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Perceptions of medical students at Najran University on the effectiveness of problem-based learning and team-based learning

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Abstract

Background Team-based learning (TBL) and problem-based learning (PBL) are two effective educational approaches used in medical education for increasing knowledge acquisition, learning motivation, and collaborative and communication skills among students. Few studies have been conducted in Saudi Arabia to evaluate medical students' perceptions of these approaches.

Aim of the study The present study aimed to evaluate the perceptions of current or previous preclinical students at the College of Medicine, Najran University (NU) about the effectiveness of PBL and TBL and to assess students' perceptions regarding the strengths and limitations of both educational approaches and their preferences.

Methods A cross-sectional survey was conducted on 106 preclinical students at NU, Saudi Arabia. The survey questionnaire was validated by a pilot study and designed based on Kirkpatrick's evaluation model. Descriptive statistics was used to analyze the collected data through IBM SPSS Statistics 2.0.

Results 73.6% of participants enjoyed PBL and found it motivating compared to TBL and classic lectures. PBL was reported as more effective for knowledge acquisition (50%), teamwork (62.3%), and high academic performance (58%).

Conclusion It is concluded that PBL was more favored by the students regarding the learning outcomes. TBL was reported to need more individual preparation and effort and require lecturer involvement, suggesting the need for structured facilitation in this learning approach and potentially indicating the challenges associated with coordinating team-based activities.

Keywords Active learning, Knowledge acquisition, Educational approaches, Motivation, PBL, TBL

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Introduction

The educational environment comprises the design, manner, and implementation of the curriculum in educational institutes, which plays an important role in the overall learning experience of a student [1]. There has been a paradigm shift in the medical curricula from a teacher-centered approach to a student-centered one over the past few decades [2]. The passive learning approaches are less appealing to the millennials, who demand an active and engaging learning environment [3]. Medical educators are asked increasingly to develop student-focused active educational approaches to motivate learners, enhance communication skills, facilitate peer discussion, and improve problem-solving and critical thinking skills, ultimately fostering student knowledge retention [4]. The shift from traditional lectures to student-centered teaching modalities has created a conducive environment for students, enabling them to accommodate their learning needs, comprehend information, and acquire essential knowledge and skills for the competitive medical market [2]. Some of the significant student-focused educational approaches followed in the medical sector for teaching and training are problem-based learning (PBL), patient-oriented problem-solving (POPS), case-based learning (CBL), and team-based learning (TBL). These educational approaches focused on active learning models, thus improving medical education and student learning outcomes [5].

The PBL approach is applied to identify and address problems in a given scenario for knowledge enhancement and better understanding. PBL involves independent or group participation, self-learning, and using materials in the form of data, photographs, or articles to solve the problem [6]. Many teachers apply PBL to enhance students' critical thinking, problem-solving, and communication skills. Many teachers and professionals are now familiar with this model and highly experienced in designing and using PBL methodologies for various disciplines [7]. Salleh et al. (2020) assert that PBL classrooms enhance students' social skills by providing authentic communication opportunities to practice (Salleh et al., 2020). Therefore, these students are expected to be skilled in interpersonal communication, be self-directed learners, and be better problem solvers [6]. PBL students collaborate in small groups, focusing on relevant problems and spending time on self-directed learning, enabling them to practice professional skills while at university; this approach prepares them well for the professional challenges than graduates of conventional curricula [6]. During the 1980s, Professor Larry Michaelsen designed a new learning approach for business schools concerning the increased class sizes and concerns about the effectiveness of learning from lectures to large groups, but recently, it has gained popularity in medical schools, too [8, 9]. The TBL model combines activities comprising individual work, teamwork, and individual feedback for applying conceptual knowledge [8]. TBL is a highly structured approach involving students and requires particular steps and core elements for implementation, and it can be applied to both large and small classes [9].

Many studies have been conducted on the effectiveness of PBL and TBL, popular student-centered approaches used in medical education, for improving students' knowledge retention, problem-solving, and critical thinking skills. Previous studies have focused on comparing TBL and PBL with classical lectures or traditional teaching methodologies and the learning outcomes of PBL and TBL with each other [8–12]. However, few studies have evaluated medical students' perceptions of these two learning models and their preferences. Therefore, this study is conducted on preclinical students of NU, Saudi Arabia, to assess students' thoughts about the effectiveness of PBL or TBL in terms of knowledge acquisition, motivation to study, and future recommended approaches. This study aims to understand preclinical students' perception of these approaches and their effectiveness as effective and student-focused educational approaches.

Materials and methods

Background on the medical program at NU

The medical program consists of the preparatory year (1st year) and three phases including phase one (2nd year) as a foundation, phase two (3rd and 4th year) as body-system-blocks, and phase three (5th and 6th year) as a clinical phase (Supplementary file 1). The students start the program at the preparatory deanship for the 1st year studying medical English terminology and general sciences. Upon completion of the preparatory year, students proceed to the 2nd year at the College of Medicine for five years after which students join the internship for one year to complete a 7-year-medical program. Phase one and two are known as preclinical phases. During the preclinical phases, students are experienced to horizontally and vertically integrated blocks. The students start studying the basic medical sciences such as anatomy, physiology, and pathology then the related clinical sciences. The applied educational approaches in the preclinical phases include not limited to interactive lectures, PBL, TBL, CBL, practical sessions, bedside teaching, and skill lab. The PBL is applied using the seven jumps approach as illustrated in Fig. 1. The TBL is applied employing the five steps as shown in Fig. 2. During the clinical phase, students study the clinical sciences such as medicine, surgery, pediatrics, and obstetrics and gynecology (Supplementary file 1).

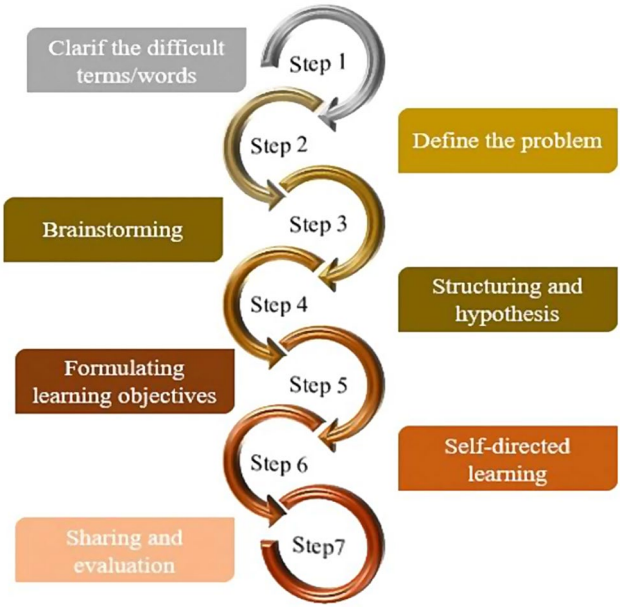

Fig. 1 Essential seven jumps/steps of problem-based learning (PBL) are applied at NU

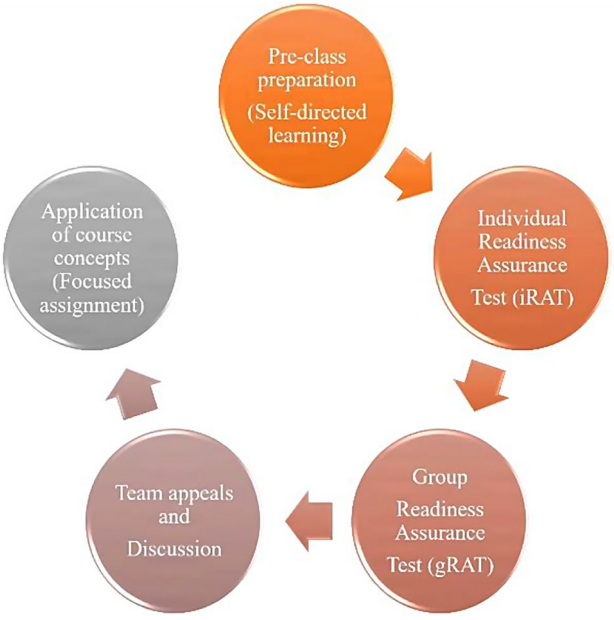

Fig. 2 Essential components of team-based learning (TBL) are applied at NU

Study design

A survey-based approach was used for this descriptive cross-sectional study. The study was conducted from September 2022 to October 2022 among the current and previous preclinical medical students at NU, Najran, Saudi Arabia, to evaluate the effectiveness of problem-based and team-based learning models. The study was designed based on Kirkpatrick's learning evaluation model using a 13-question multiple checkbox answer choice questionnaire (Supplementary file 2). The questionnaire was developed for the study, and prepared on Google Forms with two sections: informed consent in Sect. 1 and assessment questions in Section 2. Materials and methods. The assessment questions were constructed on four levels: participants' reactions to the learning models, participants' learning obtained through the models, their behavior towards the learning models, and the outcomes or their perspectives on the learning models.

Sampling size, inclusion & exclusion criteria

After the Raosoft software calculated the required sample size with a 90% confidence level and a 5% margin of error, the study included 106 of the current and previous preclinical medical students of NU according to specific inclusion criteria. All those students who had experienced PBL and TBL models, regardless of their gender, age, level, and year, were considered eligible for the study. Students from other universities, faculty members, staff, and commoners were excluded from the study. Those medical students who had studied at NU but did not experience PBL and TBL were also declared ineligible for the study.

Data collection and analysis

An online questionnaire, as described above, was used to collect from the participants using Google Forms. The questionnaire was distributed among the preclinical medical students for two weeks via WhatsApp link. The collected data were tabulated in an Excel sheet. The collected data were imported to IBM Statistical SPSS version 20 for statistical analysis. All the questions were determined for percentages and frequencies.

Results

Table 1 analyzed participants' characteristics based on their academic year and the block they have studied or have been studying. Year 3 had the highest frequency, accounting for 47.2% of the total, followed by Year 4, with 44 participants. Year 2 had 10 participants, while Year 5 and Year 6 had only one participant. The blocks were Hematology and immunology, with 26 participants accounting for 24.5% of the total. The second-highest frequency was CNS 1, with 18 participants, accounting for 17.0%. Cardiovascular had 13 participants, while Growth and development and Musculoskeletal had 13.2% and 12.3%, respectively. Reproductive had 8 participants, endocrine glands had 5, urinary had 7, and respiratory had only 2.9%. Most participants were in Years 3 and 4, suggesting a more representative study.

Table 1 Characteristics of participants

Factors		Frequency	Percentage
Year	Year 2	10	9.4
	Year 3	50	47.2
	Year 4	44	41.5
	Year 5	1	0.9
	Year 6	1	0.9
Block	Cardiovascular	13	12.3
	Central nervous system part 1 (CNS1)	18	17.0
	Endocrine and metabolism	5	4.7
	Growth and development	13	12.3
	Hematology and immunology	26	24.5
	Musculoskeletal	14	13.2
	Reproductive	8	7.5
	Respiratory	2	1.9
	Urinary	7	6.6

Table 2.1 Level 1. Participants' reactions to the learning models

Questions	Response	Frequency	Percentage
Which of the following educational approaches do you enjoy?	PBL	78	73.6
	TBL	6	5.7
	Both	10	9.4
	None	12	11.3
Which of the following educational approaches do you have a high motivation to join?	PBL	72	67.9
	TBL	9	8.5
	Both	13	12.3
	None	12	11.3

Table 2.2 Level 2. Participants' learning obtained through the models

Questions	Response	Frequency	Percentage
From your point of view, which of the educational approaches is more effective regarding knowledge acquisition?	PBL	53	50.0
	TBL	12	11.3
	Both	17	16.0
	None	4	3.8
	Prefer other educational approach	20	18.9
Regarding teamwork, which of the following educational approaches supports that?	PBL	66	62.3
	TBL	14	13.2
	Both	18	17.0
	None	8	7.5
In which of the following educational approaches do you get higher marks?	PBL	59	55.7
	TBL	8	7.5
	Both	33	31.1
	None	6	5.7

Table 2.3 Level 3. Participants' behavior toward the learning models

Questions	Response	Frequency	Percentage
If you could choose an educational approach for the whole block, which of the following would you prefer?	PBL	37	34.9
	TBL	4	3.8
	Both	23	21.7
	Classic Lectures	42	39.6
Which of the educational approaches do you think students need more individual preparation and effort?	PBL	24	22.6
	TBL	52	49.1
	Both	23	21.7
	None	7	6.6
Which of the educational approaches do you think need a lecturer to be involved?	PBL	8	7.5
	TBL	65	61.3
	Both	19	17.9
	None	14	13.2

Table 2. Kirkpatrick's learning evaluation model

The present study analyzed the perceptions of medical students at NU regarding the effectiveness of PBL and TBL using the four levels of Kirkpatrick's learning evaluation model.

The results in Table 2.1 showed participants' reactions to the learning models. Most students enjoyed PBL (73.6%) and were highly motivated to join it (67.9%). A portion of students (9.4%) preferred both educational approaches. A small percentage (11.3%) expressed a lack of interest in both PBL and TBL. TBL was the least enjoyable model (5.7%) and only 8.5% of the students showed a motivation to join it.

Table 2.2 assessed participants' learning obtained through the models. The results revealed that 50.0% of participants viewed PBL as more effective for knowledge acquisition, while 11.3% preferred TBL. The majority (62.3%) identified PBL as the best educational approach for teamwork, while 13.2% favored TBL. It was reported by 17% that both models facilitated teamwork, while 7.5% felt neither approach effectively supported teamwork. In comparison, only 7.5% achieved higher marks in TBL, while 55.7% of participants achieved higher marks in PBL.

Table 2.3 revealed some of the participants' behavior toward the learning models. The first question asked about the participants' preference for an educational approach for the entire block. 34.9% preferred PBL, while only 3.8% preferred TBL. Interestingly, a significant portion (39.6%) preferred classic lectures. According to the responses, TBL required more individual preparation and effort, with 49.1% of participants identifying it as such, while 22.6% identified it as such. The majority (61.3%) believed that TBL required lecturer involvement, while only 7.5% believed the same for PBL. Both approaches required lecturer involvement, while 13.2% did not.

Table 2.4 evaluates participants' preferences for PBL and/or TBL in future blocks and courses. The results revealed that 17.0% strongly agreed and 31.1% agreed, with 28.3% remaining neutral. The second question asked whether participants would recommend PBL and/or TBL to other medical students. The responses revealed that 59.4% answered yes, indicating most of the participants were willing to recommend PBL and TBL. Only 17% of

Table 2.4 Level 4. Results and outcomes of participants on the learning models

Questions	Response	Frequency	Percentage
Do you prefer PBL and/or TBL in future blocks and courses?	Strongly Agree	18	17.0
	Agree	33	31.1
	Neutral	30	28.3
	Disagree	9	8.5
	Strongly Disagree	16	15.1
Do you recommend PBL and/or TBL for other medical students?	Yes	63	59.4
	No	18	17.0
	Maybe	21	19.8
	Other	4	3.8

the participants answered no, and 19.8% of them were neutral.

Discussion

The present study examined the perceptions of PBL and TBL among the current and previous preclinical medical students at NU using Kirkpatrick's learning evaluation model. Compared to TBL, the overall results revealed that PBL is a more effective and favorable educational approach at NU considering different aspects such as enjoyment, motivation, knowledge acquisition, teamwork, and achievements. Burgees et al., (2020) concluded that TBL enhances healthcare education pedagogy by preparing students for complex systems, enhancing their professionalism, and attracting teachers through its active and collaborative nature [5]. In the same context, both PBL and TBL are student-centered approaches and reported as effective educational approaches [8–12]. However, the students' perceptions at NU were not positive about TBL, compared to PBL. About 50% of participants perceived TBL as requiring more individual preparation and effort, potentially indicating the challenges associated with coordinating team-based activities. Additionally, 61.3% believed TBL required lecturer involvement, suggesting the need for structured facilitation in this learning approach. Collectively, the result of the current study may suggest the need for an institutional reassessment of how TBL is conducted at NU. In addition to that, TBL was introduced newly as an educational approach at NU, compared to PBL. Therefore, the students' perceptions regarding TBL could be related to individual learning preferences or prior experiences. The latter observation is consistent with the results of Elviani [10] that students may struggle with adapting to new pedagogies and responding mentally and individually [10].

On the other hand, a significant proportion of students expressed enjoyment of PBL and high motivation to participate, aligning with the active and student-centered nature of PBL, which encourages critical thinking and problem-solving. These findings accord with those of Luo [13], who said that the PBL method encouraged discussions, interactions, positive goals, and enhancing performance because students perceive that successful learning is crucial for enhancing their overall learning experience [13]. PBL enhanced the learning environment for students by facilitating efficient study management with an interactive relationship between learners. The study emphasizes the importance of PBL among university students to enhance their learning skills, thinking, difficulties, styles, motivation, and achievements. The results accord with the findings of Almulla [7] that PBL motivated students to learn through diverse learning methods and interactions, which increased self-esteem and personal learning [7].

Most participants perceived PBL as more effective for knowledge acquisition, emphasizing its role in promoting critical thinking and deep understanding. Numerous studies [13–17] on the effectiveness of the PBL model validate the findings of the present study that the PBL model is more effective for students in developing better critical thinking skills with increasing understanding and knowledge of concepts, motivating for learning achievement and independent research. Most participants reported achieving higher marks in PBL, reinforcing its positive impact on academic success. A study by Overton & Randles [18] also showed that the knowledge of students always increased in the PBL model because students were the center of the learning process; furthermore, PBL allowed students to work individually for the solution of a problem, which ultimately increased their communication skills, and teamwork abilities [18]. The learning process in PBL proved effective in improving students' long-term memory and cooperation with other students to find the solution. The results revealed that 62.3% identified PBL as the preferred approach for teamwork, reinforcing the collaborative nature of PBL, which is in accordance with the work of Saleh et al. [19].

The behavioral outcomes of participants are explored, focusing on their academic performance and preferences for learning methods. The preference for PBL over TBL in an entire block suggests that participants view PBL as a more comprehensive and suitable approach for sustained learning. The relatively high preference for classic lectures (39.6%) indicates that traditional teacher-centered methods still hold value among participants. These results aligned with previous reports which emphasize the importance of classic lectures in comparison to these new learning approaches regardless of the matter that PBL helps students achieve their learning goals more efficiently [11, 12]. In addition to that, the focus of the PBL and TBL models is to make the teaching and learning more student-centric so that students should be more encouraged to be proactive in classes while creating an

environment of confidence for them, as demonstrated by numerous other researchers [1, 20].

Finally, understanding the reasons behind neutral or negative responses is crucial for refining and tailoring these educational approaches. A balanced integration of traditional lectures as a teacher-centered approach and student-centered approaches can cater to the diverse learning preferences of medical students, ensuring a holistic and effective educational experience [11, 12].

Conclusion

The preclinical students at NU were examined for their perceptions of PBL and TBL. The results showed that PBL was viewed as more favorable than TBL among students. Students found PBL highly motivating and effective for knowledge acquisition and teamwork skills. Most students reported that the PBL model helped in score higher grades than TBL. The students' perceptions at NU were not positive about TBL, compared to PBL. TBL was reported to need more individual preparation and effort and require lecturer involvement, suggesting the need for structured facilitation in this learning approach and potentially indicating the challenges associated with coordinating team-based activities. TBL was introduced newly as an educational approach at NU, compared to PBL. Therefore, the students' perceptions regarding TBL could be related to individual learning preferences or prior experiences. Collectively, the result of the current study may suggest the need for an institutional reassessment of how TBL is conducted at NU to refine and tailor this educational approach.

Limitations

The study's limitations, such as the specific context of NU and potential biases in participant responses, should be acknowledged. The findings are limited in generalizability to other populations due to the specificity of the institution. The study focuses specifically on the preclinical students of NU, Saudi Arabia, and their perceptions of the two learning models. Future research could explore these educational approaches across different medical schools and specialties, providing a more comprehensive understanding of their impact on education.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-024-06148-w.

Supplementary Material 1 Supplementary Material 1 file should be Supplementary Material 2 and the opposite is right

Supplementary Material 2

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Author contributions
SMQ collected data, prepared the figures, and wrote the manuscriptAZM analyzed data and wrote the manuscriptAMA collected data and wrote the manuscriptKMM collected data and wrote the manuscriptAll authors reviewed the manuscript.

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Data availability
Data is provided within the manuscript.

Declarations

Ethics approval and consent to participate
The Scientific Research and Community Service Committee at the College of Medicine, Najran University approved the study proposal, and the protocol followed the ethical guidelines of the Helsinki Declaration, 2013, for medical research with human subjects used for data collection and material. The participants were informed about the details of the study, and consent was obtained in the first section of the survey.

Clinical trial number
Not applicable.

Competing interests
The authors declare no competing interests.

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