

Attitudes Towards Problem-Based Learning of Faculty Members at 12 U.S. Medical and Dental Schools: A Comparative Study

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Abstract: Problem-based learning (PBL) is a teaching method used in medical and dental education to promote students' problem-solving skills. It may also be a viable tool for interprofessional education in which medical and dental students learn together, collaborate, and learn about, from, and with each other. The aim of this study was to compare medical and dental faculty members' attitudes about and perceptions of PBL at 12 U.S. medical and dental schools known to use PBL. In 2015, 111 medical and 132 dental faculty members (combined n=243) from six medical and six dental schools completed a survey containing ten statements and an open comment section. The response rate was 42% of those who received the survey. In the results, the medical faculty participants showed significantly higher enthusiasm for and agreement with PBL benefits than did the dental faculty participants ($p < 0.05$). The two groups agreed that PBL should be used to supplement conventional teaching ($p > 0.05$). There were no opposite attitudes or contrasts found between the two groups with regards to PBL. The strongest themes expressed by both groups were that PBL should not be used as the sole method of instruction and that students needed a solid foundation in the subject prior to engaging in PBL.

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Problem-based learning (PBL) is a teaching method that was developed in medical education and then adopted in other disciplines due to its benefits and popularity.¹ PBL is applied in small groups in which students become active rather than passive learners, thus enriching student learning both inside and outside the curriculum because it promotes self-instruction.^{2,3} In a PBL environment, students can ask questions and collaborate with each other.⁴ Through this teaching method, student learning focuses on a complex problem that does not have a single correct answer, so PBL can enhance students' problem-solving skills.⁵

A systematic review found evidence to support the use of PBL in medical education, including positive effects on students' social and cognitive competence.⁶ For example, in one study, medical students in a problem-based curriculum had significantly higher scores on the United States Medical Licensing Examination (USMLE) than students

not in a problem-based curriculum.⁷ In addition to its potential to increase standardized examination scores, PBL has been found to significantly improve medical students' performance, understanding, and knowledge retention when compared to conventional lecture-based learning^{8,9} and to create an environment that is humane and stimulating.¹⁰ Another study reported that medical students found PBL to be both useful and enjoyable,¹¹ while another reported it created positive work-related skills for medical graduates in the long term.¹² Other studies found that PBL enhanced the work environment for faculty members¹³ and that most medical faculty members who had used both conventional and PBL curricula favored the latter.¹⁴

Advantages of PBL in dental education may be comparable. One study found that PBL encouraged dental students' critical thinking.¹⁵ Similar to medical students, dental students are expected to apply knowledge learned from other fields to assess, evaluate,

and find solutions for clinical problems.¹⁶ McCarlie and Orr found that PBL was an effective method for improving these skills and allowing dental students to actively assimilate and construct knowledge.¹⁷ Comparable to PBL's potential to improve USMLE scores, Fincham and Shuler found that PBL improved dental students' scores on the National Board Dental Examination (NBDE).¹⁸ Like their medical counterparts, dental students reported PBL to be both useful and enjoyable in Guven et al.'s study,¹⁹ and Bassir et al.'s systematic review found it helped dental students apply their knowledge to clinical situations.²⁰ Bengmark et al. and Yiu et al. reported that PBL improved dental students' perceived preparation for dental practice at the completion of their education.^{21,22} Due to all these advantages, many dental faculty members have been found to be supportive of PBL.²³

Yet as with any other teaching method, PBL has limitations. For instance, studies have found that the implementation approaches to PBL by both medical and dental faculty are quite variable and occasionally inconsistent with what PBL entails.^{24,25} PBL requires well-trained educators with excellent facilitation skills.²⁶ Additionally, PBL faces mixed attitudes and resistance from some faculty members. Wittert and Nelson suggested that the evidence for positive PBL outcomes is lacking and that PBL could result in knowledge gaps.²⁷ Frambach et al. voiced concerns about "student-centered" learning and the universal application of PBL since students in some cultures preferred to learn directly from instructors instead of their peers.²⁸

An advantage of PBL in health professions education is that it provides a viable tool for interprofessional education (IPE) since, in a PBL environment, medical and dental students can learn together, collaborate, and learn about, from, and with each other.²⁹ In one study, these principles were particularly appreciated by dental students in combined PBL groups as they fostered interprofessional learning and promoted career preparation.³⁰ Problem-solving, critical thinking, and collaboration with other health care professionals are skills that can be developed through IPE. We conclude that PBL is an effective constructivist teaching method with several advantages including the potential to serve as a tool for IPE by medical and dental faculty members. It is thus essential to evaluate medical and dental faculty members' attitudes about and perceptions of this method. A comparison of medical and dental

students' attitudes towards PBL at one institution found that the medical students had a more positive attitude towards PBL than the dental students and were more willing to accept it.³¹

Therefore, the aim of this study was to compare medical and dental faculty members' attitudes about and perceptions of PBL at 12 U.S. medical and dental schools known to use PBL. Such an assessment can help identify both similarities and contrasts between the two groups and whether there is a gap in one group's support for PBL. The results could be of value for medical and dental faculty and administrators, especially for those involved in IPE and those who use or are considering using PBL as a tool for IPE involving medical and dental students. Also, this information could be beneficial for those seeking to train faculty members in using PBL.

Methods

The Institutional Review Board of the University of Louisiana at Monroe approved this study as being exempt from oversight (ID # 578-2015). We designed the survey instrument for the study to collect both quantitative and qualitative data. The instrument included ten statements about PBL using terms common to medical and dental educators. The statements were developed to measure and quantify the level of agreement between the two groups about PBL regarding their level of support of PBL; agreement on its advantages; whether PBL requires high-quality clinical problems to present to students; and whether educators should use PBL as an adjunct to, rather than a replacement of, conventional teaching. The survey statements sought to measure each of these study constructs. Our review of the relevant literature helped us develop the survey statements.^{2-4,8,9,15,17,19,20,23}

We tested the survey instrument for content validity and validated it through two methods. First, a panel of four faculty members with significant experience in survey construction provided feedback on each statement's wording and the survey's overall format and structure. Second, six individuals pilot tested the survey and provided feedback on the survey's content, clarity of items, and overall structure. Based on the feedback from faculty members and respondents, we modified the items and finalized the survey.

The survey was built electronically through SurveyMonkey (SurveyMonkey Inc., Palo Alto, CA, USA). On the cover page, the purpose of the research project was defined as comparing the attitudes and perceptions of medical and dental faculty members towards PBL. As some respondents may not be fully aware of what PBL entails, the following PBL definition from Haden et al.'s study was provided: "In PBL, there are no or very few lectures; students learn by an inquiry method through exploration of patient health care problems in small groups guided by faculty facilitators; students take responsibility for guiding their own learning and for teaching their peers. Faculty members function as 'guide on the side' rather than 'sage on the stage.'"³² Participants were informed that the procedure involved completing an anonymous and voluntary online survey that would take approximately two minutes and that there were no risks of or benefits to participation. No names, emails, or other identifying information were collected.

On the second page of the survey were four demographic questions. These questions asked participants to a) self-identify as either a medical or dental faculty member; b) select their academic rank (instructor, assistant professor, associate professor, or professor); c) select whether they were in basic or clinical sciences; and d) select their number of years of teaching experience (0-5, 6-10, 11-15, 16-20, or more than 20). On the third page, participants were asked to indicate their level of agreement with ten statements about PBL on a Likert scale with response options of strongly agree, agree, disagree, and strongly disagree. An optional free-text comment section was provided after each statement.

In 2015, an email invitation to participate in the study was sent to the administrations of 12 institutions that were known to use PBL, asking them to promote involvement in the survey by forwarding it to their full-time faculty members involved in predoctoral medical or dental students' education. The email included the study's purpose, scope, and an embedded URL that linked participants to the survey. Administrators at six medical and six dental U.S. schools forwarded the survey to their faculty once. Participating medical institutions were the State University of New York Upstate Medical University College of Medicine, Temple University School of Medicine, University of Cincinnati College of Medicine, University of Florida College of Medi-

cine, University of Missouri School of Medicine, and Western University of Health Sciences College of Osteopathic Medicine of the Pacific. Participating dental institutions were Howard University College of Dentistry, New York University College of Dentistry, The University of Texas School of Dentistry at Houston, University of California, Los Angeles School of Dentistry, University of Illinois at Chicago College of Dentistry, and University of Washington School of Dentistry. These medical and dental schools encompassed a variety of locations, founding years, and class sizes and both private and public universities.

Survey validity was assessed by Pearson product moment correlations using SPSS. To measure the internal reliability of the survey instrument, Cronbach's alpha was calculated using SPSS. Cronbach's alpha is a numeric score ranging from zero to one used to measure or estimate the reliability of survey instruments. This score reflects the internal consistency of survey items and measures the extent to which survey items are correlated with each other. A value above 0.70 is favorable, and a value above 0.80 indicates high reliability.³³ Using a priori power analysis, the statistical power was set at 0.8, the significance level at 0.05, and the effect size at 0.4. This determined the minimum number of respondents required in each group to be 100 and the total sample size to be 200 in order to achieve a statistical power of 0.8. The test of survey validity resulted in statistically significant Pearson correlations values ($p < 0.05$) from 0.434 to 0.889. All these values were higher than Pearson correlation's critical value of 0.139, which was determined based on the sample size and significance level (0.05), indicating validity of all survey statements. Reliability analysis of this survey resulted in a Cronbach's alpha score of 0.857, indicating high reliability of this survey.

To analyze the quantitative data collected in SurveyMonkey Inc.'s system, we exported the data to an encrypted personal computer. For statistical analysis, SPSS for Windows version 22.0 (IBM Corp., Armonk, NY, USA) was used. As the study sample contained two independent groups (medical and dental faculty) and the outcome variable responses were measured on an ordinal four-point Likert scale, Mann-Whitney U test was used to investigate whether any statistically significant differences between these two groups existed. Significance level (α) was set at 0.05. Cross-tabulating and filtering

results functions in SPSS and SurveyMonkey were used to analyze data by subgroup, thereby narrowing results to one subgroup at a time and filtering out results of other subgroups.

To analyze the qualitative data, we collated all the gathered comments into a Word document. The qualitative data were then coded to identify the overarching themes and subthemes presented by both groups. After all qualitative data were coded in this manner, passages that shared common codes were organized together, and responses of medical and dental faculty were again compared. The qualitative data were triangulated with the quantitative data to better understand the findings, draw conclusions, and make recommendations. Valuable comments made by medical and dental faculty members were identified regarding faculty concerns about PBL and its appropriate integration into current curricula.

Results

A total of 111 medical faculty members and 132 dental faculty members completed the survey, for an estimated response rate of 42% of those who received the survey (34% of medical faculty and 53% of dental faculty who received the survey responded). The distribution of participants by academic rank was as follows: 10% instructors, 28% assistant professors, 30% associate professors, and 32% professors. Of these respondents, 35% were in basic sciences, and 65% were in clinical sciences. The distribution of participants by years of teaching experience was as follows: 14% had 0-5 years, 16% had 6-10 years, 15% had 11-15 years, 13% had 16-20 years, and 42% had over 20 years.

No statistically significant differences were found between respondents of different academic ranks, between basic and clinical science faculty members, between respondents with different number of years of teaching experience, or between respondents from different schools ($p>0.05$). However, based on results of the Mann-Whitney U test, statistically significant differences ($p<0.05$) between medical and dental faculty respondents were found for nine of the ten statements regarding PBL (Table 1). There was no statistically significant difference for only one survey statement: that PBL should be used as a supplement to, not a replacement of, conventional teaching ($p=0.105$).

On the first nine statements in the survey, medical respondents showed significantly higher support for PBL than did dental respondents, as evidenced by two outcomes. First, the average ratings of these statements were significantly higher for medical faculty. The average ratings were calculated based on the weight of 1 to 4 assigned to the Likert scale (strongly disagree to strongly agree), and a higher rating showed higher agreement with the statement. Second, most medical respondents strongly agreed with most of the first nine statements, whereas most dental respondents agreed with these statements. This pattern of ratings of the two groups resulted in the statistically significant difference between their responses on the first nine statements in the survey.

The medical and dental faculty respondents provided 193 comments, including some concerns about PBL and some examples for appropriate integration of PBL. Table 2 presents themes and selected examples of comments made by members of both groups.

Discussion

In this study, medical and dental faculty members' attitudes about and perceptions of PBL were assessed and compared. Figure 1 shows the average ratings on each survey statement by the medical and dental respondents. This figure demonstrates that both groups tended to agree with all statements in the survey, yet there was a significantly higher agreement by medical faculty for the first nine of the ten statements. Another comparative study found that medical and dental students showed positive attitudes about PBL curricula, but the support of medical students for PBL was significantly higher than that of the dental students, and the dental students were more resistant than the medical students to further expansion of PBL in their curricula.³¹

The PBL method was originally intended as a complete replacement of conventional teaching for preclinical medical curricula.³ However, in our study, 76% of the medical faculty members and 83% of the dental faculty members either agreed or strongly agreed with the statement that PBL should be used as an adjunct to, not a replacement of, conventional teaching.

Analysis of the qualitative data obtained via the free-text comment section showed comparable perspectives in the two groups. The medical and dental

Table 1. Attitudes about problem-based learning (PBL) of medical (N=111) and dental (N=132) faculty members, by number and percentage of total respondents in each group to each statement

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree	Average Rating	Standard Deviation	Z statistic	p-value
1. I am enthusiastic about PBL.								
Medical	54 (49%)	40 (36%)	16 (14%)	1 (1%)	3.32	0.75	-2.922	0.003*
Dental	37 (28%)	69 (52%)	21 (16%)	5 (4%)	3.05	0.77		
2. PBL is an effective learning method.								
Medical	55 (50%)	48 (43%)	7 (6%)	1 (1%)	3.41	0.65	-3.041	0.002*
Dental	41 (31%)	73 (55%)	15 (11%)	3 (2%)	3.15	0.70		
3. PBL encourages students' independent thinking.								
Medical	59 (54%)	46 (42%)	5 (5%)	0	3.49	0.59	-2.958	0.003*
Dental	44 (33%)	82 (62%)	4 (3%)	2 (2%)	3.27	0.59		
4. PBL enhances students' critical thinking skills.								
Medical	58 (53%)	48 (44%)	4 (4%)	0	3.49	0.57	-2.746	0.006*
Dental	47 (36%)	72 (55%)	9 (7%)	2 (2%)	3.26	0.65		
5. PBL improves students' skills in problem-solving.								
Medical	55 (50%)	52 (47%)	4 (4%)	0	3.46	0.57	-2.559	0.010*
Dental	44 (34%)	77 (59%)	7 (5%)	2 (2%)	3.25	0.63		
6. PBL enhances students' understanding of the subject.								
Medical	46 (43%)	44 (42%)	14 (13%)	2 (2%)	3.26	0.76	-3.082	0.002*
Dental	28 (22%)	76 (58%)	23 (18%)	3 (2%)	2.99	0.70		
7. PBL improves students' communication skills.								
Medical	40 (36%)	55 (50%)	15 (14%)	0	3.23	0.67	-2.406	0.016*
Dental	24 (18%)	89 (68%)	17 (13%)	1 (1%)	3.04	0.59		
8. PBL enhances clinical reasoning.								
Medical	49 (45%)	53 (49%)	7 (6%)	0	3.39	0.61	-2.243	0.025*
Dental	40 (31%)	78 (60%)	10 (8%)	2 (2%)	3.20	0.64		
9. PBL requires high-quality clinical problems to present to students.								
Medical	67 (62%)	34 (31%)	6 (6%)	1 (1%)	3.55	0.65	-4.784	<0.001*
Dental	39 (30%)	71 (55%)	19 (15%)	0	3.16	0.65		
10. PBL should be used as an adjunct to, not a replacement of, conventional teaching.								
Medical	35 (32%)	48 (44%)	18 (16%)	9 (8%)	2.99	0.90	1.619	0.105
Dental	50 (38%)	59 (45%)	21 (16%)	1 (1%)	3.21	0.73		

Note: Percentages may not total 100% because of rounding. Some respondents skipped some statements.

*Statistically significant at $p < 0.05$

respondents voiced similar themes and had comparable concerns about this method, including that PBL could lead to knowledge gaps and that the teaching method depended on the instructor, the student, and the problems used during instruction. The strongest themes in both groups were that PBL should not be used as the sole method of instruction and that students required solid foundation first before being exposed to PBL.

We can speculate about the reasons for the higher ratings by the medical respondents than the dental respondents in our study. PBL was originally developed in medical education, so it is relatively

newer in dental education. The most recently available reports about the status of PBL suggest that PBL is more often used in medical education than dental education. A 2003-04 survey found that 70% of U.S. medical schools implemented PBL in the preclinical years,³⁴ whereas only 50% of U.S. dental schools had adopted PBL as of 2009, either entirely or in part.³² Additionally, dental curricula are well known to be overcrowded, and PBL is often viewed as an add-on.³⁵ Some dental faculty members may not be fully aware of the benefits of PBL or lack comprehensive training on this method. Schönwetter et al. suggested that dental faculty training in PBL should be continuous.³⁶

Table 2. Selected concerns about problem-based learning (PBL) expressed by medical and dental faculty members: number of responses for each in parentheses

Area of Concern	Medical Faculty	Dental Faculty
Faculty concerns about PBL	<ul style="list-style-type: none"> • Could result in knowledge gaps (3) • Instructor-dependent (3) • Student-dependent (4) • Problem-dependent (2) • Challenging student assessment (2) • Time-consuming (3) • May promote shortcuts (1) 	<ul style="list-style-type: none"> • Could result in knowledge gaps (5) • Instructor-dependent (3) • Student-dependent (3) • Problem-dependent (3) • Time-consuming (4) • Labor-intensive method (2) • May be confusing (2)
Appropriate integration of PBL	<ul style="list-style-type: none"> • Should not be used as sole method of instruction (5) • Requires solid foundation first (3) • Faculty training is required (2) • PBL depends on delivery (3) • Should be backed up by core set of lectures (1) • PBL cannot teach everything (1) 	<ul style="list-style-type: none"> • Should not be used as sole method of instruction (6) • Requires solid foundation first (3) • Faculty training is required (2) • PBL depends on delivery (2) • Requires high-quality cases (2) • Problem-solving must be evaluated pre- and post-training (1)

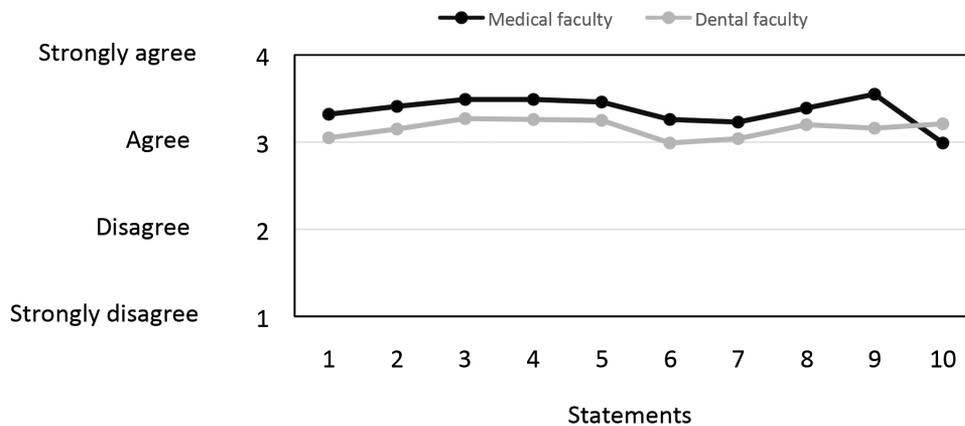


Figure 1. Average ratings of ten statements by medical and dental faculty members in study

Note: See Table 1 for the ten statements.

However, to create an effective impact of PBL, dental faculty members are expected to have pedagogical expertise and experience about PBL in order to ensure effective delivery of this method.³⁷ Furthermore, if PBL is the teaching method of choice for delivery of IPE, Lindqvist and Reeves reported that faculty members' expertise and training in PBL were vital in promoting IPE in PBL settings.³⁸

In 2010, Haden et al. surmised from their survey of U.S. dental schools that PBL use in dental curricula was unlikely to significantly increase in the future.³² According to the results of that study, current priorities in dental education did not appear

to include the increase of PBL; rather, they focused on creating interdisciplinary curricula and collaborating with other health professions schools in IPE. Nevertheless, we believe that PBL provides an excellent opportunity for IPE collaboration, especially because PBL is suitable for both medical and dental education and can be used as a tool to facilitate IPE, which is increasingly being incorporated into dental curricula.³⁹ According to Thompson, PBL and IPE work together quite well.²⁹ Dolmans et al. found that PBL stimulated collaboration between students,⁴⁰ a particular advantage achieved through IPE. IPE can train medical and dental students early in their careers

to promote patient-centered health care in which physicians and dentists collaboratively provide the best health care possible for their patients. Therefore, PBL could be considered if medical and dental students are to learn together during their training, according to Amin et al.³⁰

Our study had a number of limitations. First, the survey included only a limited number of schools in the U.S. known to use PBL, and some schools that are leaders in PBL were not included, so the results are not generalizable and are not representative of all medical and dental schools in the U.S. and abroad. Second, this study was not intended to assess faculty members' attitudes about all aspects and characteristics of PBL. Third, the survey could have been expanded to include other aspects of PBL, such as students' involvement during PBL sessions, the percentage of students who appear to be engaged, and their performance after PBL. Fourth, the study did not ask about the level of faculty training in PBL. Since the schools selected were known to use PBL, the role of the respondents in PBL could have affected their perspectives one way or another. Faculty members who do not use PBL may not have the same attitudes about it as do those who use this teaching method.

Areas and suggestions for future research on PBL could include more schools that do not use PBL, as well as addressing the limitations of this study. For example, it would be valuable to assess how the level of PBL training or implementation efforts affected faculty members' perspectives on this teaching method. Future PBL research could also assess the attitudes and perceptions of clinical faculty members and those who teach exclusively in the classroom and whether there are differences between these two groups. Finally, future PBL research could assess and compare the attitudes and perceptions of faculty members in other health care disciplines, such as nursing or pharmacy.

Conclusion

This study found that both the medical and dental faculty respondents were enthusiastic about PBL, and the two groups agreed about its benefits. There were no opposing attitudes or contrasts found between the two groups with regards to PBL. However, the medical respondents showed significantly higher enthusiasm for PBL and agreement with PBL benefits than did the dental respondents. This find-

ing points to the possible need for increased dental faculty exposure to this method and/or faculty development programs for dental faculty on PBL, perhaps especially for those who use or will consider greater use of PBL as a tool for advancing IPE involving medical and dental students.

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