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ORIGINAL RESEARCH

Role of problem-based learning in undergraduate dental education: a questionnaire-based study

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Background: There is a debate regarding the significance of problem-based learning (PBL) model in educational systems. The aim of this study was to assess the awareness of dental students at the Princess Nourah Bint Abdulrahman University (PNU), Saudi Arabia, toward PBL.

Methods: The present cross-sectional study was performed at the College of Dentistry, PNU, Riyadh, Saudi Arabia. An anonymous, standardized and self-administered questionnaire (based on nine items) coded as 1, 2, 3 and 4 was distributed to the first-, second-, third- and fourth-year undergraduate students, respectively, after a seminar that focused on the perceptions of PBL among the students at the end of the academic year 2017. The questionnaire was developed following an exhaustive search of indexed databases. Based on the students' responses (yes/no) to the questions, group mean differences (95% CI) were computed and Pearson's chi-squared test was used for data analysis. Cronbach's alpha coefficient was also determined. The level of significance was set at $P<0.05$.

Results: In total, 238 female undergraduate dental students (61 first-year, 59 second-year, 60 third-year and 58 fourth-year students) were included. The Cronbach's alpha coefficient ranged between 0.82 and 0.93. Group comparisons (95% CI) showed no statistically significant difference in the responses (yes) of students in the first, second, third and fourth year of academic years related to the perceptions listed earlier ($P>0.05$).

Conclusion: Perception of female undergraduate dental students at the PNU was inconclusive. Further studies are warranted in this regard.

Keywords: problem-based learning, dental education, perception, questionnaire

Introduction

Problem-based learning (PBL) is an educational tactic in which a problem serves as an incentive toward finding solutions and dynamic education.[1] Nearly 3 decades ago, PBL was used for dental education at an academic institution in South Sweden.[2] The concept of PBL-based educational system initiated in the Western countries;[3,4] however, it is now acknowledged globally.[5] The original objective of the PBL strategy was to improve students' abilities to resolve clinical problems.[6] In medical sciences, an essential objective of PBL is to improve students' intellectual skills so that they can confidently apply their theoretical knowledge in clinical settings. A majority of academic institutions throughout the world have adopted various forms of PBL methodologies for undergraduate and postgraduate education in medical sciences.[1,7–11] The educational pattern of PBL involves groups of students who work together under direct or indirect faculty supervision.[2,11]

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Studies[1,12] have reported that professional performance and confidence in the areas of self-directed and lifelong learning and patient management of students graduating from PBL-based medical programs are superior as compared to students graduating from programs without a PBL-based educational system. However, differing results have also been reported. It has been reported that there is no statistically significant difference in practice location (urban or rural), occupation (clinical or nonclinical) and/or employment grade (private or public) among medical students who had followed traditional and nontraditional educational curricula.[13] Although the use of PBL is increasing in medical educational programs to enhance intellectual thinking skills among students, its application in dental educational programs is still limited. Thus, there is a dearth of studies that have assessed the perception of undergraduate dental students involved in PBL programs. However, a study[14] from a university in the province of Qassim, Saudi Arabia, assessed the perceptions of dental students toward the PBL curriculum. The results showed that students perceived the PBL curriculum to be an effective means of enhancing knowledge, which helped improve their public communication skills.[14] In another study conducted at a university in Riyadh, Saudi Arabia, at least 50% students reported that they did not receive adequate training before starting the PBL sessions,[15] and nearly 25% of students agreed that the teaching staff were well trained to conduct the sessions.[15] However, this study[15] was performed on students in their first and second years of undergraduate dental education. In a study, the authors assessed the opinions of medical students in Saudi Arabia about the appropriateness of the PBL concepts. In this study, nearly 50% students considered PBL as an irrelevant educational tool.[16]

The Princess Nourah Bint Abdulrahman University (PNU) is an academic institution located in Riyadh, Saudi Arabia and is the first and only college for female students. The College of Dentistry at the PNU offers several preclinical and clinical educational tools that help students acquire knowledge and continuous methods of learning. A vision of the PNU is to provide a high level of education and training to its students, which ensures the qualification of dentists with high standards of efficiency and to introduce them to educational tools to apply their knowledge in dental sciences. In the present study, it is hypothesized that PBL is a valuable and useful educational tool for undergraduate dental students of the PNU. With this background, the aim of the present observational questionnaire-based study was to assess the perceptions and perspectives of female dental students at the PNU, Saudi Arabia, toward PBL methodology.

Materials and methods

Ethical guidelines

This study was reviewed and approved by the institutional review board of the College of Dentistry, PNU, Riyadh, Saudi Arabia (Ref# OR-0048-1956). Written information sheets, written informed consent forms and a white blank envelope were sent by postal mail to all students. The information sheet stated the purpose and objectives of the study and clearly stated that participation is completely voluntary with no penalties associated with refusal or withdrawal from participation. It was mandatory for all participants to read and sign a written informed consent before their inclusion in the present study. The participants were requested to place their signed written informed consent forms in the official mailbox of the university registrar in the white envelope provided.

Institution, study design and recruitment of participants

The present cross-sectional study was performed at the College of Dentistry, PNU, Riyadh, Saudi Arabia. The 3-year undergraduate dental educational program prepares students to provide basic health promotion and disease prevention, diagnose and develop treatment plans, analyze complex dental cases and achieve competency in all areas defined for general dental practitioners. Moreover, the PNU follows a competency-based curriculum that reflects the commitment to support the development of professionalism, lifelong learning and synthesis of clinical science concepts. A team of teachers at the College of Dentistry, PNU, was established to develop a questionnaire enabling tutors to investigate the attitude of students in the first, second, third and fourth year of undergraduate dental education toward PBL. The tutors who participated in this survey were faculty members at the College of Dentistry, PNU.

Questionnaire

A pilot study was conducted to validate the questionnaire on a sample size of 55 participants before the commencement of the study. In October 2017, an anonymous, standardized and self-administered questionnaire coded as 1, 2, 3 and 4 (for first-, second-, third- and fourth-year undergraduate dental students, respectively) was distributed to the first-, second-, third- and fourth-year undergraduate students after a seminar, which focused on the perceptions of PBL among the students at the end of the academic year 2017. The questionnaire was developed following an exhaustive search of

indexed databases (PubMed/Medline, Scopus, Ovid and ISI Web of Knowledge). The final questionnaire was composed of the following nine questions: 1) Is PBL interesting? 2) Was proper training of PBL given before its implementation? 3) In PBL, is knowledge organized around problems rather than disciplines? 4) Does PBL help students assume responsibility for their own learning? 5) Does PBL make students active processors of information? 6) Does PBL help students elaborate and organize their knowledge? 7) Is PBL lecture-based hybrid system better than entire lecture-based curriculum? 8) Does PBL enhance the ability to find information using the Internet/library? 9) Is the role of facilitator in the process of PBL helpful? 10) Does PBL improve the decision-making skills?

Statistical analyses

Statistical analysis was performed using a social sciences software (SPSS version 14.0; SPSS Inc., Chicago, IL, USA). Group mean differences (95% CI) were computed, and Pearson's chi-squared test was used for data analysis. Reliability was described as the internal consistency of the dimensions and determined using the Cronbach's alpha coefficient.[17] The expected alpha coefficient was estimated at 0.75.

Results

General characteristics

Two hundred and thirty-eight students volunteered to participate in the present study and signed the written informed consent form. Among these, 61, 59, 60 and 58 were from the first, second, third and fourth year of undergraduate education, respectively. The mean age of students in the first, second, third and fourth year of undergraduate education was 21.3±0.6, 22.7±0.4, 23.5±0.4 and 24.4±0.3 years, respectively. There was no statistically significant difference in the mean ages of participants. Reliability, as calculated using the Cronbach's alpha coefficient, showed acceptable consistency, which ranged between 0.82 and 0.93. Cronbach's alpha was very similar in the factorial analysis.

Perception of PBL among students in the first, second, third and fourth year of undergraduate dental education

Table 1 summarizes the self-perceived responses of students in the first, second, third and fourth year of undergraduate dental education toward PBL methodology. Table 2 summarizes the group mean differences (95% CI) toward the perception of PBL among the study groups.

Group comparisons (95% CI) showed no statistically significant difference in the responses (yes) of students in the first, second, third and fourth year of the academic years related to the perceptions listed earlier ($P>0.05$; Table 2).

Discussion

Student performance is an influential factor essential to their learning outcomes. There is a dearth of studies that assess the evaluation criteria and precise conclusions on the influences of PBL.[18] The present study was performed to assess perspectives and perceptions of dental students at the PNU regarding the PBL curriculum and to compare their perceptions among students in different academic years, that is, first year, second year, third year and final year of undergraduate dental education. The present cross-sectional questionnaire-based study was based on the hypothesis that PBL is a valuable educational tool

Table 1 Students' responses to PBL questionnaire

Questionnaire related to PBL	Students' responses (yes), n (%)			
	First year (n=61)	Second year (n=59)	Third year (n=60)	Fourth year (n=58)
Is PBL strategy interesting?	21 (34.4)	29 (49.1)	36 (60)	40 (68.9)
Was proper training of PBL given before its implementation?	30 (49.1)	32 (54.2)	38 (63.3)	41 (70.7)
In PBL, is knowledge organized around problems rather than disciplines?	27 (44.3)	33 (55.9)	38 (63.3)	41 (70.7)
Does PBL help students assume responsibility for their own learning?	11 (18)	15 (25.4)	28 (46.7)	39 (67.2)
Does PBL make students active processors of information?	12 (16.7)	18 (30.5)	25 (41.7)	33 (56.9)
Does PBL help students elaborate and organize their knowledge?	22 (36.1)	31 (52.5)	39 (65)	41 (70.7)
Is PBL lecture-based hybrid system better than entire lecture-based curriculum?	28 (45.9)	34 (57.6)	40 (66.7)	46 (79.3)
Does PBL enhance the ability to find information using the Internet/library?	30 (49.1)	37 (62.7)	41 (68.3)	44 (78.9)
Is the role of facilitator in the process of PBL helpful?	25 (40.9)	33 (55.9)	38 (63.3)	46 (79.3)
Does PBL improve the decision-making skills?	22 (36.1)	37 (62.7)	40 (66.7)	42 (72.4)

Abbreviation: PBL, problem-based learning.

Table 2 Group mean differences (95% CI) toward the perception of PBL among the study groups

Group comparisons	Group mean difference (%)	95% CI of group mean difference	*P*-value
Is PBL strategy interesting?			
First year vs second year	34.4 to 49.1=–14.7	–16.4 to –5.5	*P*>0.05
First year vs third year	34.4 to 60=–25.6	–31.2 to –20.4	*P*>0.05
First year vs fourth year	34.4 to 68.9=–34.5	–40.1 to –28.4	*P*>0.05
Second year vs third year	49.1 to 60=–10.9	–15.5 to –6.6	*P*>0.05
Second year vs fourth year	49.1 to 68.9=–19.8	–22.4 to –15.5	*P*>0.05
Third year vs fourth year	60 to 68.9=–8.9	–12.5 to –5.6	*P*>0.05
Was proper training of PBL given before its implementation?			
First year vs second year	49.1 to 54.2=–5.1	–8.6 to –3.4	*P*>0.05
First year vs third year	49.1 to 63.3=–14.2	–19.4 to –10.5	*P*>0.05
First year vs fourth year	49.1 to 70.7=–21.6	–23.5 to –18.5	*P*>0.05
Second year vs third year	54.2 to 63.3=–9.1	–12.5 to –7.4	*P*>0.05
Second year vs fourth year	54.2 to 70.7=–16.5	–19.5 to –11.2	*P*>0.05
Third year vs fourth year	63.3 to 70.7=–7.4	–10.1 to –5.8	*P*>0.05
In PBL, is knowledge organized around problems rather than disciplines?			
First year vs second year	44.3 to 55.9=–11.6	–14.6 to –8.8	*P*>0.05
First year vs third year	44.3 to 63.3=–19	–21.6 to –10.7	*P*>0.05
First year vs fourth year	44.3 to 70.7=–26.4	–30.4 to –19.5	*P*>0.05
Second year vs third year	55.9 to 63.3=–7.4	–11.9 to –6.7	*P*>0.05
Second year vs fourth year	55.9 to 70.7=–14.8	–20.5 to –9.6	*P*>0.05
Third year vs fourth year	63.3 to 70.7=–7.4	–10.8 to –5.1	*P*>0.05
Does PBL help students assume responsibility for their own learning?			
First year vs second year	18 to 25.4=–7.4	–11.1 to –4.7	*P*>0.05
First year vs third year	18 to 46.7=–28.7	–36.5 to –19.4	*P*>0.05
First year vs fourth year	18 to 67.2=–49.2	–56.5 to –39.6	*P*>0.05
Second year vs third year	25.4 to 46.7=–21.3	–26.7 to –16.2	*P*>0.05
Second year vs fourth year	25.4 to 67.2=–41.8	–52.5 to –35.8	*P*>0.05
Third year vs fourth year	46.7 to 67.2=–20.5	–30.8 to –17.3	*P*>0.05
Does PBL make students active processors of information?			
First year vs second year	16.7 to 30.5=–13.8	–16.4 to –8.4	*P*>0.05
First year vs third year	16.7 to 41.7=–25	–30.5 to –17.4	*P*>0.05
First year vs fourth year	16.7 to 56.9=–40.2	–44.6 to –29.7	*P*>0.05
Second year vs third year	30.5 to 41.7=–11.2	–18.6 to –8.2	*P*>0.05
Second year vs fourth year	30.5 to 56.9=–26.4	–31.6 to –18.2	*P*>0.05
Third year vs fourth year	41.7 to 56.9=–15.2	–17.6 to –10.7	*P*>0.05
Does PBL help students elaborate and organize their knowledge?			
First year vs second year	36.1 to 52.5=–16.4	–21.4 to –11.6	*P*>0.05
First year vs third year	36.1 to 65=–28.9	–32.7 to –18.2	*P*>0.05
First year vs fourth year	36.1 to 70.7=–34.6	–45.2 to –27.9	*P*>0.05
Second year vs third year	52.5 to 65=–12.5	14.9 to 27.3	*P*>0.05
Second year vs fourth year	52.5 to 70.7=–18.2	–16.3 to –9.8	*P*>0.05
Third year vs fourth year	65 to 70.7=–5.7	–6.7 to –4.6	*P*>0.05
Is the PBL lecture-based hybrid system better than the entire lecture-based curriculum?			
First year vs second year	45.9 to 57.6=–11.7	–20.5 to –7.4	*P*>0.05
First year vs third year	45.9 to 66.7=–20.8	–30.6 to –15.8	*P*>0.05
First year vs fourth year	45.9 to 79.3=–33.4	–45.2 to –27.4	*P*>0.05
Second year vs third year	57.6 to 66.7=–9.1	–13.6 to –6.8	*P*>0.05

(*Continued*)

Table 2 (*Continued*)

Group comparisons	Group mean difference (%)	95% CI of group mean difference	*P*-value
Second year vs fourth year	57.6 to 79.3=–21.7	–29.3 to –17.4	*P*>0.05
Third year vs fourth year	66.7 to 79.3=–12.6	–20.6 to –9.1	*P*>0.05
Does PBL enhance the ability to find information using the Internet/library?			
First year vs second year	49.1 to 62.7=–13.6	–20.6 to –10.2	*P*>0.05
First year vs third year	49.1 to 68.3=–9.2	–16.3 to –4.8	*P*>0.05
First year vs fourth year	49.1 to 78.9=–29.8	–32.7 to –16.5	*P*>0.05
Second year vs third year	62.7 to 68.3=–5.6	–8.8 to –3.7	*P*>0.05
Second year vs fourth year	62.7 to 78.9=–16.2	–19.6 to –7.4	*P*>0.05
Third year vs fourth year	68.3 to 78.9=–10.6	–14.6 to –5.5	*P*>0.05
Is the role of the facilitator in the process of PBL helpful?			
First year vs second year	40.9 to 55.9=–15	–21.4 to –9.3	*P*>0.05
First year vs third year	40.9 to 63.3=–10.3	–15.4 to –7.6	*P*>0.05
First year vs fourth year	40.9 to 79.3=–26.3	–33.4 to –21.7	*P*>0.05
Second year vs third year	55.9 to 63.3=–7.4	–13.5 to –5.8	*P*>0.05
Second year vs fourth year	55.9 to 79.3=–23.4	–30.8 to –19.5	*P*>0.05
Third year vs fourth year	63.3 to 79.3=–16	–21.5 to –12.3	*P*>0.05
Does PBL improve decision-making skills?			
First year vs second year	36.1 to 62.7=–26.6	–32.6 to –14.8	*P*>0.05
First year vs third year	36.1 to 66.7=–30.6	–39.5 to –26.2	*P*>0.05
First year vs fourth year	36.1 to 72.4=–36.3	–45.1 to –28.6	*P*>0.05
Second year vs third year	62.7 to 66.7=–4	–7.2 to –3.3	*P*<0.05
Second year vs fourth year	62.7 to 72.4=–9.7	–13.6 to –5.4	*P*>0.05
Third year vs fourth year	66.7 to 72.4=–5.7	–7.4 to –2.2	*P*>0.05

Abbreviation: PBL, problem-based learning.

for undergraduate dental education. This hypothesis was based upon results from previous studies from Saudi Arabia that assessed the same topic, however, with varying results.[14,19,20]

The present results showed a lack of awareness among students with reference to PBL educational strategy. For example, there was no statistically significant difference in the responses of students from all the academic years regarding their perception about the role of PBL in identifying the areas of weakness and its ability in establishing a concrete action plan to achieve their learning goals. Similarly, none of the students perceived that PBL helps in identifying the areas of weakness requiring improvement and in time management. It is pertinent to mention that an amalgam of basic science and clinical courses are essential components of the curricula at medical and dental institutions.[21–23] Students in the first year of undergraduate dental education are more theoretically oriented and may be more focused on basic sciences as compared to students in the second, third and fourth year of undergraduate dental education. Moreover, at least in the undergraduate dental education in Saudi Arabia, interactions with patients are also limited among undergraduate students in the first year of dental education. From the results of the present study, it is speculated that there is a lack of proper understanding of the concept of PBL among the students. In general, PBL is a complex phenomenon and its objectives are distinct from traditional teaching methods. In this regard, it may be difficult for students (particularly, those in the initial years of undergraduate dental education) to understand the value of PBL. The authors of the present investigation support the results of another study[5] in which students reported that they felt anxious because the program was demanding and that experienced teachers are critical to their success. One way of managing such situations is to increase interactions between instructor/teachers and students and provide exposure to latest resources related to PBL under supervision.

It has been reported that facilitators have an important role in promoting students' language use and the use of information obtained from online resources.[24] Therefore, the establishment of PBL strategy in clinical scenarios might help students discuss treatment plans with their teachers/supervisors and explain them in simple words to their patients. It is also recommended that although PBL involves self-directed learning, direct invigilation by instructors/supervisors/teachers should be kept under consideration as PBL is often challenging for teachers, particularly those who teach using traditional methods.

A limitation of the present study is that the participants were not given prior training with reference to the role of PBL in an educational environment. It is recommended that participation of students as well as teachers in PBL-based educational programs should be periodic, and the evaluation system for students (as well as teachers) should be long term rather than temporary. Although all participants in the present system were females, this may not necessarily compromise the outcomes of the present study. It is also recommended that an online evaluation system should be developed to better understand the effectiveness of PBL and teachers' performance at the PNU, Riyadh, Saudi Arabia.

Conclusion

Within the limits of the present study, it is concluded that there is a lack of awareness among undergraduate dental students at the PNU toward the PBL educational strategy. Prior education of faculty and clear conceptions may be helpful strategies in implementing PBL strategy in educational systems.

Disclosure

The authors report no conflicts of interest in this work.

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