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Perception of Benefits and Outcomes of Problem-Based Learning among Pre-Clinical Phase Medical Students – A Cross-sectional Study at MAHSA University, Malaysia

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Abstract

Background

Problem-Based Learning (PBL) is a student-centered teaching method frequently employed in medical education to promote self-directed learning, critical thinking, and problem-solving abilities. Students' perspectives of the advantages, execution, and problems differ across institutions. The purpose of this study was to assess pre-clinical medical students' perspectives on the advantages, results, appropriateness, and obstacles of PBL, as well as their attitudes towards facilitator performance, at a private medical university in Malaysia.

Methods:

During the academic year 2023–2024, a cross-sectional survey was done among MBBS students in Years 1 and 2. Implementing convenience sampling, 185 students completed a standardised, pretested questionnaire administered online. The tool used 5-point Likert scales and dichotomous responses to measure perceived PBL advantages, session appropriateness, facilitator effectiveness, and difficulties. SPSS version 29 was used for data analysis, which included descriptive statistics, independent t-tests, ANOVA, and Chi-square tests.

Results:

Students expressed a significantly positive attitude towards PBL. The majority believed that PBL was good for expanding core knowledge (88.1%), improving problem-solving abilities (85.4%), and encouraging self-directed learning (82.7%). Over 90% of respondents said that facilitators helped them achieve their learning objectives, created positive group dynamics, and encouraged conversations with clinical significance. Students did, however, express obstacles, with 92.4% indicating that PBL preparation was time-consuming. Over half (57.3%) said PBL was only effective for specific courses, and 47.6% reported that introverted pupils found it difficult to fully participate. Year 1 students were more likely to see PBL as a substitute for lectures ($p = .048$), but female students were more likely to see PBL as encouraging self-directed learning ($p = .032$).

Conclusion:

Pre-clinical students significantly preferred PBL for its improvements to basic cognitive abilities and collaborative skills, and facilitators received favourable feedback well. Key problems addressed were pupils' inconsistent dedication, incorrect topic selection, and the need for suitable strategies to aid quieter children. Addressing issues like as high time commitment and uneven participation is critical for improving the efficacy of PBL in medical education.

Introduction

Problem-based learning (PBL) is an educational technique used in medical institutions to promote inquiry, critical thinking, and the application of knowledge through clinical scenarios. It is also utilized in other health-related institutions, such as dentistry and nursing [1]. PBL has been used in medicine courses for over 50 years. It is a method that delegates leadership from teachers to students and is based on a self-directed learning approach [2,3]. The triggers or real-world problems in the cases or scenarios enable students to set their own learning objectives.

A scoping review of 124 studies on PBL in medical education found that, compared with traditional lecture-based methods, PBL is effective in improving social and communication skills, problem-solving abilities, and self-learning skills. Knowledge retention and academic performance were comparable or superior. However, the implementation of PBL may be limited due to the need for additional resources and ongoing training [3].

Challenges in PBL implementation included a lack of preparation time, teamwork issues, and difficulty accessing reading materials [4]. A study involving educators from Ireland and Hong Kong found that factors affecting PBL effectiveness include problem nature, assessment methods, students' pre-college learning culture, and facilitator roles. It stressed the importance of faculty training, clear guidelines, and strong communication between curriculum developers and facilitators [5].

One local study conducted in UCSI University regarding the perception of 115 medical students towards PBL, many of the students from phase 1 mentioned that the PBL sessions are effective for their learning and have a positive attitude towards the benefits of PBL. However, more than half of the students reported that PBL was time-consuming, and that some students dominated the PBL session while others were passive in the discussion [6]. According to another local study, PBL is not widely accepted among medical students at Management and Science University (MSU) [7]. According to another study at MAHSA University, 77% of students' internal locus of control (ILOC) and 19% of their academic self-concept (ASC) were related to their views toward PBL. This underscores the importance of PBL in strengthening medical students' cognitive capacities, which are highly influenced by their acceptance and appreciation of PBL as a teaching approach. According to the study, educators should concentrate on the delivery and facilitation of PBL, as well as the environment that influences PBL [8].

A recent local study conducted at Universiti Kebangsaan Malaysia (UKM) and Maldives National University (MNU) found that both students and lecturers had positive perceptions of PBL in the UKM curriculum. The study involved 179 students and 61 lecturers, with 86.69% of students having positive perceptions and 69.87% having a positive attitude. However, no significant differences were found based on gender, university, year of study, or CGPA. Among lecturers, 63.62% had positive perceptions, and 85.83% had a positive attitude. MNU lecturers had significantly higher attitude scores than their UKM counterparts. Overall, both students and lecturers viewed PBL positively, recognizing its benefits in enhancing knowledge, learning experiences, and soft skills [9]. Another recent local study conducted among Year 1 MBBS students at a private university in Malaysia compared the effectiveness of small-

group teaching (SGT) and PBL among Year 1 MBBS students. Both groups showed significant improvement in post-test scores, with PBL increasing by 11 marks and SGT by approximately 10.6 marks. However, no significant difference was found between the two methods, indicating their equal effectiveness in delivering educational content. The findings underscore the value of both methods in improving learning outcomes [10].

Due to a limitation of Malaysian studies evaluating medical students' perception of benefits and outcomes of PBL, as well as the controversy of the results among them, this study was conducted to determine the perception of benefits and outcomes of PBL of pre-clinical medical students at MAHSA University toward PBL. The results of this study may enhance future advancements of the existing PBL.

Methods

Study Design and setting of the study

This cross-sectional study was conducted at the Faculty of Medicine, MAHSA University. The target population of the study was the pre-clinical medical students (years 1 and 2) for the academic year 2023–2024.

During the preclinical stage (year 1 and 2), basic medical sciences are taught in organ-system modules namely -Basic Medical Science (MBMS), Basic Mechanism of Disease (MBMD), Genetics, Immunology & Molecular Medicine (MGIM), Cardiovascular system (MCVS), Haematology System (MHEM), Respiratory System (MRSP), Epidemiology and Biostatistics (MERB), Gastro-Intestinal System And Nutrition (MGIN), Musculoskeletal System (MMSK), Urinary System (MURI), Nervous System (NVS), Reproductive System (MRPD), Endocrine and Metabolism (MEDM) [11]. Each PBL group includes twelve students. The facilitators were lecturers from various preclinical departments within the Faculty of Medicine at MAHSA University.

Sampling method

The convenience sampling method was used to select participants from MBBS years 1 and 2. The inclusion criteria included: MBBS students (both genders) in years 1 and 2 at MAHSA University who provided written informed consent to participate in the study. The exclusion criteria included undergraduate students from other programs/faculties and those who did not give informed consent.

Sample size calculation

There were approximately 315 students in years 1 and 2. The sample size was calculated using Slovin’s formula [12]:

$$:n = \frac{N}{1+Ne^2} = \frac{315}{1+(315\times0.05^2)} = \frac{315}{1+(315\times0.8375)} = \frac{315}{1.7875} = 167$$

n represents the sample size,

N represents the target population,

e represents the margin of error

10% of the calculated sample size, 167, was added for potential nonresponse of the participants for a variety of reasons, resulting in 183 participants.

Data collection

Data was collected using a structured questionnaire via a Google form. The questionnaire was adopted from Al-Drees el al (2015) [13].

Instrument

The sociodemographic features and other relevant variables are shown in Tables 1 and 2. Participants were required to answer a questionnaire presented in a Google Form regarding their perception, knowledge, and attitudes about the PBL. The questionnaire that measured students' perceptions of the benefits of PBL sessions (consisting of 7 items) and the questionnaire that measured students' perceptions of the appropriate running of PBL sessions (consisting of 7 items) (Table 3) were adapted from Al-Drees et al. They tested the internal consistency of all the included items by Cronbach's alpha reliability test and showed a value of 0.88 ($\chi 2 = 1783.7$, $p = 0.001$) (11). These items were rated on a 5-point Likert scale: strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree [13].

Furthermore, quantitative scores (Table 4) acquired using the SurveyMonkey application (SurveyMonkey, London, UK) were utilized to evaluate the PBL facilitators by students. This section consisted of ten items (with answers "yes" or "no") and two students' comments with free text. The first set of comments from students focused on their positive aspects about PBL (Table 5), while the second set focused on their suggestions for improving the sessions (Table 6).

In addition, the study determined the challenges of PBL among pre-clinical medical students at MAHSA University as a teaching method by using scales with answers "yes" or "no" (Table 7) that were adapted from Jindal et al. [14].

Pretest of the questionnaire study

The questionnaire was pretested among 10% of the main sample size. Thus 16 participants were included from the faculty of medicine.

Statistical analysis

Data was analyzed using IBM SPSS version 29.0 (USA) statistical software. Descriptive analyses of the categorical variables were done by calculating the frequency (number and percent); however, the continuous variables were calculated by the mean and standard deviation (SD) or median and interquartile range (IQR). t-test and ANOVA test were used to compare the score perception, knowledge, and attitude response of the participants according to sociodemographic factors and year of study. The Chi-square test was used to compare the students' views regarding the PBL facilitator.

Results

A total of 185 medical students from a private university participated in the study. The mean age of the participants was 20.9 years (SD = ± 2.3). The majority were female (70.8%), while males accounted for 29.2%. Most of the participants were in their first academic year (59.5%), and the remainder were in their second year (40.5%).

Table 1
Characteristics of the study's participants (n = 185)

Variables	Frequency	%	Mean (± SD*)
Sex			
Male	54	29.2	
Female	131	70.8	
Ethnicity			
Malay	83	44.9	
Chinese	35	18.9	
Indian	27	14.6	
Other	40	21.6	
Academic year			
Year 1	110	59.5	
Year 2	75	40.5	

The average duration of each PBL session was 2.1 hours (SD = ± 0.7), and the average group size was 11.7 students (SD = ± 5.3). On average, students had attended 5.4 PBL sessions (SD = ± 5.5) during the semester. The majority of students (87.0%) found the PBL topics useful for their end-of-block

examinations. Regarding the duration of self-directed learning (SDL) per day, 32.9% of students reported studying for 2 hours, 21.1% for 3 hours, 19.5% for 1 hour, and 16.8% for 4 hours, while 9.7% reported other durations. The preferred location for SDL varied: 42.2% preferred both home and library, 32.4% preferred home only, 16.8% chose the library, and 8.6% reported other locations such as cafés or outdoor spaces.

Table 2
Characteristics of Problem-Based Learning (PBL) Sessions (n = 185)

Variables	Frequency	%	Mean (± SD*)
Duration of the PBL Session			2.1 hr. (± 0.7)
Number of students in the PBL group			11.7 (± 5.3)
Are the PBL topics useful in the end-of-block exam			
Yes	161	87.0	
No	24	13.0	
Duration for self-directed learning (SDL) (per day)			
1 hour	36	19.5	
2 hours	61	32.9	
3 hours	39	21.1	
4 hours	31	16.8	
> 4 hours	18	9.7	
Preferred place for self-directed learning			
Library	31	16.8	
Home	60	32.4	
Both	78	42.2	
Others*	16	8.6	
*Café or friend’s house			

Most students perceived PBL sessions positively. Over half (55.7%) agreed that PBL helped them understand basic sciences, and 28.1% strongly agreed. Similarly, 51.9% agreed and 36.2% strongly agreed that PBL increased their knowledge of basic sciences. Regarding encouragement for SDL, 48.6% agreed and 34.1% strongly agreed.

A total of 51.4% of students agreed and 25.9% strongly agreed that PBL helped improve their decision-making skills. For problem-solving skills, 56.8% agreed and 28.6% strongly agreed. Regarding

collaborative learning, 59.5% agreed and 28.1% strongly agreed. Additionally, 49.7% agreed and 29.7% strongly agreed that PBL helped them identify their strengths and weaknesses.

Table 3
Perception of problem-based learning (PBL) session benefits

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
PBL helps me to understand basic sciences	2 (1.1)	7 (3.8)	21 (11.4)	103 (55.7)	52 (28.1)
PBL helps me to increase my basic sciences knowledge	1 (0.5)	3 (1.6)	18 (9.7)	96 (51.9)	67 (36.2)
PBL encourages self-directed learning	1 (0.5)	4 (2.2)	27 (14.6)	90 (48.6)	63 (34.1)
The PBL method helps me improve my decision-making skills	1 (0.5)	5 (2.7)	36 (1.5)	95(51.4)	4 (25.9)
The PBL method helps me to develop problem-solving skills	1 (0.5)	4 (2.2)	21 (11.4)	105(56.8)	53 (28.6)
The PBL method encourages collaborative learning	1 (0.5)	2 (1.1)	19 (10.3)	110(59.5)	52 (28.1)
The PBL method helps me to identify my strengths and weaknesses	2 (1.1)	7 (3.8)	29 (15.7)	92 (49.7)	55 (29.7)

Students expressed mixed opinions about the appropriateness of PBL as a substitute for lectures: 31.4% agreed and 14.1% strongly agreed, while 27.0% were neutral. Regarding the adequacy of training before PBL, 37.3% agreed and 10.3% strongly agreed that training was sufficient, while 35.7% were neutral. Most students (58.4% agreed and 31.9% strongly agreed) viewed PBL as an interactive method. Concerning content repetition between PBL and lectures, 36.8% agreed and 37.8% were neutral. A total of 44.3% agreed and 20.5% strongly agreed that students contributed equally in PBL sessions. Feedback to peers was acknowledged by 39.5% of students (agree) and 14.1% (strongly agree), while another 39.5% were neutral. For group discussions, 52.4% agreed and 37.3% strongly agreed that they actively contributed. Most students (49.2% strongly agreed and 42.7% agreed) reported attending PBL sessions on time.

Table 4
Appropriateness of Problem-Based Learning (PBL) Session

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
PBL can substitute lectures	14 (7.6)	37 (20)	50 (27)	58 (31.4)	26 (14.1)
There is proper student training before starting the PBL session	3 (1.6)	28 (15.1)	66 (35.7)	69 (37.3)	19 (10.3)
PBL is an interactive method of learning	1 (0.5)	4 (2.2)	13 (7.0)	108 (58.4)	59 (31.9)
There is a repetition between PBL and lectures	8 (4.3)	20 (10.8)	70 (37.8)	68 (36.8)	19 (10.3)
Students contribute equally in the PBL session	5 (2.7)	20 (10.8)	40 (21.6)	82 (44.3)	38 (20.5)
I give feedback to the others	6 (3.2)	6 (3.2)	73 (39.5)	73 (39.5)	26 (14.1)
I contribute to group discussions	2 (1.1)	0 (0)	17 (9.2)	97 (52.4)	69 (37.3)
I attend the PBL session on time	2 (1.1)	0 (0)	13 (7.0)	79 (42.7)	91 (49.2)

Evaluation of PBL facilitators indicated overwhelmingly positive perceptions. A majority of students (97.3%) felt their tutor was supportive, and 95.1% had confidence in their tutor. Most students (90.8%) believed all learning objectives were identified, and 97.3% stated that their tutor guided them toward those objectives. Regarding coverage of required learning, 88.6% were confident that all content was covered. Furthermore, 93.0% of students found group dynamics to be productive, and 92.4% reported that discussions extended beyond factual recitation. A similar proportion (92.4%) could relate their learning to clinical relevance. Additionally, 83.2% discussed clinical experiences during PBL, and 89.2% felt capable of applying their knowledge in practical contexts, such as explaining concepts to patients

Table 5
Student evaluations of the PBL facilitator (n = 185)

Item	Yes n (%)	No n (%)
Was your tutor supportive?	180 (97.3)	5 (2.7)
Did you have confidence in your tutor?	176 (95.1)	9 (4.9)
Did you have confidence that all learning objectives had been identified?	168 (90.8)	16 (9.2)
Did your tutor guide you to the learning objectives?	180 (97.3)	5 (2.7)
Are you confident that you covered the required learning?	164 (88.6)	21 (11.4)
Was the group dynamic productive?	172 (93.0)	13 (7.0)
Did the discussion rise above “recitation of facts”?	171 (92.4)	14 (7.6)
Were you able to discuss the clinical relevance of your learning?	171 (92.4)	14 (7.6)
Was clinical experience discussed?	154 (83.2)	31 (16.8)
Were you able to apply knowledge? (e.g. How would you explain this to a patient?)	165 (89.2)	20 (10.8)

Despite these positive perceptions, students identified several challenges with PBL. The most prominent issue was the time-consuming nature of preparation, reported by 92.4% of participants. Over half (57.3%) felt PBL was only effective for selected topics, and 47.6% noted that introverted students struggled to participate fully. Other concerns included some peers not taking sessions seriously (23.8%) and difficulties with group dynamics (24.9%).

Table 6
Challenges of PBL among study participants (n = 185)

Item	Yes n (%)	No n (%)
Preparation requires time	171(92.4)	14 (7.6)
Inadequate group discussion	46 (24.9)	139 (75.1)
Lack of coordination	32 (17.3)	153 (82.7)
Large group size	30 (16.2)	155 (83.8)
Briefing inadequate	29 (15.7)	156 (84.3)
Students don’t take seriously	44 (23.8)	141 (76.2)
Problem in searching information	40 (21.6)	145 (78.4)
Introverts are unable to express	88 (47.6)	97 (52.4)
Creates confusion	33 (17.8)	152 (82.2)
Waste of time	10 (5.4)	175 (94.6)
Difficulty in understanding	15 (8.1)	170 (91.9)
Good for only selected topics	106 (57.3)	79 (42.7)

Perceived PBL session benefits by students gender and year of study

Overall, students reported positive perceptions of PBL, with mean scores ranging from 3.90 to 4.22 on a 5-point scale. No significant gender differences were found for most items. However, a significant difference was noted in the perception that PBL encourages self-directed learning (p = .032), with more females (85.5%) than males (75.9%) agreeing. Differences by year of study were not statistically significant, though first-year students generally showed more positive responses than second-year students.

Table 7
Perception to problem-based learning (PBL) session benefits by gender and academic year

Question		Male n (%)	Female n (%)	P value	1st Year n (%)	2nd Year n (%)	P value
PBL helps me to understand basic sciences	Agree	44 (81.5%)	111(84.7%)	0.186	95 (86.4%)	60 (80.0%)	0.245
	Neutral	5 (9.3%)	16 (12.2%)		12 (10.9%)	9 (12.0%)	
	Disagree	5 (9.3%)	4 (3.1%)		3 (2.7%)	6 (8.0%)	
PBL helps me to increase my basic sciences knowledge	Agree	46 (85.2%)	117 (89.3%)	0.125	101 (91.8%)	62 (82.7%)	0.130
	Neutral	5 (9.3%)	13 (9.9%)		8 (7.3%)	10 (13.3%)	
	Disagree	3 (5.6%)	1 (0.8%)		1 (0.9%)	3 (4.0%)	
PBL encourages self-directed learning	Agree	41 (75.9%)	112 (85.5%)	0.032**	96 (87.3%)	57 (76.0%)	0.100
	Neutral	9 (16.7%)	18 (13.7%)		11 (10.0%)	16 (21.3%)	
	Disagree	4 (7.4%)	1 (0.8%)		3 (2.7%)	2 (2.7%)	
PBL method helps me improve my decisions making skills	Agree	40 (74.1%)	103 (78.6%)	0.798	85 (77.3%)	58 (77.3%)	0.069
	Neutral	12 (22.2%)	24 (18.3%)		24 (21.8%)	12 (16.0%)	
	Disagree	2 (3.7%)	4 (3.1%)		1 (0.9%)	5 (6.7%)	
PBL method helps me to develop problem solving skills	Agree	47 (87.0%)	111 (85.4%)	0.742	99 (90.0%)	59 (79.7%)	0.145
	Neutral	5 (9.3%)	16 (12.3%)		9 (8.2%)	12 (16.2%)	
	Disagree	2 (3.7%)	3 (2.3%)		2 (1.8%)	3 (4.1%)	
PBL method encourages collaborative learning	Agree	44 (81.5%)	118 (90.8%)	0.144	100 (90.9%)	62 (83.8%)	0.309
	Neutral	8 (14.8%)	11 (8.5%)		9 (8.2%)	10 (13.5%)	

Question		Male n (%)	Female n (%)	P value	1st Year n (%)	2nd Year n (%)	P value
	Disagree	2 (3.7%)	1 (0.8%)		1 (0.9%)	2 (2.7%)	
PBL method helps me to identify my strengths and weaknesses	Agree	41 (75.9%)	106 (80.9%)	0.496	87 (79.1%)	60 (80.0%)	0.931
	Neutral	11 (20.4%)	18 (13.7%)		18 (16.4%)	11 (14.7%)	
	Disagree	2 (3.7%)	7 (5.3%)		5 (4.5%)	4 (5.3%)	

Perceived Appropriateness of PBL by Gender and Year of Study

Most students viewed PBL sessions as appropriate. A significant gender difference was observed in perceptions of receiving proper training before PBL (p = .040), with females reporting higher disagreement. Additionally, more first-year students agreed that PBL could substitute lectures (p = .048), indicating decreasing agreement with this view in later years. No other significant differences were observed. Table 8 shows the appropriateness PBL by gender and academic year.

Table 8
Appropriateness of Problem-Based Learning (PBL) by gender and academic year

Question		Male n (%)	Female n (%)	P value	1st Year n (%)	2nd Year n (%)	P value
PBL can substitute lectures	Agree	23 (42.6%)	61 (46.6%)	0.451	55 (50.0%)	29 (38.7%)	0.048**
	Neutral	18 (33.3%)	32 (24.4%)		32 (29.1%)	18 (24.0%)	
	Disagree	13 (24.1%)	38 (29.0%)		23 (20.9%)	28 (37.3%)	
There is proper students' training before starting the PBL session	Agree	25 (46.3%)	63 (48.1%)	0.040**	53 (48.2%)	35 (46.7%)	0.604
	Neutral	25 (46.3%)	41 (31.3%)		41 (37.3%)	25 (33.3%)	
	Disagree	4 (7.4%)	27 (20.6%)		16 (14.5%)	15 (20.0%)	
PBL is an interactive method of learning	Agree	47 (87.0%)	120 (91.6%)	0.634	101 (91.8%)	66 (88.0%)	0.598
	Neutral	5 (9.3%)	8 (6.1%)		7 (6.4%)	6 (8.0%)	
	Disagree	2 (3.7%)	3 (2.3%)		2 (1.8%)	3 (4.0%)	
There is a repetition between PBL and lectures	Agree	23 (42.6%)	64 (48.9%)	0.425	58 (52.7%)	29 (38.7%)	0.073
	Neutral	20 (37.0%)	50 (38.2%)		40 (36.4%)	30 (40.0%)	
	Disagree	11 (20.4%)	17 (13.0%)		12 (10.9%)	16 (21.3%)	
Students contribute equally in PBL session	Agree	35 (64.8%)	85 (64.9%)	0.927	70 (63.6%)	50 (66.7%)	0.425
	Neutral	11 (20.4%)	29 (22.1%)		27 (24.5%)	13 (17.3%)	
	Disagree	8 (14.8%)	17 (13.0%)		13 (11.8%)	12 (16.0%)	
I give feedback to the others	Agree	34 (63.0%)	65 (50.0%)	0.273	65 (59.1%)	34 (45.9%)	0.210
	Neutral	17 (31.5%)	56 (43.1%)		39 (35.5%)	34 (45.9%)	

Question		Male n (%)	Female n (%)	P value	1st Year n (%)	2nd Year n (%)	P value
	Disagree	3 (5.6%)	9 (6.9%)		6 (5.5%)	6 (8.1%)	
I contribute in group discussions	Agree	48 (88.9%)	118 (90.1%)	0.808	98(89.1%)	68 (90.7%)	0.869
	Neutral	5 (9.3%)	12 (9.2%)		11 (10.0%)	6 (8.0%)	
	Disagree	1 (1.9%)	1 (0.8%)		1 (0.9%)	1 (1.3%)	
I attend PBL session on time	Agree	46 (85.2%)	124 (94.7%)	0.099	100 (90.9%)	70 (93.3%)	0.734
	Neutral	7 (13.0%)	6 (4.6%)		9 (8.2%)	4 (5.3%)	
	Disagree	1 (1.9%)	1 (0.8%)		1 (0.9%)	1 (1.3%)	

Discussion

This study explored the perceptions of benefits, outcomes, and challenges concerning PBL among pre-clinical medical students at MAHSA University in Malaysia and found a mainly positive opinion that is broadly comparable with global trends in medical education. Overall, the findings support PBL's status as a basic pedagogical technique for developing higher-order cognitive and professional abilities, while also revealing context-specific implementation problems that require consideration in curriculum design and faculty development.

Perceived Benefits and Positive Outcomes of PBL Sessions

The majority of students appreciated several benefits of PBL. More than four-fifths agreed that PBL improved their comprehension and knowledge of basic sciences while also encouraging the development of self-directed learning, decision-making, problem-solving, and collaborative learning skills. These findings are consistent with recent evidence that PBL produces superior or comparable outcomes to traditional lecture-based learning in domains such as critical thinking, clinical reasoning, and self-directed learning skills [3,15,16]. A randomised controlled trial and meta-analysis in pharmaceutical education revealed that PBL significantly enhanced problem-solving, self-directed learning, and communication skills when compared to lecture-based learning [16]. Similarly, a recent comprehensive study of health professions education found that PBL-based curricula are related to greater or similar academic accomplishment and higher levels of learner engagement than conventional methodologies [15,17]. The students in this study strongly supported PBL as an environment for self-

directed learning, which is consistent with earlier research in medical and health sciences education. PBL environments can effectively promote autonomy, self-management, and autonomous learning among undergraduate medical students [18]. According to more recent large-scale research, most undergraduate medical students are now reasonably comfortable with self-directed learning, and student-centered approaches such as PBL can help to strengthen this readiness, especially in private institutions with more curricular flexibility[17,19].

The current study's qualitative feedback emphasized reported improvements in communication skills, presentation abilities, self-confidence, teamwork, and group bonding, as well as stronger integration of basic and clinical sciences. These perceptions are consistent with findings from clerkship settings, where PBL has been shown to significantly improve clinical reasoning, diagnostic skills, and physician-patient communication, as evidenced by Mini-CEX evaluations and learner satisfaction surveys [20,21]. The high rates of active participation in group discussions and punctual attendance imply that, when properly planned, PBL can generate a stimulating learning environment that supports both cognitive and affective aspects of professional development [14,15]. These findings support the idea that PBL not only increases knowledge acquisition but also cultivates attitudes and abilities that are associated with lifelong learning and collaborative practice.

Perceptions Regarding PBL Session Appropriateness and Implementation Nuances

Although students mainly appreciated PBL, their perspectives on its importance as comparison to lectures were more distinct. Nearly half believed that PBL could replace lectures, while more than a quarter disagreed or remained undecided. This ambivalence reflects continuing discussions in the literature over whether PBL should completely replace lectures or be used in a complementary, mixed fashion [15,22,23]. According to recent reviews, PBL is most effective when embedded within an integrated curriculum in which lectures, skills sessions, and PBL cases are intentionally aligned rather than positioned as competing modalities [15,22,23]. The perception of duplicate content. across PBL and lectures in our study implies that such alignment may not yet be perfect and that a clearer mapping of learning objectives across instructional forms is required.

Concerns associated with content redundancy are comparable with findings from other PBL curricula, where ineffective collaboration between PBL committees and discipline-based lecturers has resulted in topic duplication and fewer possibilities for significant student inquiry [15]. A carefully coordinated curriculum, supported by interdisciplinary planning teams and explicit mapping of PBL triggers to assessment blueprints, is thus critical for avoiding overlapping and maximizing each instructional strategy's distinct strengths [15,22].

Students' modest perceptions of equitable contribution and peer evaluation during PBL sessions emphasize the necessity of group-process management. Unequal participation and inconsistent feedback methods have often been noted as dangers in small-group learning, especially when roles and expectations are not explicitly discussed [16]. Structured role rotation, clear peer feedback rules, and

focused facilitator interventions to bring quieter students into the debate may help to address these problems and improve the educational value of group interactions.

Challenges in PBL Implementation

Despite the generally optimistic view, some practical problems were found. The most common view was that preparation for PBL takes a long time, as expressed by more than 90% of students. This is similar with previous research in Malaysia and other countries, where PBL has been criticized for its high preparation requirements for both students and staff [4,14,23]. Recent comparative studies confirm that, while PBL can improve engagement, critical thinking, and clinical competence, it necessitates significant time investment and careful resource scaffolding [20,24].

Nearly half of the participants in the study speculated that introverted students struggled to fully engage, and more than half saw PBL as only useful for specific themes. These findings support general concerns that PBL may mistakenly favour more vocal students and work better for problem-oriented, integrative subjects rather than primarily factual information [15,22]. Studies on self-directed learning readiness also show that not all learners are equally comfortable with the autonomy and ambiguity inherent in PBL, particularly early in their training [17,25]. Targeted group communication training, specific assistance for quieter learners, and careful case selection (prioritizing themes that lend themselves to reasoning and integration) may help alleviate these challenges.

Additional challenges highlighted, such as insufficient group discussion, a lack of coordination, and the feeling that some students do not take sessions seriously, highlight the importance of specific evaluation procedures that recognize participation, preparation, and collaborative behaviours. Recent research demonstrates that formative and low-stakes summative evaluation of PBL processes might improve student accountability and engagement while maintaining the intrinsic motivation that PBL aims to develop [15,26].

Evaluation of PBL Facilitators

Students' extremely positive views of PBL facilitators in this study highlight the importance of professors in determining PBL effectiveness. High levels of perceived support, trust in facilitators, and satisfaction with guidance towards learning objectives and clinical relevance are consistent with current views of PBL tutors as learning coaches who scaffold inquiry, manage group dynamics, and model professional reasoning. The literature consistently emphasizes the importance of well-trained facilitators; however, inadequately prepared tutors can inadvertently revert sessions to didactic teaching or allow groups to drift without achieving core objectives [15].

Recent global and regional reviews highlight the importance of institutionally supported, ongoing faculty development programs that focus not only on the procedural steps of PBL, but also on deeper pedagogical principles such as constructivism, cognitive load management, and the cultivation of psychological safety in small groups [15,22]. The enthusiastic evaluations of facilitators at MAHSA University indicate that existing training and quality assurance mechanisms are effective; however,

continuing professional development and peer observation systems could help to sustain and enhance facilitator competence, particularly as new staff and early-career academics assume PBL tutor roles [16].

Demographic Influences on Perceptions

The current study discovered that female students were more likely than men to regard PBL as encouraging self-directed learning, whilst first-year students were more likely than second-year students to see PBL as a viable substitute for lectures and to feel appropriately prepared for PBL. These findings are somewhat consistent with recent research indicating that preparedness for self-directed learning and receptivity to active learning formats differ by gender, institutional type, and year of study [17,25]. Some writers propose that female students may display stronger self-regulatory behaviours and participation in structured collaborative situations, which might contribute to more favourable views towards SDL-promoting pedagogies [17,19].

The more critical approach of second-year students in this study may be attributed to greater curricular exposure and cognitive load as students go through pre-clinical training. As learners encounter more complex content and higher assessment stakes, they may become more aware of redundancy and perceived gaps in preparatory training [26,27]. Longitudinal study designs might be beneficial for future work to assess how views change over time and to distinguish between cohort effects and real developmental pathways in PBL acceptance.

Student Suggestions for Improvement

Students made some practical proposals that closely align with current best practice recommendations for PBL implementation. Calls for brief case summaries, organized preparation materials, and clinically orientated films are consistent with the larger trend towards scaffolded resources that decrease superfluous cognitive burden while preserving PBL's inquiry-driven nature [15]. Smaller group sizes (6–8 students), better articulation of learning objectives, more organized feedback, and improved clinical integration are all extensively supported in the PBL literature as techniques to promote participation, equality, and perceived relevance [20,22].

Logistical recommendations, such as adjusting session times, optimizing room conditions, and providing appropriate technological support, may appear insignificant, but they can have a significant impact on engagement and group dynamics, especially in resource-constrained settings. Importantly, students' emphasis on facilitator behaviours (e.g., promoting interaction, guiding discussion depth, and providing individualized feedback) reinforces the need for continuous faculty development and reflective practice among tutors [15,16].

Furthermore, the findings of this study, when integrated within recent international literature, show that PBL remains a valued, effective strategy for pre-clinical medical education when supported by thoughtfully designed curricula, adequately prepared facilitators, and learner-centered institutional policies. Addressing the highlighted challenges, particularly time burden, unequal participation, subject

selection, and alignment with lectures, will be vital for maximizing PBL's effect and satisfying the requirements of high-impact medical education journals for both empirical rigour and theoretical underpinning.

Conclusion

The study highlights that pre-clinical medical students at MAHSA University generally view Problem-Based Learning (PBL) positively, appreciating its role in deepening their understanding of basic sciences, encouraging self-directed and collaborative learning, and building key problem-solving and decision-making skills. Facilitators are seen as pivotal in guiding learning and fostering effective group interactions. However, challenges such as the significant time investment needed for preparation, unequal participation among students, and overlapping content between PBL and lectures were noted. Addressing these issues is important to enhance the effectiveness and student experience of PBL in medical education.

Recommendations

The proposed recommendations outline a comprehensive strategy to enhance PBL at MAHSA University and similar institutions by focusing on several key areas:

- **Optimizing Preparation and Resources**: Introduce concise case summaries, annotated clinical videos, and curated reading lists; utilize online platforms for consistent access.
- **Enhancing Student Training**: Conduct workshops on PBL methodology, group roles, and communication; implement mock PBL sessions to boost confidence.
- **Refining Curriculum Integration**: Align learning objectives with PBL cases and lectures; introduce PBL gradually, starting with lecture-heavy modules.
- **Improving Group Dynamics**: Limit group sizes to 6–8; assign rotating roles and train facilitators to support quieter members for balanced participation.
- **Facilitator Development and Support**: Offer regular faculty workshops on feedback techniques and facilitation skills; provide session guides for consistency.
- **Addressing Logistical Aspects**: Modify session lengths and schedules based on feedback; equip PBL rooms with collaboration-friendly tools and seating.

Study limitations

The study's limitations highlight important factors to consider when interpreting its findings. Since it is a cross-sectional study, it captures perceptions only at a single point in time, limiting the ability to infer causality or track changes over time. The use of convenient sampling may introduce selection bias, which can affect how representative the results are for the entire pre-clinical medical student population at MAHSA University or other institutions. The reliance on self-reported data from questionnaires makes

the findings susceptible to social desirability bias, where participants might respond in ways they believe are expected rather than their true feelings. Additionally, the primarily closed-ended questionnaire limits deeper qualitative insights into why students hold certain perceptions or experience specific challenges. Conducting the study at a single institution and focusing solely on pre-clinical students further limits the generalizability of the results to other phases of medical education or different educational settings. Lastly, some "Others" categories in tables lack detailed descriptions, reducing clarity about alternative resources or preferences. Recognizing these limitations is crucial for contextualizing the study's conclusions and for guiding future research to build on these findings more comprehensively.

Declarations

Ethics Approval and Consent to Participate

Ethics approval was obtained from MAHSA University, Malaysia (RMC/OCT/2023/EC01). Informed consent obtained from all the participants. Before completing the questionnaire, participants received information sheets outlining the study objectives and signed a written consent form in compliance with the Helsinki Declaration [28]. Participation in this study was completely voluntary.

Consent for publication.

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

SM led the conceptualization, study design, methodology development, data collection, and drafted the original manuscript. MA contributed to the methodology, performed the statistical analyses, verified data accuracy, and prepared the tables. NA supported the methodology and contributed to data interpretation. LS conducted the literature review and assisted in developing the questionnaire (Google Form). MSK contributed to the discussion, conclusion, recommendations, and identification of study

limitations. BTA contributed to writing and reviewing the manuscript. SA provided the final critical review and editing of the manuscript.

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