

Medical imaging in problem-based learning and impact on the students: A cross-sectional study

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Abstract

Objective: To investigate the medical students' performance with and perception towards different multimedia medical imaging tools.

Method: The cross-sectional study was conducted at the College of Medicine, Qassim University, Saudi Arabia, from 2019 to 2020, and comprised third year undergraduate medical students during the academic year 2019-2020. The students were divided into two groups. Those receiving multimedia-enhanced problem-based learning sessions were in intervention group A, while those receiving traditional problem-based learning sessions were in control group B. Scores of the students in the formative assessment at the end of the sessions were compared between the groups. Students' satisfaction survey was also conducted online and analysed. Data was analysed using SPSS 21.

Result: Of the 130 medical students, 75(57.7%) were males and 55(42.3%) were females. A significant increase in the mean scores was observed for both male and female students in group A compared to those in group B ($p < 0.05$). The perception survey was filled up by 100(77%) students, and open-ended comments were obtained from 88(88%) of them. Overall, 69(74%) subjects expressed satisfaction with the multimedia-enhanced problem-based learning sessions.

Conclusions: Radiological and pathological images enhanced the students' understanding, interaction and critical thinking during problem-based learning sessions.

Keywords: Radiological images, PBL sessions, Medical students, Qassim University, Medical imaging.

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Introduction

Problem-based learning (PBL) is one of the pedagogical learning methodologies and allows more critical thinking and problem-solving. The tutor's role during PBL sessions is to guide and facilitate the open discussion and to encourage interpersonal communication.¹ An introductory session allows brainstorming related to prior knowledge of the students, sharing information and formulating their own intended learning outcomes. This is followed by individual and group study. Later, the students present their collaborative work during a discussion session.² One of the advantages of PBL is that it provides the future physicians with the skills needed to integrate basic and clinical knowledge in order to arrive at the accurate diagnosis. In addition, it promotes their ability to select the relevant diagnostic test and to avoid the unnecessary ones.^{3,4} A meta-analysis detected that students' interaction in small groups enhanced their engagement, especially in clinical situations. It offered them a productive experience and sources of information, enabling independent learning and peer-sharing of knowledge.⁴

PBL depends on learning through exploration, which is influenced by students' activities and interaction. Therefore, students' interest is the driving force.^{1,5} The use of multimedia in PBL activities promotes students' engagement, interaction and high thinking levels.¹ The audio-visual aids have been used in the health sciences institutions to improve the learning process. In 1999, the Faculty of Health Sciences (FHS) in Sweden created web-based digital scenarios for undergraduate students, while in Germany it was found that students' overall satisfaction improved with online simulations.⁶

Due to the recent limitations imposed by the coronavirus disease-2019 (COVID-19) pandemic, educational institutions had to terminate physical in-person learning. As a result, the College of Medicine at Qassim University in Saudi Arabia had to redesign its PBL modality to the online format.

The current study was planned to investigate the medical students' performance with and perception towards different multimedia medical imaging tools.

Subjects and Methods

The cross-sectional study was conducted at the College of Medicine, Qassim University, Saudi Arabia, from 2019 to 2020, and comprised third year undergraduate medical students of either gender during the academic year 2019-

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2020 in the Urinary System Block.

After obtaining informed consent, the students were randomly assigned into 12 groups: 7 groups of male students, and 5 of female students. A faculty member was assigned as a tutor to each group.

The Urinary System Block comprised four weeks of teaching. In each week, two related PBL sessions were conducted. The first session was for the preliminary discussion of a given scenario and for elaborating the learning issues through student-student and student-tutor interaction. The second session was devoted to the students' presentation of the learning objectives as well as for the formative end-of-session assessment. Regarding the PBL scenario of the first session, implemented over the four weeks of the block, two scenarios were augmented with digitalised multimedia and the remaining two were left as traditional ones with written scenarios. The students receiving multimedia-enhanced PBL sessions formed intervention group A, while those receiving traditional PBL

sessions formed control group B.

The multimedia utilised was in the form of digitalised radiological images, gross and histopathological pictures as well as short educational videos. A newly-constructed template that ensured proper implementation of the 7-jumps of the PBL was introduced to enable the students to express their thoughts in a logical sequence and to proceed smoothly during the PBL sessions (Figure 1).

The choice of multimedia was determined and prepared by the researchers in line with the block objectives. All PBL tutors were given standardised training before the PBL sessions, and received educational videos that explained the added digitalised images. A students' satisfaction survey was also conducted online and was analysed.

Data was analysed using SPSS 21. The z-test was used for normality test using Skewness and Kurtosis measures. The value of <1.96 indicated normal distribution. Comparison between the mean PBL marks of the formative assessment,

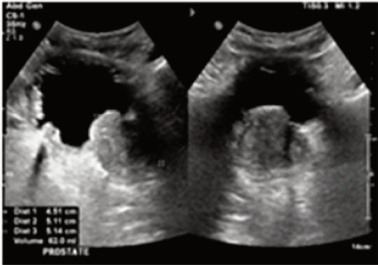
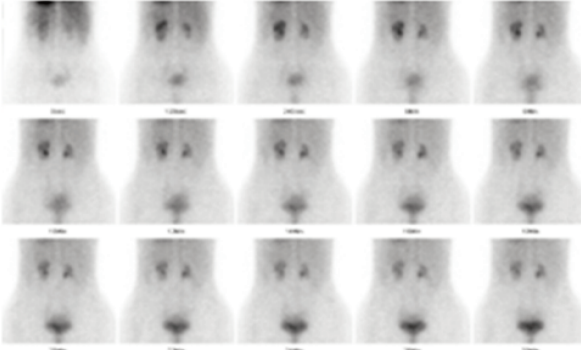
Qassim University - College of Medicine		PBL and TBL Reviewing Committee	
		Students' year	3
		Block	Urinary System CMD 332
		PBL week	4
Laboratory Findings		Radiological Findings	
Lab. test	Results	<ul style="list-style-type: none"> ▪ Abdomino-Pelvic Ultrasound (Picture 1) shows the prostatic mean volume = 62 cc. ▪ DTPA test (Picture 2). The scan from 0 second till 28 minutes shows: Which kidney shows more <u>reuptake and excretion of tracer</u>? What about the <u>size</u> of both kidneys? <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Picture (1)</p> </div> <div style="text-align: center;">  <p>Picture (2)</p> </div> </div>	
BUN	45 mg/dL		
Serum creatinine	6 mg/dL		
PaCO ₂	20 mmol/L		
Serum HCO ₃	16 mmol/L		
pH	7.2		
Serum Total PSA	9 ng/ml		
eGFR	8 mL/min/1.73 m ²		
Urine analysis:			
WBCs	20 / HPF		
RBCs	15 / HPF		
Protein	+++		
Student's Outcome			
Positive Phenomena	1		4
	2		5
	3		6
Negative Phenomena	1		2
Facts			
Hypothesis			
Learning issues - Raised questions	1		1
	2		2
	3		3

Figure-1: PBL template. (PBL: Problem-based learning)

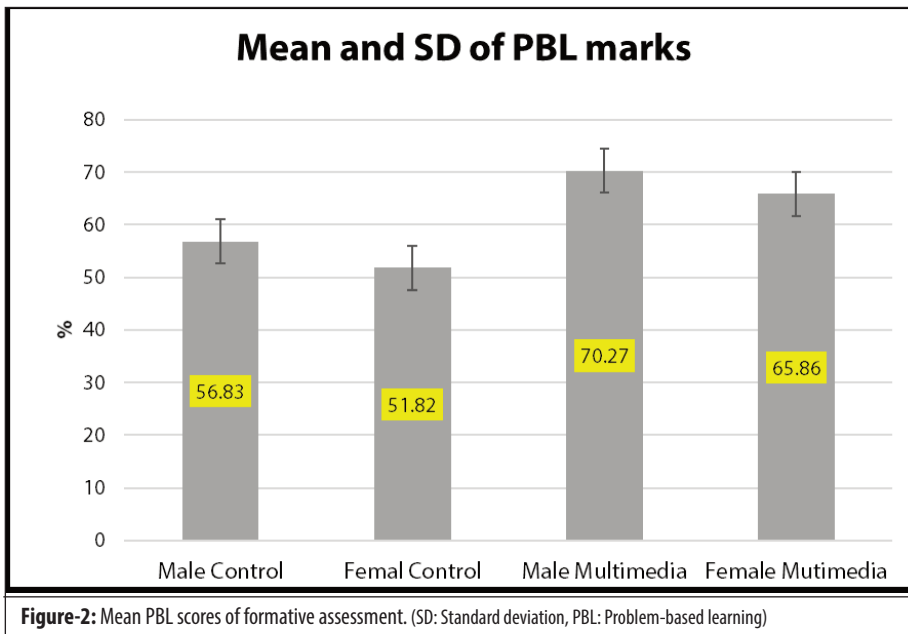


Figure-2: Mean PBL scores of formative assessment. (SD: Standard deviation, PBL: Problem-based learning)

Table: Mean score of formative assessment.

	Male (n=75)	Female (n=55)
Control PBL (traditional)	56.83±18.23	51.82±16.18
Multimedia PBL	70.27±19.42 ^a	65.86±16.74 ^b

performed at the end of the second session, was done along gender lines. The online satisfaction survey was scored on a 5-point Likert scale. Open-ended comments were obtained and analysed by an independent investigator. Cronbach's alpha test was used for mean PBL marks of the formative assessment and the students' survey to detect their internal consistency and reliability. Kendall's tau B, which is a non-parametric measure of association existing between two variables, was used to test the correlation of the items. Descriptive statistics, including frequencies and percentages as well as mean and standard deviation, were used to express the quantitative variables with their analysis through paired t-tests. $P < 0.05$ was considered statistically significant.

Results

Of the 130 medical students, 75(57.7%) were males and 55(42.3%) were females. The difference between the genders was non-significant ($p > 0.05$), while within the gender, both males and females showed significant increase in the mean PBL marks (Table 1, Figure 2). Cronbach's alpha value was 0.76 and Kendall's tau B ranged from 0.07 to 0.641.

The perception survey was filled up by 100(77%) students. Cronbach's alpha value for all items of the survey was 0.952, and Kendall's tau B ranged from 0.228 to 0.720.

Open-ended comments were obtained from 88(88%) students, and they were classified into three categories; perception towards the introduction of radiological and pathological images in PBL sessions; further support for PBL scenarios with relevant multimedia for other basic and clinical disciplines for optimum integration; and overall improvement of the pillars of PBL itself. A total of 72(82%) subjects expressed satisfaction towards the incorporation of multimedia in the PBL scenario. Participants said: "I think the presence of medical and pathology images in the PBL scenario is very important to understand the problem". "Adding these images offered real-life scenarios." "The newly attached clinical and radiological

images as well as short educational videos provided us with a clearer perspective on the case, especially the radiographic ones, and they gave a sense of a real-life experience, and added a little bit of mystery behind the case which made it more interesting".

Also, 56(64%) subjects reflected their enthusiasm for incorporating more images from other disciplines to the PBL scenarios. "I suggest introducing images in other topics, especially anatomy and histology". Other students preferred also including multimedia for the physiology. "The images explained mostly the difficult topics like the [electrocardiogram] ECG."

Finally, 69(74%) subjects expressed overall satisfaction about the improvement of the learning outcomes. "The learning issues became easier to be recognised that saved our and tutor's time for more interaction and discussion" (Figure 3).

Discussion

Digital technologies have been recently identified to allow progressive innovation in online teaching strategies.^{7,8} Virtual education has been implemented in medical institutions as the potential solution to ensure the continuity of the educational process in the wake of the COVID-19 pandemic.⁹⁻¹² Several studies have examined the effectiveness of recent technologies in medical education modalities, such as PBL.¹³⁻¹⁵

The significant increase in PBL scores of male and female students in the sessions enhanced by radiology and histopathology images and other multimedia more than

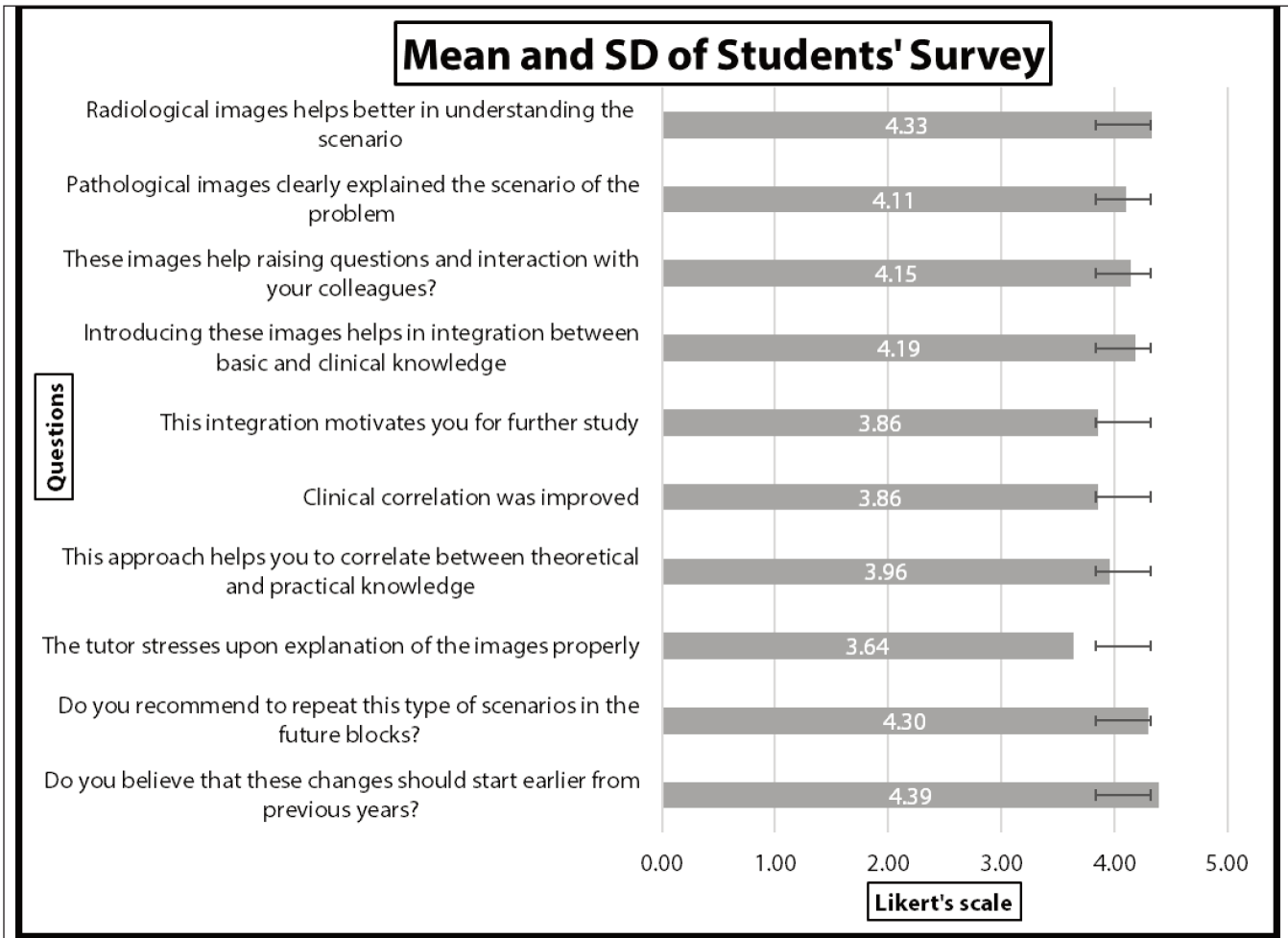


Figure-3: Mean values of the students' survey. (The SD is in the plot area of the figure)

the traditional ones encouraged the college administration to implement the modality in other modules as well. Similarly encouraging results have been reported earlier from various countries, including Pakistan, Japan, Australia, Denmark and the United States.^{2,4,16-18}

The Cronbach's alpha test in the current study revealed a relatively high level of internal consistency of the results of the formative assessment and the students' survey. Kendall's tau B test showed that all correlation coefficients of the results of the formative assessment and the survey were positive, which reflected their validity. This finding showed that the items in the surveys were correlated well. In addition, the survey revealed that the third-year medical students' attitudes towards medical imaging are significantly affected by early exposure to radiologist in the PBL scenario.

Digital medical imaging and educational videos need to be practiced more widely in modern medical curricula.

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References

- Goh D, Kale U. From print to digital platforms: A PBL framework for fostering multimedia competencies and consciousness in traditional journalism education. *Journal Mass Commun Educ* 2015;70:307-23. Doi: 10.1177/1077695815589473
- Fatima SS, Ghias K, Jabeen K, Sabzwari S. Enhancing Cognitive Engagement of Pre-clinical Undergraduate Medical Students via Video Cases and Interactive Quizzes in Problem-based Learning. *Cureus* 2019;11:e3832. doi: 10.7759/cureus.3832.
- Ludwig S, Schuelper N, Brown J, Anders S, Raupach T. How can we teach medical students to choose wisely? A randomised controlled cross-over study of video- versus text-based case scenarios. *BMC Med* 2018;16:107. doi: 10.1186/s12916-018-1090-y.
- Gavani VZ, Hazrati H, Ghojzadeh M. The efficacy of digital case

- scenario versus paper case scenario on clinical reasoning in problem based learning: A systematic review and meta-analysis. *Res Dev Med Educ* 2015;4:17-22. doi:10.15171/rdme.2015.003
5. Persson AC, Fyrenius A, Bergdahl B. Perspectives on using multimedia scenarios in a PBL medical curriculum. *Med Teach* 2010;32:766-72. doi: 10.3109/01421591003688381.
 6. Blackburn G. A university's strategic adoption process of an PBL-aligned eLearning environment: an exploratory case study. *Educ Technol Res Dev* 2017;65:147-76. Doi: 10.1007/s11423-016-9472-3
 7. Norheim OF. Ethical priority setting for universal health coverage: challenges in deciding upon fair distribution of health services. *BMC Med* 2016;14:75. doi: 10.1186/s12916-016-0624-4.
 8. Ravitz J, Blazevski J. Assessing the role of online technologies in project-based learning. *Interdiscip J Probl -based Learn* 2014;8:65-79. doi: 10.7771/1541-5015.1410
 9. Hafiz H, Oei SY, Ring DM, Shnitser N. Regulating in pandemic: evaluating economic and financial policy responses to the coronavirus crisis. [Online] 2020 [Cited 2020 October 06]. Available from URL: <https://lawdigitalcommons.bc.edu/cgi/viewcontent.cgi?article=2280&context=lsfp>
 10. Goh PS, Sandars J. A vision of the use of technology in medical education after the COVID-19 pandemic. *MedEdPublish* 2020;9:49. Doi: 10.15694/mep.2020.000049.1
 11. McVeigh K. We feel compelled': the doctors planning to return to NHS frontline. News release. The Guardian Media Center. [Online] 2020 [Cited 2020 October 06]. Available from URL: <https://www.theguardian.com/world/2020/mar/20/compelled-doctors-planning-return-nhs-frontline-coronavirus>.
 12. Rose S. Medical Student Education in the Time of COVID-19. *JAMA* 2020;323:2131-2. doi: 10.1001/jama.2020.5227.
 13. Choules AP. The use of e-learning in medical education: a review of the current situation. *Postgrad Med J* 2007;83:212-6 doi: 10.1136/pgmj.2006.054189
 14. Lajoie SP, Hmelo-Silver CE, Wiseman JG, Chan LK, Lu J, Khurana C, et al. Using online digital tools and video to support international problem-based learning. *Interdiscip J Probl-based Learn* 2014;8:60-75. Doi: 10.7771/1541-5015.1412
 15. Coiado OC, Yodh J, Galvez R, Ahmad K. How COVID-19 Transformed Problem-Based Learning at Carle Illinois College of Medicine. *Med Sci Educ* 2020;30:e1353-4. doi: 10.1007/s40670-020-01063-3.
 16. Chi DL, Pickrell JE, Riedy CA. Student learning outcomes associated with video vs. paper cases in a public health dentistry course. *J Dent Educ* 2014;78:24-30.
 17. Choi HJ, Yang M. The effect of problem-based video instruction on student satisfaction, empathy, and learning achievement in the Korean teacher education context. *High Educ* 2011;62:551-61. Doi: 10.1007/s10734-010-9403-x.
 18. Ikegami A, Ohira Y, Uehara T, Noda K, Suzuki S, Shikino K, et al. Problem-based learning using patient-simulated videos showing daily life for a comprehensive clinical approach. *Int J Med Educ* 2017;8:70-6. doi: 10.5116/ijme.589f.6ef0.