

Effectiveness of problem-based learning strategies compared to conventional anatomy teaching approaches

Quratulain Javaid, Ambreen Usmani

Abstract

Objective: To determine the effectiveness of problem-based learning compared to conventional teaching strategies, and to determine the impact of sub-disciplines of Anatomy on learning outcomes of the subject.

Method: The cross-sectional, descriptive study was conducted at Bahria University Health Sciences, Karachi, from August to October 2022, and comprised 1st and 2nd year medical students and 1st year dental students of either gender who were being taught by the hybrid method including both conventional and problem-based learning strategies. Data was collected using a questionnaire circulated through Google Forms. It had close-ended questions that were scored on a Likert scale. Anatomy sub-disciplines explored were gross, embryology and histology. Data was analysed using SPSS 23.

Results: Of the 251 subjects, 125(49.8%) were males and 126(50.2%) were females. The overall age ranged aged 18-23 years. There were 115(45.8%) 1st year medical students, 111(44.2%) 2nd year medical students and 25(10%) 1st year dental students. Among 1st year medical students 60(52.17%), among 2nd year medical students 64(57.6%) and among 1st year dental students 14(56%) respondents favoured problem-based learning compared to conventional methodology. Highly significant results were obtained regarding need of topic revision ($p < 0.001$), whether knowledge of conventional teaching method is enough for understanding the clinical scenarios ($p = 0.017$), whether pictures shown during the problem-based learning sessions were enough for understanding anatomy ($p = 0.035$), relevance of questions in oral structured practical examination ($p = 0.019$) and viva ($p = 0.002$). When the participants were asked regarding the anatomy sub-discipline that required revision for comprehensive learning, 72(28.3%) mentioned gross anatomy.

Conclusion: Students considered problem-based learning to be more inductive in enhancing learning compared to conventional teaching.

Key Words: Problem-based learning strategies, Conventional anatomy, Teaching approaches.

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Introduction

Problem-based learning (PBL) is a teaching modality that is used to incorporate both the clinical as well as basic science subjects. It has been postulated that the conventional teaching methods (CTM) is better for teaching anatomy than the PBL method, but it is still a matter of disagreement. A study in the Netherlands found that knowledge of anatomy after PBL teaching was not lower than the CTM approach¹ Integrated teaching has become a part of medical curriculum for teaching of undergraduate medical students. The curriculum is collaborated both vertically and horizontally to enhance knowledge dissemination. Students' learning improved when integrated teaching methods were adopted, as it has a vitality both for the present and future medical

years.² A study in China mentioned that team-based learning (TBL) is different from CTM. The research documented that learning, collaboration, enthusiasm towards the subject, communication and ability of learning improved significantly in a TBL compared to CTM where students learn individually on their own. Furthermore, capacity of generalisation, mutual collaboration and expression of knowledge were also found to increase with TBL.³ In a study comprising first year Doctor of Physical Therapy (DPT) students reported better anatomical knowledge after a PBL workshop compared to a group of controls.⁴

The topic of effectiveness of PBL over CTM, or vice versa, remains controversial. A review study showed that PBL does not have an advantage or a disadvantage compared to CTM. It has been postulated that some students believe that PBL increases their knowledge, creativity and interest, while others reflected that integrated learning method took longer than the conventional one.⁵ A study documented that PBL was considered to be a good medium for learning by majority of students.⁶ Another

Department of Anatomy, Bahria University Health Sciences, Karachi, Pakistan

Correspondence: Quratulain Javaid. Email: docannie2010@gmail.com

ORCID ID. 0000-0002-2858-2896

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study mentioned the importance of PBL use in imparting anatomical knowledge other than the use of cadavers.⁷

One study mentioned various deficiencies in anatomy teaching, curriculum and design. The learning deficiencies due to CTM can be of major problems in the clinical years and professional lives of the medical students.⁸

The current study was planned to determine the effectiveness of PBL compared to CTM, and to determine the impact of sub-disciplines of Anatomy on learning outcomes of the subject.

Subjects and Methods

The cross-sectional, descriptive study was conducted at Bahria University Health Sciences, Karachi, from August to October 2022. After approval from the institutional ethics review committee, the sample size was calculated using OpenEpi version 3.6⁹ Purposive sampling method was used to recruit participants after acquiring informed consent and voluntary participation in research. Additional participants were recruited to ensure account for possible dropouts. Those included were 1st and 2nd year students of Bachelor of Medicine, Bachelor of Surgery (MBBS), and 1st year students of Bachelor of Dental Surgery (BDS) who were being taught by the hybrid method including both CTM and PBL strategies. Students being taught by CTM only were excluded.

Data was collected using a questionnaire circulated through Google Forms. It had close-ended questions that were scored on a Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. The domains assessed were impact of PBL on Anatomy learning, impact of CTM on Anatomy learning, and how the teaching and learning of gross, embryology and histology sub-disciplines of Anatomy impacted undergraduate students. Confidentiality of data was maintained throughout the study.

Data was analysed using SPSS 23. Chi-square test was used to compare the impact of different modes of teaching on Anatomy learning, and its association with education background, gender, and the year of study. Data was expressed as frequencies and percentages. $P \leq 0.05$ was considered significant.

Results

Of the 251 subjects, 125(49.8%) were males and 126(50.2%) were females. The overall age ranged aged 18-23 years. There were 115(45.8%) 1st year medical students, 111(44.2%) 2nd year medical students and 25(10%) 1st year dental students.

Table-1: Demographic data.

Variables	Response Counts (Percentage)
Year of study	
1st year MBBS	115 (45.8%)
2nd year MBBS	111 (44.2%)
1st year BDS	25 (10%)
Profession of parents	
Both parents are doctors	3 (1.2%)
Only one parent is a doctor	17 (6.8%)
Other than medical profession	202 (80.5%)
Educational board	
Matric	234 (93.2%)
O-level	20 (8%)
Residence	
Day-scholar	35 (13.9%)
Hostelite	207 (82.5%)

MBBS: Bachelor of Medicine, Bachelor of Surgery, BDS: Bachelor of Dental Surgery.

Among 1st year medical students 60(52.17%), among 2nd year medical students 64(57.6%) and among 1st year dental students 14(56%) respondents favoured PBL over CTM.

When asked whether the teaching strategies had an effect on individual learning, significant results were obtained for PBL ($p < 0.05$), while for CTM the results were non-significant ($p > 0.05$).

Regarding whether the time duration for understanding difficult concepts was enough, both for conventional and PBL based teaching, students belonging to 1st and 2nd year MBBS were mostly on the same page while BDS students differed (Table 2).

Regarding the requirement of revision post-lecture, the results were not significant for PBL ($p > 0.05$), but were highly significant for CTM ($p = 0.001$). When asked whether pictures shown during PBL sessions were enough for understanding Anatomy, the responses were not significant ($p > 0.05$), but were significant ($p = 0.035$) for CTM.

When students were asked regarding PBL and relevance of questions in various modes of examinations, including viva, short answer questions (SAQ) and oral structured practical examination (OSPE), non-significant results were noted for all ($p > 0.05$) except OSPE ($p = 0.048$). For CTM, significant results were noted for OSPE ($p = 0.019$) and viva ($p = 0.002$) (Table 2). The students differed in their opinions regarding the relevance of teaching methodologies and examination questions based on best-choice questions (BCQs) both for PBL and CTM (Figure 1).

When asked about the Anatomy sub-discipline that has

Table-2: Impact of PBL and conventional teaching methods on undergraduate students.

PBL Questions	Likert's scale	Year of study			p value
		1 st year MBBS Counts (Percentage)	2 nd year MBBS Counts (Percentage)	1 st year BDS Counts (Percentage)	
The time duration is enough for understanding the difficult concepts	Strongly disagree	7 (6%)	5 (4.5%)	2 (8%)	0.972
	Disagree	8 (6.9%)	12 (10.9%)	3 (12%)	
	Neutral	30 (25.9%)	30 (27.3%)	6 (24%)	
	Agree	34 (29.3%)	28 (25.5%)	6 (24%)	
	Strongly agree	37 (31.9%)	35 (31.8%)	8 (32%)	
The time duration should have been more	Strongly disagree	32 (27.6%)	28 (25.5%)	4 (16%)	0.831
	Disagree	25 (21.6%)	27 (24.5%)	6 (24%)	
	Neutral	25 (21.6%)	26 (23.6%)	7 (28%)	
	Agree	16 (13.8%)	15 (13.6%)	6 (24%)	
	Strongly agree	18 (15.5%)	14 (12.7%)	2 (8%)	
It enhances individual learning	Strongly disagree	8 (6.9%)	6 (5.5%)	4 (16%)	0.015*
	Disagree	8 (6.9%)	21 (19.1%)	4 (16%)	
	Neutral	24 (20.7%)	23 (20.9%)	4 (16%)	
	Agree	50 (43.1%)	27 (24.5%)	10 (40%)	
	Strongly agree	26 (22.4%)	33 (30%)	3 (12%)	
Intercommunication skills are increased	Strongly disagree	3 (2.6%)	6 (5.5%)	1 (4%)	0.228
	Disagree	6 (5.2%)	10 (9.1%)	3 (12%)	
	Neutral	17 (14.7%)	26 (23.6%)	5 (20%)	
	Agree	46 (39.7%)	26 (23.6%)	6 (24%)	
	Strongly agree	44 (37.9%)	42 (38.2%)	10 (40%)	
Teachers are able to facilitate sufficient knowledge during the time slot	Strongly disagree	4 (3.4%)	6 (5.5%)	2 (8%)	0.177
	Disagree	16 (13.8%)	13 (11.8%)	1 (4%)	
	Neutral	24 (20.7%)	32 (29.1%)	7 (28%)	
	Agree	45 (38.8%)	27 (24.5%)	5 (20%)	
	Strongly agree	27 (23.3%)	32 (29.1%)	10 (40%)	
Revision of the topic is required after the session for better understanding	Strongly disagree	2 (1.7%)	3 (2.7%)	0 (0%)	0.678
	Disagree	10 (8.6%)	10 (9.1%)	0 (0%)	
	Neutral	17 (14.7%)	22 (20%)	4 (16%)	
	Agree	33 (28.4%)	32 (29.1%)	10 (40%)	
	Strongly agree	54 (46.6%)	43 (39.1%)	11 (44%)	
The knowledge during the session is enough for correlating with the clinical aspects given in the text book	Strongly disagree	4 (3.4%)	7 (6.4%)	3 (12%)	0.772
	Disagree	17 (14.7%)	16 (14.5%)	5 (20%)	
	Neutral	35 (30.2%)	31 (28.2%)	4 (16%)	
	Agree	38 (32.8%)	35 (31.8%)	8 (32%)	
	Strongly agree	22 (19%)	21 (19.1%)	5 (20%)	
Anatomical pictures/radiograph shown during the session are enough and suitable for learning	Strongly disagree	10 (8.6%)	11 (10%)	2 (8%)	0.906
	Disagree	17 (14.7%)	17 (15.5%)	3 (12%)	
	Neutral	32 (27.6%)	35 (31.8%)	5 (20%)	
	Agree	36 (31%)	27 (24.5%)	10 (40%)	
	Strongly agree	21 (18.1%)	20 (18.2%)	5 (20%)	
The questions asked in VIVA are relevant and easy to understand as per the learning style	Strongly disagree	2 (1.7%)	7 (6.4%)	2 (8%)	0.157
	Disagree	13 (11.2%)	13 (11.8%)	3 (12%)	
	Neutral	29 (25%)	40 (36.4%)	7 (28%)	

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	Likert's scale	Year of study			p value
		1 st year MBBS	2 nd year MBBS	1 st year BDS	
The questions asked in SAQs are relevant and easy to understand as per the learning style	Agree	54 (46.6%)	33 (30%)	7 (28%)	0.894
	Strongly agree	18 (15.5%)	17 (15.5%)	6 (24%)	
	Strongly disagree	2 (1.7%)	4 (3.6%)	1 (4%)	
	Disagree	11 (9.5%)	12 (10.9%)	3 (12%)	
	Neutral	28 (24.1%)	31 (28.2%)	7 (28%)	
The questions asked in OSPE are relevant and easy to understand as per the learning style	Agree	56 (48.3%)	41 (37.3%)	10 (7%)	0.048*
	Strongly agree	19 (16.4%)	22 (20%)	4 (16%)	
	Strongly disagree	2 (1.7%)	1 (0.9%)	2 (8%)	
	Disagree	9 (6.9%)	5 (4.5%)	1 (4%)	
	Neutral	23 (19.8%)	36 (32.7%)	10 (40%)	
Conventional Teaching Questions	Agree	52 (44.8%)	51 (46.4%)	8 (32%)	
	Strongly agree	31 (26.7%)	17 (15.5%)	4 (16%)	
	Strongly disagree	2 (1.7%)	7 (6.4%)	2 (8%)	
	Disagree	11 (9.5%)	10 (9.1%)	4 (16%)	
	Neutral	30 (25.9%)	39 (35.5%)	8 (32%)	
The time duration is enough for understanding the difficult concepts	Agree	49 (42.2%)	37 (33.6%)	9 (36%)	0.285
	Strongly agree	24 (20.7%)	17 (15.5%)	2 (8%)	
	Strongly disagree	15 (12.9%)	14 (12.7%)	2 (8%)	
	Disagree	16 (13.8%)	14 (12.7%)	6 (24%)	
	Neutral	30 (25.9%)	42 (38.2%)	7 (28%)	
The time duration should have been more	Agree	30 (25.9%)	26 (23.6%)	7 (28%)	0.404
	Strongly agree	25 (21.6%)	14 (12.7%)	3 (12%)	
	Strongly disagree	5 (4.3%)	5 (4.5%)	2 (8%)	
	Disagree	13 (11.2%)	15 (13.6%)	6 (24%)	
	Neutral	34 (29.3%)	38 (34.5%)	6 (24%)	
It enhances individual learning	Agree	40 (34.5%)	36 (32.7%)	7 (28%)	0.696
	Strongly agree	24 (20.7%)	16 (14.5%)	4 (16%)	
	Strongly disagree	9 (7.8%)	8 (7.3%)	2 (8%)	
	Disagree	18 (15.5%)	18 (16.4%)	3 (12%)	
	Neutral	37 (31.9%)	43 (39.1%)	9 (36%)	
Intercommunication skills are increased	Agree	30 (25.9%)	26 (23.6%)	5 (20%)	0.926
	Strongly agree	22 (19%)	15 (13.6%)	6 (24%)	
	Strongly disagree	2 (1.7%)	2 (1.8%)	2 (8%)	
	Disagree	7 (6%)	6 (5.5%)	2 (8%)	
	Neutral	31 (26.7%)	40 (36.4%)	9 (36%)	
Teachers are able to impart sufficient knowledge during the time slot	Agree	54 (46.6%)	43 (39.1%)	7 (28%)	0.456
	Strongly agree	22 (19%)	19 (17.3%)	5 (20%)	
	Strongly disagree	0 (0%)	4 (3.6%)	1 (4%)	
	Disagree	5 (4.3%)	9 (8.2%)	3 (12%)	
	Neutral	21 (18.1%)	41 (37.3%)	6 (24%)	
Revision of the topic is required after the session for better understanding	Agree	42 (36.2%)	38 (34.5%)	7 (28%)	0.001**
	Strongly agree	48 (41.4%)	18 (16.4%)	8 (32%)	
	Strongly disagree	5 (4.3%)	2 (1.8%)	0 (0%)	
	Disagree	5 (4.3%)	9 (8.2%)	3 (12%)	
	Neutral	21 (18.1%)	41 (37.3%)	6 (24%)	
The knowledge during the session is enough for correlating with the clinical aspects given in the text book	Strongly disagree	5 (4.3%)	2 (1.8%)	0 (0%)	0.017*

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	Disagree	5 (4.3%)	4 (3.6%)	4 (16%)	
	Agree	45 (38.8%)	43 (39.1%)	5 (20%)	
	Strongly agree	28 (24.1%)	19 (17.3%)	3 (12%)	
Anatomical pictures/radiograph shown during the session are enough and suitable for learning	Strongly disagree	5 (4.3%)	2 (1.8%)	0 (0%)	0.035*
	Disagree	5 (4.3%)	4 (3.6%)	4 (16%)	
	Neutral	33 (28.4%)	42 (38.2%)	13 (52%)	
	Agree	45 (38.8%)	43 (39.1%)	5 (20%)	
	Strongly agree	28 (24.1%)	19 (17.3%)	3 (12%)	
The questions asked in VIVA are relevant and easy to understand as per the teaching style	Strongly disagree	4 (3.4%)	1(0.9%)	3 (12%)	0.002**
	Disagree	5 (4.3%)	10 (9.1%)	3 (12%)	
	Neutral	24 (20.7%)	45 (40.9%)	6 (24%)	
	Agree	56 (48.3%)	35 (31.8%)	9 (36%)	
	Strongly agree	27 (23.3%)	19 (17.3%)	4 (16%)	
The questions asked in SAQs are relevant and easy to understand as per the teaching style	Strongly disagree	1 (0.96%)	1 (0.9%)	2 (8%)	0.154
	Disagree	8 (.9%)	8 (7.3%)	3 (12%)	
	Neutral	28 (24.1%)	37 (33.6%)	7 (28%)	
	Agree	53 (45.7%)	44 (40%)	7 (28%)	
	Strongly agree	26 (22.4%)	20 (18.2%)	6 (24%)	
The questions asked in OSPE are relevant and easy to understand as per the teaching style	Strongly disagree	2 (1.7%)	0 (0%)	2 (8%)	0.019*
	Disagree	4 (3.4%)	9 (8.2%)	2 (8%)	
	Neutral	29(25%)	37 (33.6%)	7 (28%)	
	Agree	48 (41.4%)	49 (44.5%)	9 (36%)	
	Strongly agree	33 (28.4%)	15 (13.6%)	5 (20%)	

PBL: Problem-based learning, MBBS: Bachelor of Medicine, Bachelor of Surgery, BDS: Bachelor of Dental Surgery. p value significant $\leq 0.05^*$, highly significant $\leq 0.001^{**}$

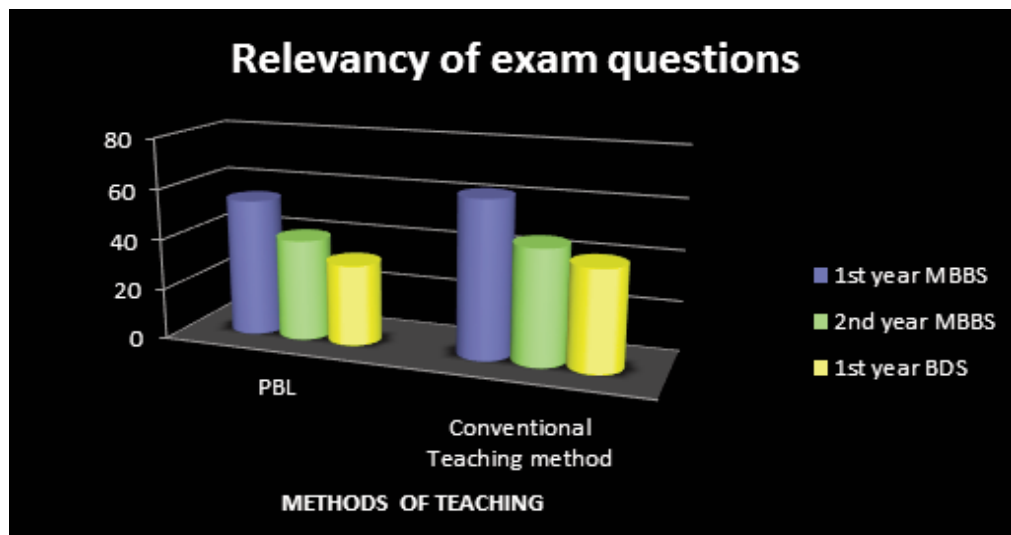


Figure-1: Relevancy of exam questions asked in best-choice questions (BCQs) according to teaching methodology.

PBL: Problem-based learning

created enthusiasm towards learning, participants gave variable responses (Figure 2). The sub-discipline that was easier to comprehend was gross anatomy for 78(31.1%) students overall, followed by embryology 27(10.8%) and

histology 25(10%), while 29(11.6%) students mentioned the combination of gross anatomy and embryology, 20(8%) gross anatomy and histology and 3(1.2%) histology and embryology.

When questioned regarding the subject that required more time for understanding the difficult concepts, 73(29.1%) opted for embryology, followed by gross anatomy 69(27.5%) and histology 26(10.4%), while 23(9.2%) mentioned all the three sub-

disciplines, 21(8.4%) mentioned gross anatomy and embryology, 20(8%) gross anatomy and histology, and 11(4.4%) chose histology and embryology.

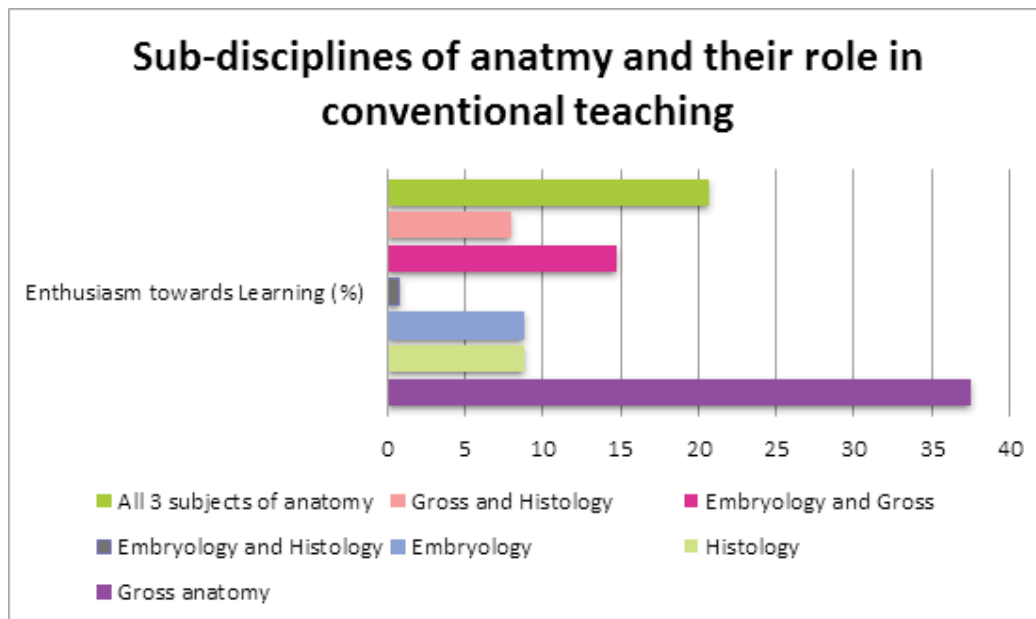


Figure-2: Anatomy sub-disciplines and their role in the development of enthusiasm towards learning by conventional teaching method.

When the participants were asked regarding the subject that required revision of topic for comprehensive learning, 72(28.3%) chose gross anatomy, followed by 36(14.3%) embryology and 22(8.8%) histology, while 32(12.4%) opted for gross anatomy and embryology, 11(4.4%) for histology and embryology, and 10(4%) for gross anatomy and histology.

When the participants were asked regarding which sub-discipline's examination questions were according to the teaching content taught, 60(23.9%) chose gross anatomy, followed by 32(12.4%) histology and 18(7.2%) embryology, while 34(13.5%) opted for the combination of gross anatomy and histology, 21(8.4%) for gross anatomy and embryology, and 6(2.4%) for histology and embryology.

Discussion

The current study showed that students considered PBL more effective in understanding the concepts of anatomy compared to CTM, which was in line with studies conducted in a variety of settings globally¹⁰⁻¹³.

PBL plays significant role in the development of different sets of essential skills compared to didactic lectures. The current study suggested that PBL helped in the development of interpersonal skills, which endorsed earlier findings.¹⁴

In the current study, MBBS students thought that time for Anatomy course and curriculum was enough, while BDS students differed. Mutalik et al. mentioned that with the

passage of time Anatomy curriculum is given less time, and, therefore, proficiency of the clinicians in the subject is affected.¹⁵ Similarly, a study on Polish students mentioned that Anatomy curriculum needed more time along with the adoption of better teaching modalities so that future clinicians may retain more anatomical knowledge and be more efficient in their work.¹⁶

The present study revealed that the students thought

there was a strong need for revision as the topics covered in Anatomy classes were extensive. Parallel results were documented earlier.^{17,18}

The current study revealed that majority of students appreciated the usage of pictures and radiographs in both PBL and CTM. Mutalik et al. also documented that 68% of their students were in favour of radiological anatomy.¹⁵ The current study found that the clinical implications of Anatomy topics can be better understood by CTM than PBL. Sarkar et al. reported comparable results.¹⁹

The current study showed that majority of students were satisfied with the questions asked in various types of examinations, like SAQs, BCQs and OSPEs, and the way the topics were taught. While 1st year MBBS students believed that viva questions were in line with they had been taught in CTM, majority of 2nd year MBBS and BDS students differed. Sadeesh et al. mentioned that 61.4% students were satisfied with gross anatomy viva questions, while 82% were satisfied with embryology questions.²⁰ Srivastava et al. mentioned that 44.6% of students were satisfied with the mode of assessment in examinations.²¹ A study revealed that students preferred OSPE examination more than viva examination, as there is no examiner stress, no bias, and enough time to think and come up with the correct answer.²²

The current study revealed that the students considered embryology a subject that required more time for deeper

understanding, followed by gross anatomy. Perhaps, they found the developing anatomy more complicated than the other sub-disciplines of Anatomy. Analogous results were reported by an earlier study, according to which, medical students found more difficulty in studying and learning gross anatomy, while BDS students found embryology more difficult.²³

In the current study, the students found gross anatomy to be the easiest subject, followed by embryology and histology. A study revealed that students faced the most difficulty in studying embryology, followed by gross anatomy and histology.²⁴ The current students were of the opinion that, gross anatomy teaching was mostly relevant to the questions asked in various modalities of exams, followed by histology and embryology. Waseem et al.²⁵ reported contradictory results and documented that students ranked histology as less relevant compared to gross anatomy and histology. The students generally think that histology will not help them in their future years.²³ They are also not generally happy about having to draw histological diagrams.²⁴ In the current study also, the students found gross anatomy questions asked in exams to be more in line with what they had been taught, followed by histology and embryology. Qamar et al. mentioned similar results regarding gross anatomy.²⁶

The current study highlighted a detailed comparison between PBL and CTM as perceived by medical and dental students. The findings, however, have limited generalisability because they are based on single-centre data and with a small sample size.

There is no one single best methodology that can be adopted to teach Anatomy. The curriculum and teaching modalities have to be trimmed or added according to the need of the day, and also according to the learning abilities of the students. The current study portrayed a snapshot of how the two modalities impact students' Anatomy learning. The learning and memorisation of anatomical structural knowledge depend on various factors in which one of the factors is teaching modality. Other factors could be prior education of students, and the availability of manpower, like talented and experienced teachers. Also, resources play a crucial role. The new approaches, like PBL, require specialised setups with extra space for the sessions, added stationery, trained faculty, etc. Although the current study as well global research do favour PBL as the better approach to learning Anatomy, the availability of resources still favour CTM in resource-constrained settings

Conclusion

The students considered PBL to be more inductive in

enhancing learning compared to CTM. PBL plays an imperative role in developing intercommunication skills. The students CTM appropriate for understanding clinical implications. They regarded relevance between CTM and questions asked in OSPE and viva examinations. Gross anatomy was most reported to be interesting and the easiest to understand compared to histology and embryology.

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References

1. Prince KJ, Van Mameren H, Hylkema N, Drukker J, Scherpbier AJ, Van Der Vleuten CP. Does problem-based learning lead to deficiencies in basic science knowledge? An empirical case on anatomy. *Med Educ.* 2003; 37:15-21. doi: 10.1046/j.1365-2923.2003.01402.x.
2. Johnston S, Vaughan B. We need one more hour solely based on anatomy... Give us anatomy!': Early-year learner perceptions of anatomy within an integrated & case-based learning osteopathy curriculum. *Int J Osteopath Med.* 2020; 36:49-54. doi:10.1016/j.ijosm.2020.02.001
3. Yan J, Ding X, Xiong L, Liu E, Zhang Y, Luan Y, et al. Team-based learning: assessing the impact on anatomy teaching in People's Republic of China. *Adv Med Educ Pract.* 2018; 9:589-94. doi: 10.2147/AMEP.S169949
4. Bains M, Kaliski DZ. An anatomy workshop for improving anatomy self-efficacy and competency when transitioning into a problem-based learning, Doctor of Physical Therapy program. *Adv Physiol Educ.* 2020; 44:39-49. doi: 10.1152/advan.00048.2019.
5. Williams JM. Is Student Knowledge of Anatomy Affected by a Problem-Based Learning Approach? A Review. *J Educ Train Stud.* 2014; 2:108-12. doi:10.11114/jets.v2i4.509
6. Okoye HC, Meka IA, Ugwu AO, Yahaya IA, Otokunfor O, Ojo OO, et al. Perception of problem based learning versus conventional teaching methods by clinical medical students in Nigeria. *Pan Afr Med J.* 2019; 33:1-6. doi: 10.11604/pamj.2019.33.311.19169.
7. Krishnaveni S, Rahe R, Johnson WM. A comparative study on analysis of various teaching learning methodologies in anatomy. *Int J Anat Res.* 2019; 7:7029-32.
8. Kumar R, Singh R. Model pedagogy of human anatomy in medical education. *Surg Radiol Anat.* 2020; 42:355-65. doi: 10.1007/s00276-019-02331-7.
9. Dean AG, Sullivan KM, Soe MM. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version. www.OpenEpi.com, updated 2013/04/06, accessed 03/12/2023.
10. Nair SK, Rai N. Comparing the effectiveness of case based learning with conventional teaching in anatomy. *Acad Anat Int.* 2019; 5:34-6.
11. Al-Madi EM, Celur SL, Nasim M. Effectiveness of PBL methodology in a hybrid dentistry program to enhance students' knowledge and confidence. (a pilot study). *BMC Med Educ.* 2018; 18:1-6. doi: 10.1186/s12909-018-1392-y.
12. Rahmatika H, Lestari SR, Sari MS. A PBL-based circulatory system e-module based on research results to improve students' critical thinking skills and cognitive learning outcome. *J Pendidik IPA Indones.* 2020; 9:565-75. DOI: 10.23887/jpi-undiksha.v9i4.25647
13. Alfalah SF, Falah JF, Alfalah T, Elfalah M, Muhaidat N, Falah O. A comparative study between a virtual reality heart anatomy

- system and traditional medical teaching modalities. *Virtual Real.* 2019; 23:229-34. DOI: 10.1007/s10055-018-0359-y
14. Bolla SR, Saffar RA. Anatomy teaching in Saudi medical colleges-is there necessity of the national core syllabus of anatomy. *Anat Cell Biol.* 2022; 55:367-72. doi: 10.5115/acb.22.041
 15. Mutalik M, Belsare S. Methods to learn human anatomy: perceptions of medical students in paraclinical and clinical phases regarding cadaver dissection and other learning methods. *Int J Res Med Sci.* 2016; 4:2536-41. DOI: 10.18203/2320-6012.ijrms20161888
 16. Holda MK, Stefura T, Koziej M, Skomarovska O, Jasińska KA, Salabun W, et al. Alarming decline in recognition of anatomical structures amongst medical students and physicians. *Ann Anat.* 2019; 221:48-56. DOI: doi:10.1016/j.aanat.2018.09.004
 17. Holla SJ, Ramachandran K, Isaac B, Koshy S. Anatomy education in a changing medical curriculum in India: Medical student feedback on duration and emphasis of gross anatomy teaching. *Anat Sci Educ.* 2009; 2:179-83. doi: 10.1002/ase.79.
 18. Hall S, Stephens J, Parton W, Myers M, Harrison C, Elmansouri A, et al. Identifying medical student perceptions on the difficulty of learning different topics of the undergraduate anatomy curriculum. *Med Sci Educ.* 2018; 28:469-72.
 19. Sarkar S, Sharma S, Raheja S. Implementation of Blended Learning Approach for Improving Anatomy Lectures of Phase I MBBS Students—Learner Satisfaction Survey. *Adv Med Educ Pract.* 2021; 12:413-20. doi: 10.2147/AMEP.S301634
 20. Sadeesh T, Prabavathy G, Ganapathy A. Evaluation of undergraduate medical students' preference to human anatomy practical assessment methodology: a comparison between online and traditional methods. *Surg Radiol Anat.* 2021; 43:531-5. doi: 10.1007/s00276-020-02637-x.
 21. Srivastava A, Singh A. Perception and feedback of medical students about teaching methods in anatomy. *Indian J Clin Anat Physiol.* 2020; 7:104-9. DOI:10.18231/j.ijcap.2020.022
 22. Rokade SA, Mane AK. Objective structured practical examination (OSPE) versus viva voce: the Indian students' and faculty perception. *South-East Asian J Med Educ.* 2019; 13:17-24.
 23. Anjum A, Mahmood R, Qureshi HA, Alam MA, Qadeer M, Rathore A, et al. Learning Anatomy from YouTube: Perception of Medical and Dental Students. *Int Medical J.* 2022; 29:266-8.
 24. Qamar K, Bashir S, Khalid R, Abaid M, Khadim R. Reasons for difficult topics in anatomy and their solutions as per undergraduate medical students. *Khyber Med Univ J.* 2021; 13:161-5. doi: 10.35845/kmuj.2021.21177
 25. Waseem N, Rasheed A, Gill M, Asad A, Shamim MO, Waseem F. The attitudes of medical students towards clinical relevance of histology. *Pak Armed Forces Med J.* 2021; 28:351-6. DOI: <https://doi.org/10.51253/pafmj.v71i1.3756>
 26. Qamar K, Saleem S, Ali H, Khan MA, Ambreen F, Khan SA. Do practical gross anatomy exams affect the overall performance of students? a mix study. *Rawal Med J.* 2018; 43:747-50.

Author's Contributions

QJ: Conception and design, analysis, interpretation of data, drafting, final approval, accountable for all aspects of work.

AU: Conception, critical revision, accountable for all aspects of work.