Knowledge explosion has been accompanied by decreasing reliance on didactic lecturing because the focus of education has been shifted from teaching to learning. This educational paradigm shift has led to extensive embrace of problem-based learning (PBL). PBL is a professional educational approach that is based on researches done on “how a learner most effectively learns.” PBL is a student-centered educational approach that stimulates students to explore, inquire, clarify, analyze, debate, discuss, and manage information. This is done through a suitable scenario that triggers students’ thinking and curiosity, and consequently improves their learning capacity. The core idea of PBL is to challenge students and to activate their contextual learning during their professional life. PBL provides constructive learning in which learners construct their own meaning, and students are not passive receptacles. Educators have made the correct choice in applying PBL as a pedagogical practice, yet the need to base implementation on constructivism is obligatory if the aim is a better preparation of graduates for practice.

PBL can also promote many skills such as clinical reasoning, problem-solving, and lifelong learning. A
A study conducted among the second-year undergraduate medical students in China found that students were more satisfied with hybrid-PBL curriculum than with traditional lecturing. In response to the growing concerns about the conventional methods of medical education, some of the medical schools in Saudi Arabia have reformed to hybrid-PBL curricula. In 2007, the Faculty of Medicine, King Abdulaziz University Hospital (KAUH), Jeddah, launched a hybrid system-based curriculum. It seeks to conform with the prescriptions for curriculum innovation as outlined in Tomorrow’s Doctors, as mandated by the UK General Medical Council.

A study was conducted on medical students from the following 2 colleges in Riyadh: (1) King Saud bin Abdulaziz University for Health Sciences (KSAU-HS), which implemented a hybrid-PBL program and (2) King Saud University (KSU) with the traditional lecturing method. Results revealed that students studied hybrid–PBL curriculum in KSAU-HS had higher perceptions in learning and academic self-perception compared to students from KSU.

Understanding students’ perceptions of both learning methods can be helpful for evaluating their strengths and weaknesses. Research that assesses the impact of PBL on learners’ problem-solving and communication skills, self-direction, and motivation is vital. Furthermore, evaluating the effect of learning methods require more efforts for ensuring that students are gaining the highest benefits from their learning. There are many unanswered or partially answered questions regarding the benefits of PBL compared to traditional lectures. Limited numbers of epidemiological studies were conducted for evaluating medical students’ preference of PBL or traditional lectures after the introduction of the new hybrid–PBL curriculum in Jeddah, thus emphasizing the need for such studies.

The objective of the study was to compare between the preference of medical students for PBL and the preference for traditional lectures regarding learning outcomes (e.g., knowledge, attitude, and skills) gained from both methods.

METHODS

A cross-sectional study was carried out at the Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia. It was conducted during the elective module of the fourth-year medical students during the year 2011. The target population was all medical students who studied the hybrid-PBL curriculum (third, fourth, and fifth year).

Ethical statement

The study was approved by the Institutional Review Board of the Faculty of Medicine, KAUH, and it conformed to the ethical standards of the Helsinki declaration. During field work, the team followed the ethical consideration of confidentiality and freedom of participation. The objectives of the research were discussed for each participant separately, and upon acceptance, a signed consent was taken from each one. In addition, all administrative approvals were taken.

A multi-stage, stratified, random sample method was set up. Stratification was done on the basis of gender and the educational year. The sample was estimated using the following equation:

\[ n = \frac{Z^2 \cdot p \cdot q}{\epsilon^2} \]

\( n \): the minimum sample size, \( Z \) = constant (1.96), \( p \): is the “proportion or prevalence that meets our criteria.” As we do not know the previous proportion \( p \) from previous studies, so it was set at 0.5 (the most conservative estimate that leads to the largest “n”).

\( q = 1 - p = 0.5 \)

The minimum calculated sample size to achieve a precision of ±5% with a 95% confidence interval was 384. For stratification purposes, the sample was exceeded to reach 460 during field work.

Data collection was done through pre-structured, validated, confidentially anonymous, self-administered questionnaire. Estimation of internal reliability was made through calculating Cranach coefficient.

The questionnaire collected:

- Personal and sociodemographic information: age, sex, etc.
- Students’ perception toward PBL and traditional lectures: Students’ perceptions were assessed through their response to 20 statements inquired about both methods of learning using a “five-point Likert scale,” a scale of “1” indicating strong disagreement and of “5” indicating strong agreement.

These statements inquired about PBL and traditional lectures regarding:

1. Knowledge gained (4 items): Learning method that helps in recalling basic knowledge, providing large quantity of information within a shorter time, linking knowledge of basic and clinical sciences, etc.
2. Attitude (6 items): Students’ feelings toward both methods regarding constructive learning, motivation, learning in a shorter time, etc.
3. Skills gained (8 items): Skills provided from both methods as critical thinking, effective communication, team building, searching skills, lifelong learning skills, etc.
4. Future outcome (1 items): A statement inquired about students’ preference of either method regarding expectation of their future outcome (through studying by each method).

5. Satisfaction (1 items): A statement inquired about students’ preference of either method according to their learning satisfaction.

**Statistical analysis**

The data was coded and entered into statistical computer program (SPSS Inc, version 21.0; Chicago, Ill., USA). A total score was calculated for each of knowledge, attitude, academic performance, skills, and satisfaction for both PBL and traditional lectures. Descriptive and analytical statistics were carried; t test was used for comparing 2 means; \( P < .05 \) was considered statistically significance.

**RESULTS**

A total of 460 medical students enrolled in the study. Their age ranged from 18-23 with a mean of 21.1 (1.4) years. The majority of students were Saudi (93.7%) and single (96.3%). The male-to-female ratio was almost 1:1. The sample included 36.7%, 39.3%, and 23.9% students from the third, fourth, and fifth year, respectively. The majority of participants had sufficient and exceeding family income. The fathers (71.3%) and mothers (56.5%) of most of the students had a university degree or above.

Table 1 illustrates the students’ perceptions of knowledge gained by PBL and traditional lectures. No statistical significant difference was observed between both methods regarding the amount of recalled knowledge or provision of a large quantity of information within a shorter time (\( P > .05 \)). However, students preferred PBL (mean score = 4.04 [1.13]) to traditional lectures (score=3.29 [1.11]) for a better linkage between knowledge of basic and clinical sciences. A highly statistical significant difference (\( t \text{ test} = 10.15, P < .001 \)) was observed.

Table 2 portrays medical students’ perceptions of both learning methods regarding learning attitudes. PBL improves attitude to learning. Students preferred PBL for gaining more motivation to learn, constructive learning, and helping them to discuss information in a professional way. Highly statistical significant differences were present between students’ opinion of both methods (\( P < .001 \)).

Table 3 shows that students preferred PBL more to traditional lectures for providing better learning skills, with the presence of highly statistical significant differences (\( P < .001 \)). These skills are critical thinking, team building, effective communication, self-directed learning, self-assessment, ability to cope with changes, etc. The mean total skill gained from PBL (47.2 [10.6]) was much higher than that from traditional lectures (33.0 [9.9]), with the presence of a high statistical significant difference (\( t \text{ test} = 20.93, P < .001 \)).

Table 3 also demonstrates that students were more satisfied with PBL than with traditional lectures.

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**Table 1. Comparison between medical students’ perception of knowledge gained from both problem-based learning and traditional lecture.**

| Students’ attitude                              | Type  | Mean score | SD   | t-test | P     |
|-------------------------------------------------|-------|------------|------|--------|-------|
| Method helps in recalling basic knowledge       | PBL   | 3.75       | 1.14 | 1.60   | .111  |
|                                                 | Lectures | 3.87       | 1.04 |        |       |
| Method provides better linkage between knowledge of basic and clinical sciences | PBL   | 4.04       | 1.13 | 10.15  | .000* |
|                                                 | Lectures | 3.29       | 1.11 |        |       |
| Method provides intact content needed from learning | PBL   | 3.49       | 1.11 | 0.232  | .817  |
|                                                 | Lectures | 3.51       | 1.16 |        |       |
| Method provides a large quantity of information within a shorter time | PBL   | 3.45       | 1.33 | 0.673  | .501  |
|                                                 | Lectures | 3.51       | 1.31 |        |       |

PBL: Problem-based learning.
Table 2. Comparison between medical students’ perception of problem-based learning and traditional lectures regarding attitudes toward learning.

| Attitude                                                                 | Type    | Mean score | SD    | t test | P     |
|--------------------------------------------------------------------------|---------|------------|-------|--------|-------|
| I feel that I am more comfortable in learning with this method           | PBL     | 3.47       | 1.340 | 0.704  | .482  |
|                                                                           | Lectures| 3.33       | 1.282 |        |       |
| I feel that I learn in a shorter time                                     | PBL     | 3.63       | 1.340 | 4.569  | <.001 |
|                                                                           | Lectures| 3.53       | 1.282 |        |       |
| I feel that I learn better in this method                                 | PBL     | 3.72       | 1.280 | 4.808  | <.001 |
|                                                                           | Lectures| 3.32       | 1.215 |        |       |
| I feel that this method motivates me to learn                             | PBL     | 3.85       | 1.249 | 10.859 | <.001 |
|                                                                           | Lectures| 2.98       | 1.179 |        |       |
| I feel that this method is more constructive to me                        | PBL     | 3.65       | 1.89  | 5.710  | <.001 |
|                                                                           | Lectures| 3.22       | 1.083 |        |       |
| I feel that this method makes me to discuss information in a professional way | PBL   | 3.99       | 1.152 | 14.907 | <.001 |
|                                                                           | Lectures| 2.82       | 1.227 |        |       |

(P<.001). A higher mean score was given for PBL compared to traditional lectures for providing better future learning outcome, with a highly statistical significant difference (P<.001).

DISCUSSION

Medical education is currently undergoing innovative evidence-based reform, which includes increased reliance on student-centered approaches as PBL.17 Walsh stated that PBL is based on the slovenly, complex problems encountered in the real world as a stimulus for learning.18 Results of the present study showed that there is no statistical significant difference in the amount of knowledge recalled by PBL or traditional lectures. This finding is in line with the results from Netherlands,19 meta-analysis review,20 and Indiana University School of Dentistry, USA.21

However, students in the present study preferred PBL to traditional lectures, as it improves the information link of basic and clinical sciences. This agrees with the results from the Indiana study.21

Regarding attitudes, the current study found a statistically significant difference between the preference of PBL and traditional lectures, with PBL received more positive learning attitudes than lectures. Similar results reported by Cowan, et al22 from a study conducted in Riyadh. The majority (60%) of their students felt that the student-centered approach enhanced their learning. Meanwhile, Gregson et al23 assessed the students’ perceptions of PBL in studying pharmacology. They found that students had a better understanding and more confidence in the knowledge they gained from PBL. Another study conducted in Nigeria revealed that the interest of medical students in didactic lectures is declining.17 Furthermore, a randomized clinical trial was done among 40 Iranian nursing students; 20 students enrolled in PBL group, and 20 enrolled in a traditional lecture group. The results showed a statistical significant difference in the level of learning attitude, with a more positive learning attitude among students in the PBL group.24

Regarding future learning outcomes, the current study showed that students gave significantly better scores for PBL than for traditional lectures (P<.05). Curtis et al25 also found that the application of PBL clerkship was associated with higher scores in the National Board of Medical Examiners.

Students in the current study preferred skills gained
Table 3. Comparison between medical students’ perception of skills, satisfaction, and outcome gained from problem-based learning and traditional lecture

| Skills                      | Type   | Mean score | SD  | t test | P    |
|-----------------------------|--------|------------|-----|--------|------|
| Critical thinking           | PBL    | 4.13       | 1.42| 14.68  | <.001|
|                             | Lectures | 2.86      | 1.19|        |      |
| Team building               | PBL    | 4.04       | 1.17| 21.89  | <.001|
|                             | Lectures | 2.38      | 1.13|        |      |
| Effective communication     | PBL    | 4.12       | 1.10| 22.07  | <.001|
|                             | Lectures | 2.41      | 1.13|        |      |
| Self-directed learning      | PBL    | 4.10       | 1.11| 17.97  | <.001|
|                             | Lectures | 2.68      | 1.27|        |      |
| Self-assessment             | PBL    | 3.82       | 1.18| 14.66  | <.001|
|                             | Lectures | 2.67      | 1.18|        |      |
| Problem solving             | PBL    | 4.03       | 1.10| 19.60  | <.001|
|                             | Lectures | 2.57      | 1.17|        |      |
| Coping with change          | PBL    | 3.84       | 1.11| 14.78  | <.001|
|                             | Lectures | 2.75      | 1.12|        |      |
| Life-long learning          | PBL    | 3.81       | 1.20| 9.38   | <.001|
|                             | Lectures | 3.05      | 1.25|        |      |
| Total skills score          | PBL    | 47.22      | 10.85| 20.93  | <.001|
|                             | Lectures | 33.0      | 9.94|        |      |
| Satisfaction with PBL       | PBL    | 3.70       | 1.25| 4.94   | <.001|
|                             | Lectures | 3.30      | 1.24|        |      |
| Provides better learning outcome for my future | PBL | 3.77 | 1.23 | 5.24 | <.001 |
|                             | Lecture | 3.33      | 1.27|        |      |

PBL: Problem-based learning.

from PBL to traditional lectures. From their opinion, PBL provides them with better critical thinking, reasoning, team building, communication, self-directed learning, and summarization skills than do traditional lectures. Highly statistical significant differences (P<.001) were present. These results agree with the results of Schmidt et al26 who reported that the Dutch students graduated from schools implemented PBL curriculum rated themselves as having much better interpersonal competencies and skills than other graduates. They rated themselves as having better problem-solving, self-directed learning, information-gathering, and task-supporting skills compared to other graduates.26,27 These results also agree with the results of another study performed in Hong Kong.26 However, results from the Iranian study,24 which used dimensions of California Critical Thinking Disposition Inventory, revealed a diverse and often contradictory result about critical thinking dispositions of nursing students in Asian and non-Asian countries.

Finally, the present study showed that students are more satisfied with PBL than with traditional lectures. This result is consistent with the results of another Saudi study performed for comparing PBL curriculum at the Al-Qaseem campus with traditional teaching curriculum at the Riyadh campus. Results showed that
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75% of students from the PBL campus were satisfied with their curriculum compared to 20% of students from the traditional-based campus.29 Chang et al.30 conducted another study on medical students using hybrid curriculum for studying anesthesia, and they found that most of the students preferred PBL to the lecture-based traditional teaching.

In conclusion, PBL as an approach to instruction has attracted more medical students in the current study. Students preferred PBL to lectures for better linking knowledge of basic and clinical sciences. However, no significant difference (P > 0.05) was observed between knowledge gained by both methods, according to the opinion of students.

Medical students preferred PBL to traditional lectures for improving most of the learning outcome domains. From the medical students’ opinion, PBL provides them with better attitude to learning, better learning skills, more satisfaction, and better future outcome as future physicians. The faculty of medicine needs to provide more integration between PBL and traditional lectures, with an increase amount of PBL for improving different learning domains, especially attitude, skills, and learning outcome. The study recommended introduction of PBL in all faculties and schools of Jeddah and Saudi Arabia for better skills and learning outcome. Conduction of more researches is required among medical graduates who studied the hybrid PBL curriculum to evaluate the skills and outcomes gained and to determine how well they prepared for practice after graduation.

There is no competing interest.

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