical thinking ability of the students but also their coordination with the peer group for a teamwork which is highly required in their future professional life.^[12] It was quite obvious from students' perspectives analyzed in previously mentioned studies that students perceived CBL to be a more efficient and more clinically applicable than the conventional teaching methods. However, studies analyzing faculties' perspectives and their acceptance level to CBL were found to be very few after a thorough literature search.

In the present study, it was observed that the better implementation of CBL depends on the quality of case designed for the session. Designing a case scenario for learning a concept requires complete understanding, lot of efforts, and validation. Hence, CBL can be better implemented after proper training of the faculties and prior clinical exposure of students. CBL does not increase effectively the lower order cognition like recalling, but it significantly increases the higher-order cognition such as in-depth understanding analysis and reasoning.^[13] It was also opined that fully fledged conversion of curriculum to CBL is not a good idea as some of the basic concepts cannot be learned through CBL.^[14] Not only participation of students increased group dynamics and sharing among students but also active participation of students motivated the faculties or the facilitators to deliver more relevant information in a more effective way; however, some other teachers had an opinion that in this process, most of the contents ought to be delivered are missed due to time constraints and format limitation.^[15] Orban *et al.* stated that with the implementation of CBL in regular curriculum, the student's knowledge transformed from theory-based bookish knowledge to analytical reasoning type which would be helpful for their clinical practice

Table 2: Comparison of pre- and postsession responses

Questionnaire serial number*	Mean±SD	
	Pre session	Post session
1	2.76±0.58	2.93±0.38
2	2.24±0.58	2.92±0.38
3	2.20±0.56	2.77±0.50
4	2.35±0.67	2.48±0.66
5	2.53±0.63	2.74±0.52
6	2.44±0.63	2.72±0.53
7	2.11±0.50	2.51±0.57

*Questions 1-7 refer to those mentioned in methodology. SD=Standard deviation

Table 3: Paired t-test and significant two-tailed test (n=54)

Question	SEM	Paired differences	t	df	Significant (two-tailed)
		95% CI of the difference (lower-upper)			
1	0.06339	-0.29381--0.03952	-2.629	53	0.011*
2	0.09090	-0.86751--0.50286	-7.538	53	<0.001**
3	0.09384	-0.76230--0.38585	-6.117	53	<0.001**
4	0.09907	-0.32835-0.06909	-1.308	53	0.196
5	0.08517	-0.37453--0.03288	-2.392	53	0.020*
6	0.08932	-0.45693--0.09862	-3.110	53	0.003*
7	0.09353	-0.59501--0.21981	-4.356	53	<0.001**

*P≤0.05 is statistically significant, **P≤0.001 is statistically highly significant. df=Degree of freedom, SEM=Standard error of mean, CI=Confidence interval

Table 4: Major limits/hurdles emerging from open-ended responses of faculties

Potential limits to the implementation of CBL	Number of responses, n (%)
Lack of management support	14 (26.9)
Requires multidisciplinary coordination	12 (22.2)
Lack of proper infrastructure	11 (20.3)
Difficulty in selection of case	9 (16.6)
Framing of case is time consuming	7 (12.9)

CBL=Case-based learning

or professional life.^[16] Persson *et al.*, in a similar study, observed that the fragmented knowledge regarding a concept turned to integrated holistic type with the implementation of CBL method.^[17] Reed *et al.* inferred that there was no statistically significant difference in the clinical reasoning ability among the students who were either under conventional curriculum or case-based curriculum.^[18] CBL not only presents different and challenging scenarios for the students but also for teachers. Subhada *et al.* found that the role of a medical teacher as a facilitator was really challenging as he had to observe only during the discussion despite thorough knowledge of the subject. This study also found that by this method, in-depth understanding of the subject developed as students were able to answer the applied questions based on the concept.^[19]

Through this discussion, it is clear that CBL method is no doubt superior to conventional curriculum, still, it is difficult to implement as most of the faculties do pose a conservative mindset toward the conventional curriculum. The present scenario reflects that faculties are convinced about the benefits of this method, but quite not sure whether they will be able to handle the class using CBL module due to lack of training.

Limitation and recommendation

One of the limitations of the study is that the sample population has been drawn from only two workshops. Therefore, the results of the study cannot be generalized. Subjective bias is also another limitation. The authors recommend that greater awareness should be spread among faculties through workshops and training sessions so that CBL method may be implemented more effectively and professional education may achieve new heights in the time to come.

Conclusion

It has been proved through various studies that CBL being one of the methods of active teaching is really effective and should be implemented in the current scenario. However, this study indicates that most of the faculties are not aware of the active learning modules. Reasons cited for the non-compliance of this method are vivid and genuine. However, most of the participants

in this study agreed to imply the same at their institutes in the scheduled curriculum. This study takes a more critical review and argues that there are potential limits to CBL from faculty's perspectives which should be considered carefully.

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Conflicts of interest

There are no conflicts of interest.

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Appendix 1

Case history: A 38-year-old Sherpa on a trekking expedition had carried a load from 6100 m to 7000 m and returned. The following morning, he complained of severe headache and malaise. He was anorexic and remained in his sleeping bag

Physical examination: Around 10 am, on examination, he had breathlessness on the slightest exertion, cyanosis of lips, dry cough, and the core temperature was 38°C. The skin was cold. The pulse was 120/min. The respiratory rate was 40/min. Crepitations were heard at the lung bases. The second heart sound on the pulmonary area was loud. At noon, he started for a lower camp at 5800 m accompanied by two team members. He could not carry even a light load. Every 100–150 m he had to stop, even though the route was downhill. He began coughing white frothy sputum, which later became pink. At about 100 m above the camp, he was given oxygen. After breathing oxygen for about 3 h at the camp, he declared himself fit and refused any more oxygen. He descended unaided to a lower camp the next day, carrying a load.

Investigations

- Electrocardiography: tachycardia and right axis deviation
- Chest X-ray: pulmonary vessels enlarged, right ventricle, and dense lung fields
- ECHO: Ppa: 800 mmHg and no atrial septal defect
- P_aO_2 : 23 mmHg
- S_aO_2 : 48%

Tutor guide

Symptoms	Causes	Inference
Cough	Nature, causes	Differential diagnosis
Breathlessness	Why	Differential diagnosis
Tachypnoea	Why	Ask for physiological causes
Tachycardia	Why	
Exertion	Causes	
Cyanosis	Why	Physiology of O_2 saturation differential diagnosis
Cold	Why	Responses to cold: vasoconstriction
Please read: Physiological responses at high, acclimatization/adaptation to hypoxia, Mountain illness: HAPE, pulmonary wedge pressure, rights ventricular hypertrophy, right axis deviation path physiology of HAPE. HAPE=High-altitude pulmonary edema		