Original Article

Medical undergraduates' feedback towards Problem-based learning (PBL): College of Medicine, Majmaah University, Saudi Arabia

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Received on 15th September 2017 Accepted on: 20th October 2017

Abstract:

Background: An integrated outcome based curriculum is defined as the curriculum that is based on predefined exit outcomes which students need to display at the end of the course. The Problem-based learning (PBL) was developed in 1968 at McMaster University as one of the student centred teaching modality promoting self-directed and lifelong learning. The college of medicine, Majmaah University, was started in 2010 with integrated, outcome based hybrid curriculum.

Objectives: The objective of the study was to assess the perception and feedback of medical students, Majmaah University towards problem-based learning (PBL)

Materials and Methods: The current study was cross-sectional. The study population consisted of all medical undergraduates (Year 1, 2 and 3) studying in college of medicine,

الملخص

مقدمة: يتم تعريف المنهج المبني على المخرجات على أنه المنهج الذي يتم تنظيمه على أساس الخروج بمخرجات تعليمية محددة مسبقا والتي يحتاج الطلاب لإتقانها مع نهاية البرنامج التعليمي. نشأت فكرة التعليم المبني على حل المشكلات في العام ١٩٦٨ في جامعة ماكماستر باعتبارها واحدة من الجامعات التي تطرح تعليما يجعل الطالب مركزا للعملية التعليمية والتي تحفز التوجيه الذاتي في التعلم وسياسة التعلم مدى الحياة. وقد بدأت كلية الطب بجامعة المجمعة في عام ٢٠١٠ بمنهج تكاملي مبني على المخرجات.

تهدف هذه الدراسة الى تقييم التصور ومقارنة ردود فعل الطلاب من السنوات الدراسية المختلفة عن التعليم المبني على حل المشكلات باعتبارها واحدة من طرق التدريس والتعلم في المقررات الدراسية التي تُطرح في المرحلة الثانية (السنوات الأساسية) من منهج كلية الطب.

طريقة البحث: تم تصميم البحث بطريقة «الدراسة القطعية». تألف مجتمع الدراسة من جميع طلاب المرحلة الدراسية (السنة الأولى والثانية والثالثة) الذين يدرسون في كلية الطب بجامعة المجمعة. تم استخدام استبيان ذاتي مبني على أساليب

Majmaah University. A self-administered questionnaire on VARK (visual, auditory, reader and kinesthetic) learning styles and learning theories on a five point Likert rating scale was used.

Results: Sixty two students (54.2%) agreed that problem-based learning (PBL) is a reliable tool for facilitating visual/spatial learning. Around 75% of students strongly agreed that PBL is a reliable tool for facilitating auditory learning. Ninety-nine (88.1%) students stated that PBL facilitates in developing interpersonal skills. Eighty two (72.4%) students perceived that PBL helped in developing the skills of problem solving, decision taking and practical application of ideas. No significant association was observed between year-wise analysis and perception of students for various PBL questions ($p>0.05$).

Conclusion- The Problem-based learning (PBL) is a teaching and learning tool that caters to variety of learning styles and helps in developing vital skills that are necessary to form a good doctor.

Key words: Outcome-based curriculum, Problem-based learning, Visual learning, auditory learning, problem solving, medical undergraduate students

التعلم VARK (البصري والسمعي والمقروء والحركي) ونظريات التعلم على مقياس (Likert) من خمس نقاط.

النتائج: التعليم المبني على حل المشكلات هي أداة موثوقة لتسهيل التعلم البصري / المكاني، وافق غالبية الطلاب عليها ٦٢ (٥٤,٢٪). وقد وافق حوالي ٧٥٪ من الطلاب بشدة على أن التعليم المبني على حل المشكلات هو أداة موثوقة لتيسير التعلم السمعي. أجاب ٩٩ (٨٨,١٪) من الطلاب بأن التعليم المبني على حل المشلات ساهم في تطوير مهارات التعامل مع الآخرين. اعتبر ٨٢ (٧٢,٤٪) من الطلاب أن هذه الطريقة ساعدت في تطوير مهارات حل المشكلات واتخاذ القرارات والتطبيق العملي للأفكار. لم يُلاحظ وجود ارتباط كبير بين ردود فعل الطلاب من مختلف الأعوام وتصورهم في مختلف الأسئلة عن التعليم المبني على حل المشلات .($p > 0.05$)

الاستنتاج: التعليم المبني على حل المشكلات هو أداة تعليمية تحتوي على مجموعة متنوعة من أساليب التعلم وتساعد في تطوير المهارات الحيوية التي هي ضرورية لتخريج طبيب جيد.

Introduction:

During 1980, it was perceived that amount of knowledge relevant for medical undergraduate is getting too much [1]. The General Medical Council, UK further stated that tomorrow doctors would probably apply the skills and knowledge that cannot be predicted in their present learning scenario [2]. In the last two decades, a shift has been noticed in medical curriculum from the traditional subject based approach towards integrated, system based curricula[3]. A more holistic definition appears for the curriculum that includes programme objectives, teaching and learning methods and educational strategies [4]. The problem-

based learning was introduced as one of the student-centered teaching and learning methods by McMaster University, Canada in 1960s [5]. As mentioned earlier by Harden, the outcome-based education (OBE) is a sophisticated strategy for curriculum planning that offers a number of advantages. The two basic requirement of OBE are explicitly stated learning outcome and all the decisions of the learning outcome should be based on these outcomes. An integrated curriculum denotes a teaching strategy in which the content is derived from different subject or specialties and focuses on a certain theme or topic or module. The PBL is an instructional method that challenges the learner to "learn to learn," by working cooperatively in small groups to solve real world problems [6]. According to Albanese, several theories advocate the rationale behind the PBL, some of these theories are information processing theory, cooperative learning theories, self-determination theory and control theory [7]. In medical education, the PBL may be used as a curriculum design or just a teaching learning methodology.

A study has been conducted in College of Medicine; King Saud University regarding the perceptions of the medical undergraduates towards Problem based learning in an outcome-based curriculum, the study showed the important role of PBL in a system-based curriculum, which Showed the importance of PBL as a different learning, student-based skills. Students reported that the PBL sessions promote students' knowledge and motivation. They also reported that the sessions contribute to the development of interpersonal, communication, and presentation skills [8].

Material and Method:

This cross-sectional study was done at College of Medicine, Majmaah University, Saudi Arabia from November 2013 to April 2014 and is comprised of 1st, 2nd, and 3rd year medical students. The College of Medicine, Majmaah University was started in 2010 as one of the newly established colleges in Saudi Arabia. It adopted an integrated outcome-based curriculum. Here the various specialties of medical sciences are integrated in the form of different modules that are taken through several semesters. A mix of teaching and learning methodologies are used and problem based learning (PBL) is one of them used in Phase II of the curriculum. The phase II is of two and half year's duration consist of system-based modules mainly comprised of basic medical science subjects along with pathology, microbiology, biochemistry with thirty percent blend of clinical subjects. The total number of the students enrolled in year 1, 2 and 3 were 133. All students were included in this study by using complete enumeration sampling technique. Ethical approval was obtained from Majmaah University Ethics Committee.

A self-administered questionnaire based on the VARK learning styles and learning theories on five-point Likert rating scale was used. The questionnaire included the perception of students regarding facilitating visual,

auditory, kinesthetic learning and reading and writing skills by PBL. The questionnaire also included questions about perceptions of the students regarding achieving of vertical integration, horizontal integration, providing peer feedback and stimulation of deep learning by PBL as teaching and learning method. The reliability of the questionnaire was checked by Cronbach's Alpha with a split-half method. The data were analyzed using SPSS 22.0. Mean±S.D was reported for quantitative variables. Frequencies and percentages were reported for qualitative variables. One way Analysis of Variance (ANOVA) was applied to compare mean score with years; post hoc Turkey's test was applied to observe which group mean differs. Pearson Chi-square and Fisher Exact tests were applied to observe associations between qualitative variables. A p-value of <0.05 was considered as statistically significant.

Results:

Majority of the students belonged to studying year 1 (n=48, 42.9%), almost one quarter students were studying in year 2 and (n=24, 21.4%) were studying in year 3. When asked about *"Is problem based learning is a reliable tool for facilitating visual/spatial learning"* majority of the students disagreed to it (n=38, 33.9%), twenty-seven students were uncertain in their opinion (n=27, 24%), twenty-three (20.5%) strongly agreed to it, seventeen students (12.5%) agreed and a small percentage (n=03, 3.5%) strongly agreed. When this item was associated with years of study, no significant association was observed (p=0.699). *"Problem based learning is a reliable tool for facilitating auditory learning"* more than half of the students agreed to it (n=60, 53.6%), one quarter students (n=29, 25.9%) strongly agreed, twenty-one (18.8%) were uncertain in their opinion and a small percentage (n=01, 0.9%) disagreed and strongly disagreed respectively. When this item was associated with years of study, no significant association was observed (p=0.166). *"Problem based learning is a reliable tool for facilitating kinesthetic learning"* majority of the students strongly disagreed to it (n=35, 31.3%), twenty-seven (24%) disagreed, nine (8%) were uncertain in their opinion, (n=24, 21.4%) students agreed to it and only (n=15, 13%) strongly agreed. When this item was associated with years of study, no significant association was observed (p=0.696). *"Problem based learning is a reliable tool for developing reading and writing skills"* majority of the students agreed to it (n=52, 46.4%), one quarter of students (n=38, 33.9%) strongly agreed, fifteen (13.4%) were uncertain in their opinion and a small percentage (n=5, 4.5%) students disagreed and strongly disagreed respectively. When this item was associated with years of study, no significant association was observed (p=0.342). *"Problem based learning helped in developing verbal/linguistic skills and self-confidence"* majority of the students strongly agreed to it (n=63, 56.3%), almost one quarter students (n=40, 35.7%) agreed and (n=09, 8.0%) were uncertain in their

opinion. When this item was associated with years of study, no significant association was observed (p=0.604). *"Problem based learning facilitates in developing interpersonal skills"* majority of the students strongly agreed to it (n=61, 54.5%), one quarter students (n=38, 33.9%) agreed and (n=13, 11.6%) were uncertain in their opinion. When this item was associated with years of study, no significant association was observed (p=0.378).

"Problem based learning stimulates deep learning" majority of the students strongly agreed to it (n=48, 42.9%), more than one quarter of students (n=40, 35.7%) agreed, seventeen (15.2%) were uncertain in their opinion and a small percentage of students (n=6, 1; 5.4, 0.9%) disagreed and strongly disagreed respectively. When this item was associated with years of study, no significant association was observed (p=0.054). *"Problem based learning helped in achieving curriculum outcomes"* majority of the students agreed to it (n=44, 39.3%), twenty-nine (37.5%) strongly agreed, thirty one (27.7%) were uncertain in their opinion and a small percentage of students (n=7, 1; 6.3, 0.9%) disagreed and strongly disagreed respectively. When this item was associated with years of study, no significant association was observed (p=0.495).

"Problem based learning fulfills vertical integration i.e., basic medical sciences efficiently integrated with clinical sciences" majority of the students agreed to it (n=43, 38.4%), more than one quarter students (n=41, 36.6%) were uncertain in their opinion, (n=25, 22.3%) strongly agreed and a small percentage of students (n=3, 2.7%) disagreed to it. When this item was associated with years of study, no significant association was observed (p=0.259). *"Problem based learning fulfills horizontal integration i.e., integration between different subjects of basic medical sciences"* majority of the students agreed to it (n=48, 42.9%), almost one quarter students (n=36, 32.1%) strongly agreed, twenty-six (23.2%) were uncertain in their opinion and a small percentage of students (n=2, 1.8%) disagreed to it. When this item was associated with years of study, no significant association was observed (p=0.634). *"Problem based learning provided the opportunity of peer teaching and peer feedback"* almost 50% students agreed to it, one quarter students (n=41, 36.6%) strongly agreed, fifteen (13.4%) were uncertain in their opinion and a small percentage of students (n=2, 1.8%) disagreed to it. When this item was associated with years of study, no significant association was observed (p=0.355).

"Receiving of the feedback, during the problem based learning sessions modified your attitude towards learning" majority of the students agreed to it (n=41, 36.6%), one quarter students were uncertain in their opinion (n=38, 33.9%), twenty-eight (25.0%) strongly agreed and a small percentage of students (n=5, 4.5%) disagreed to it. When this item was associated with years of study, no significant association was observed (p=0.187). *"Problem based learning*

developed skills like problem solving, taking decisions and practical application of ideas" majority of the students agreed to it (n=42, 37.5%), forty (35.7%) strongly agreed, twenty-six (23.2%) were uncertain in opinion and a small percentage of students (n=4, 3.6%) disagreed to it. When this item was associated with years of study, no significant association was observed (p=0.077). *"Problem based learning promotes self-directed learning"* equal number of students strongly agreed and agreed to the statement (n=46, 41.1%) respectively, fifteen (13.4%) strongly agreed, fifteen (13.4%) were uncertain in their opinion and a small percentage of students (n=4, 1; 3.6, 0.9%) students disagreed and strongly disagreed to it. When this item was associated with years of study, no significant association was observed (p=0.359) (*table 1)*.

Moreover, mean scores were calculated for all the responses of students. Significant difference was observed between years of study and mean response scores. Perception and attitude of year 1 students differed significantly with year 2 & year 3 students (p=0.040) *(table II)*.

Table 1: Year wise associations with perception & attitude of students

Items	Years			Items	Years		
	1 n(%) N = 48	2 n(%) N = 40	3 n(%) N = 24		1 n(%) N = 48	2 n(%) N = 40	3 n(%) N = 24
PBL is a reliable tool for facilitating visual / spatial learning:				**PBL stimulates deep learning:**			
Strongly Disagree	11 (22.9)	06 (15.0)	09 (37.5)	Strongly Disagree	01 (2.10)	00 (0.00)	00 (0.00)
Disagree	17 (35.4)	16 (40.0)	05 (20.8)	Disagree	05 (12.4)	01 (2.50)	00 (0.00)
Neutral	06 (12.5)	15 (37.5)	06 (25.0)	Neutral	12 (25.0)	03 (7.50)	02 (8.30)
Agree	13 (27.1)	00 (0.00)	04 (16.7)	Agree	14 (29.2)	14 (35.0)	12 (50.0)
Strongly Agree	01 (2.10)	03 (7.50)	00 (0.00)	Strongly Agree	16 (33.3)	22 (55.0)	10 (41.7)
	p-value =0.514				p-value =0.054		
PBL is a reliable tool for facilitating auditory learning?				**PBL helped in achieving curriculum outcomes:**			
Strongly Disagree	00 (0.00)	00 (0.00)	01 (4.20)	Strongly Disagree	00 (0.00)	01 (2.50)	00 (0.00)
Disagree	01 (2.10)	00 (0.00)	00 (0.00)	Disagree	06 (12.5)	01 (2.50)	00 (0.00)
Neutral	10 (20.8)	09 (22.5)	02 (8.30)	Neutral	14 (29.2)	10 (25.0)	07 (29.2)
Agree	26 (54.2)	17 (42.5)	17 (70.8)	Agree	16 (33.3)	18 (45.0)	10 (41.7)
Strongly Agree	11 (22.9)	14 (35.0)	04 (16.7)	Strongly agree	12 (25.0)	10 (25.0)	07 (29.2)
	p-value =0.166				p-value =0.495		
PBL is a reliable tool for facilitating kinesthetic learning:				**PBL fulfills vertical integration:**			
Strongly Disagree	14 (29.2)	12 (30.0)	09 (37.5)	Strongly Disagree	00 (0.00)	00 (0.00)	00 (0.00)
Disagree	14 (29.2)	10 (25.0)	05 (20.8)	Disagree	02 (4.20)	01 (2.50)	00 (0.00)
Neutral	04 (8.30)	03 (7.50)	02 (8.30)	Neutral	22 (45.8)	13 (32.5)	06 (25.0)
Agree	13 (27.1)	07 (17.5)	04 (17.7)	Agree	15 (31.3)	19 (47.5)	09 (37.5)
Strongly Agree	03 (6.30)	08 (20.0)	04 (16.7)	Strongly Agree	09 (18.8)	07 (17.5)	09 (37.5)
	p-value =0.773				p-value =0.259		

PBL is a reliable tool for developing reading and writing skills:				**PBL fulfills horizontal integration:**			
Strongly Disagree	01 (2.10)	01 (2.50)	00 (0.00)	Strongly Disagree	00 (0.00)	00 (0.00)	00 (0.00)
Disagree	05 (10.4)	00 (0.00)	00 (0.00)	Disagree	01 (2.10)	01 (2.50)	00 (0.00)
Neutral	05 (10.4)	06 (15.0)	04 (16.7)	Neutral	15 (31.3)	08 (20.0)	03 (12.5)
Agree	21 (43.8)	17 (42.5)	14 (58.3)	Agree	18 (37.5)	18 (45.0)	12 (50.0)
Strongly Agree	16 (33.3)	16 (40.0)	06 (25.0)	Strongly Agree	14 (29.2)	13 (32.5)	09 (37.5)
	p-value = 0.342				p-value = 0.634		
PBL helped in developing verbal/ linguistic skills and self-confidence:				**PBL provided the opportunity of peer teaching and peer feedback:**			
Strongly Disagree	00 (0.00)	00 (0.00)	00 (0.00)	Strongly Disagree	00 (0.00)	00 (0.00)	00 (0.00)
Disagree	00 (0.00)	00 (0.00)	00 (0.00)	Disagree	02 (4.20)	00 (0.00)	00 (0.00)
Neutral	06 (12.5)	02 (5.00)	01 (4.20)	Neutral	09 (18.8)	02 (5.0)	04 (16.7)
Agree	14 (29.2)	16 (40.0)	10 (41.7)	Agree	21 (43.8)	22 (55.0)	11 (45.8)
Strongly Agree	28 (58.3)	22 (55.0)	03 (54.2)	Strongly Agree	16 (33.3)	16 (40.0)	09 (37.5)
	p-value =0.604				p-value =0.355		
PBL facilitates in developing interpersonal skills:				**Receiving feedback, during the PBL sessions modifies your attitude towards learning:**			
Strongly Disagree	00 (0.00)	00 (0.00)	00 (0.00)	Strongly Disagree	00 (0.00)	00 (0.00)	00 (0.00)
Disagree	00 (0.00)	00 (0.00)	00 (0.00)	Disagree	05 (10.4)	00 (0.00)	00 (0.00)
Neutral	08 (16.7)	02 (5.00)	03 (12.5)	Neutral	18 (37.5)	11 (27.5)	09 (37.5)
Agree	17 (35.4)	12 (30.0)	09 (37.5)	Agree	13 (27.1)	19 (47.5)	09 (37.5)
Strongly Agree	23 (47.9)	26(65.0)	12 (50.0)	Strongly Agree	12 (25.0)	10 (25.0)	06 (25.0)
p-value =0.378				p-value =0.187			

Table (2)

Comparison of Mean Score – students' responses on 14 items:

	Year 1 Mean ± S.D n=48	Year 2 Mean ± S.D n=40	Year 3 Mean ± S.D n=24	p-value
Mean Scores	2.85 ± 0.60	3.09 ± 0.42**	3.12 ± 0.35**	0.040*

*statistically significant at 5% level of significance
**LSD significant multiple comparisons (year 1 with year 2&3)

Discussion:

The students in a medical school are adult learners and PBL is an appropriate teaching learning methodology for such learners. In this study, we studded perception of medical students about various aspects of PBL. The Problem based learning is based on information processing theory, where the new knowledge is constructed upon the existing knowledge and it is itself derived from the constructivist educational theory [9]. Studies have shown that there is a difference in

students' perception about PBL in a traditional curriculum where it is adopted as a new learning methodology and a curriculum where PBL is included from the beginning [10]. This study showed that majority of the students in all three years responded that PBL facilitates auditory learning with read and write. As discussed in results, PBL as teaching and learning method is a valid tool for facilitating auditory learning, around 25.9 % of students strongly agreed and 53.6 % agreed to it. For developing reading and writing skills, 33.9% students strongly agreed and 46.4 % agreed, PBL as reliable tool. On the part of facilitating kinesthetic learning, 31.3% students strongly disagreed, 24% students disagreed that it would be achieved by PBL. For the facilitation of visual and spatial learning by PBL, around 38% students strongly disagreed and 20.5% disagreed. Our finding is supported by the study of Alkhasawneh et al. (2008) which showed that there was increase in VARK score post-test after PBL than pre-test. Each session of PBL involves a discussion among the group members so auditory learning is facilitated. Between the sessions of PBL the students have to go through lot of text material in order to cover the learning objectives, this has a role in facilitation of read/write learning. The visual learning can be enhanced in PBL sessions by the inclusion of pictures, diagrams etc. in the case scenario or the using concept maps for achieving learning objectives. As Hsu cited the use of concept maps in discussion part of PBL and has reported it as quite beneficial. Similarly kinesthetic learning can be facilitated by applying role-play, demonstration etc. in the given problem or learning objective [10].

This study shows that the students perceive positive impact of PBL on self-development like self-confidence and interpersonal skills. Most students (56.3%) strongly agreed and 35.7% agreed to the statement that PBL helped in developing verbal/linguistic skills and self-confidence. Similarly, 54.9% students strongly agreed and 33.9% agreed that PBL facilitates in development of interpersonal skills. These findings are consistent with Stokes et al. (1997); he reported that interpersonal, leadership and metacognitive skills were required during the PBL experience. Creativity, teamwork, self-management, communication and problem-solving skills were also enhanced. Huang in

his study reported that 80% of the students perceived that PBL was more interactive than their own learning style [12]. Dochy et al [13] referred seven classical steps of solving PBL, in which only step six supports individual activity while all other steps are collaborative activities with focus on sharing of knowledge.

Our study shows that PBL has significantly positive effect on learning behavior like deep learning, advantage of multiple feedback and positive modification of attitude towards leaning. 36.6% students strongly agreed while about 50% of them agreed to the perception that PBL provides opportunity for peer teaching and peer feedback; and 25.0% students strongly agreed while 36.6% agreed that PBL modified their attitude towards learning, this finding is consistent with Chung and Chow reported that the students' perceived that PBL helped them develop the self-evaluation skills [14]. Kilroy stated that the PBL learning clinical reasoning process and self-directed learning skills. He further stated that PBL increases the self-motivation in students by helping them identifying their learning needs [9]. Dochy et al stated that PBL was developed in order to instill in students the skills of professionalism such as problem solving, analysis, synthesis and evaluation [13].

Development of deeper understanding is one of the key features of Problem based learning [15]. A review conducted by Azer [16] showed that usage of multiple resources such lectures, basic medical sciences museum, practical's, web based programmes, students seminars etc. as learning resource for PBL sessions would facilitate in building in depth understanding of complex concepts. The findings of this study showed similar results that around 43% students strongly agreed and 36 % agreed on stimulation of deep learning by Problem based learning. In our settings, the students are using multiple resources for PBL sessions. It was suggested that a well-aligned learning resource facilitates deep learning in PBL session [17].

In our study, it was found that 40 % students strongly agreed and 38 % students agree for achieving curriculum outcomes by using Problem based learning as teaching and learning method. Studies showed that learning environment plays important role for achieving high quality learning outcomes

by any teaching and learning method [18]. Study conducted by Ruiz-Gallardo et al. [19] reported positive correlation between students' performance and Problem based learning as teaching and learning tool. The focus for the integration is stressed from long time in medical education and integrated curricula are widely implemented word wide in medical education [20]. The integration of the disciplines of same level is termed as horizontal integration such as integrating biochemistry, anatomy and physiology in initial years of medical schools [21]. Our study showed that 32% strongly agreed and 43% agreed that PBL session facilitates horizontal integration. Hasan stressed that using well designed PBL in system-based modules would facilitate horizontal integration [22]. AMEE guide number 96 stressed that key role of integration is to remove the barrier between basic medical sciences and clinical sciences i.e., to facilitate the process of vertical integration [20]. The results of this study reflects 38% strongly agreed and 37 % agreed that Problem based learning facilitates vertical integration. The college of Medicine, Majmaah applied spiral curricula that reflect both horizontal and vertical integration. Several studies Schelton and Smidt, 1998) have suggested that students perceive that PBL helps them integrate theory and practice in a better way [23, 24, and 25]. Comparing mean score of students' responses gave a p value of 0.040.

Limitations:

First, this study has small number of the sample because only three batches were available during the study period. With due time, more number of batches will be available who have finished or attended Phase II of the curriculum. Second, only male students were included in our study, as female college was not started at that time.

Conclusion:

The study concluded that PBL helps in increasing students' self-confidence and interpersonal skills. Positive perception about PBL for learning behavior showed that PBL sessions help the students to become lifelong learners. The positive impact of PBL on curriculum strategies will encourage the administrators and the educators that their efforts are in the right direction. The result of this study shows that PBL facilitates all

learning modes although visual and kinesthetic modes do not have much encouraging trend. The visual learners can be facilitated by including diagrams and charts in the problem scenario and concept maps, flow charts for discussion session. Similarly bringing models and specimens for anatomy, physiology and pathology can facilitate the kinesthetic learning. Usage of role-play as problem scenario and its demonstration for framing learning objectives will be appropriate maneuver for promoting kinesthetic learning.

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