Comparing Student-Generated Learning Needs with Faculty Objectives in PBL Cases in Dental Education


Abstract: The purpose of this study was to compare learning need reports generated by students during their investigation of a problem-based learning (PBL) case with the faculty-identified learning objectives established for it. Four PBL cases facilitated by four group tutors were selected for comparison. The student-generated learning needs were collected for each and were compared to the faculty-specified learning outcomes. The results were analyzed by individual case and compared among the four student groups. Over 96 percent of the faculty-specified objectives across all four cases and across all four groups of students were covered by the student-generated learning need reports. Only one of the four cases demonstrated a statistically significant difference between small groups with regard to percent coverage of the stated case objectives. Our data agree with previous research findings. Although there was some variability in the learning objectives investigated by student small groups studying the same case, the faculty-specified case objectives were included in the student-generated learning needs. First-semester dental students were capable of generating learning needs that produced an excellent match with the faculty objectives for the cases studied.

Keywords: problem-based learning, PBL, learning need reports, case objectives, student learning variability, dental education

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Dental and medical education have been evolving from traditional pedagogies that are primarily lecture-based to teaching models that use small groups and inquiry as critical elements of the learning. Many curricula now use problems or cases to initiate learning and increase student engagement in the process of learning. The move to small-group learning has taken on considerable momentum in health sciences education. Problem-based learning (PBL) is a student-centered pedagogy with an emphasis on cooperative learning and student reflection on the thinking processes. This pedagogy has been incorporated into medical school curricula since the 1960s and is widely used in medical schools around the world. Dental education has begun to incorporate PBL pedagogy, and the number of schools using PBL in some way is steadily growing. Various styles of PBL have been implemented, but the focus of the pedagogy remains on a set of common elements: student-centered learning, collaborative and cooperative learning, small-group learning, critical thinking, problem-solving driven by clinical cases, regular self- and peer evaluations, emphasis on student reflection, and development of skills for lifelong learning. In a PBL curriculum, students are presented with cases that represent ill-structured interdisciplinary clinical scenarios that become the focus for discussion.

The cases that a group of students investigate are designed to guide the students toward learning objectives that have been defined by faculty members and that contribute to the content of the curriculum. Direct faculty instruction is reduced in PBL, so that the students assume greater responsibility for their own learning. In the University of Southern California Herman Ostrow School of Dentistry’s PBL program, the cases are typically structured in six parts over six sessions intended to sequentially introduce the specific details of the case. Each segment of the case requires the students to identify the facts (what they know), develop hypotheses (what they think), and generate a set of learning needs (what they need to know). The investigation of the learning needs provides new evidence to evaluate the
hypotheses and lead to greater understanding of the nature of the simulated patient’s signs, symptoms, and condition. The learning needs are investigated by the students between the facilitated PBL sessions and generate the new content that a student acquires while investigating the case.

One area that concerns both students and faculty members is related to how well the students address the learning objectives identified by the faculty members when they developed the case and integrated that particular case into the overall curriculum. Students wonder if they cover the right things, and faculty members wonder if the students cover what they intended. Thus, the two groups have similar concerns about content. Many students and some faculty members are concerned that some small groups may not cover the school’s intended learning objectives and that there may be substantial variation between small groups with respect to learning. This potential variation may depend on factors such as facilitator skills, group dynamics, prior student knowledge, and quality of the case design. This situation leads to a common criticism of PBL: that there will be gaps in student knowledge. Yet gaps in knowledge are always present in traditional curricula since no class ever has all students receiving 100 percent scores on all course examinations.

Previous studies on this issue have examined how often and to what degree student-generated learning need reports and faculty-developed specific objectives match. There are wide ranges of values reported for the correlation in a review of five studies: percent agreement between student-completed learning needs and faculty-specified learning needs ranged from a low of 39.6 percent to a high of 79 percent. One of the first studies on this topic was in 1984; it examined the match between faculty objectives and student learning issues and reported that only a 42 percent match was achieved. In 1986, another study examined the match between faculty objectives and student learning issues using an analytic method based on experts’ judgments and a text reconstruction. The expert judgment method resulted in an average percentage overlap of 68.3 percent, and the text reduction method in an overlap of 39.6 percent. In a 1994 study, the match between learning need reports and faculty objectives was reported to be a 64 percent match. In 2004, another study involved sixteen students in two study groups enrolled in training in psychotherapy. These students generated 228 learning need reports as they worked on various problems. The learning need reports were compared to the faculty objectives for these problems. The correspondence between faculty objectives and learning need reports was 79 percent in groups and 82 to 88 percent among individual students. Finally, in 2007, one study reported on a longitudinal study involving 407 PBL students and five cases over a three-year period. These investigators reported significant variability in content of learning issues generated by the various groups and reported that the percentage of learning need reports that matched the general case objectives varied from 21 to 100 percent.

One approach to increasing the number of on-topic learning need reports is to give students a list of stated objectives for the case and insist that they cover these objectives before going off-topic. However, when the faculty fully dictates what the student should study by assigning the students specific learning topics, it changes the dynamics of the pedagogy from a student-centered to a faculty-centered process, even though making the teacher-generated learning objectives available to students did not subvert the exercise of self-directed learning skills. In the same vein, another study reported that first-year students were found to confine themselves more strictly to the content of learning issues than more senior students. This implies that the selection of learning issues may be more critical in earlier years of training.

Our hypothesis is that there is little to no variance between various PBL groups with respect to learning outcomes when investigating identical cases. The purposes of this study were to explore the congruence between first-trimester dental student-generated PBL learning needs and faculty-developed learning objectives and to investigate the degree of variability among the student small groups for each case.

Methods

During the first two years of the Doctor of Dental Surgery program at USC, each PBL group normally completes six cases per trimester. We randomly selected four cases from the first year, first trimester, and four small groups (thirty-two students out of a class of 148) for this study. Each case required six sessions, with eight learning needs (one per student) generated per group for each of the first five sessions. This resulted in thirty-two learning needs per session and 160 per case. The four cases produced 640 learning needs to compare with faculty objectives.
In the PBL process used in our small groups, the first step is to identify the facts that are known in the case. Based on the facts, the next step involves the students’ engaging in critical thinking to define their ideas/hypotheses to explain the facts of the case. As the students discuss these ideas, it becomes clear to them where their gaps in knowledge exist, and they determine the learning needs that they need to accomplish to evaluate whether their ideas/hypotheses are reasonable. The learning needs always come from the ideas/hypotheses defined by the group. There may be any number of learning needs generated, but to gain this new knowledge the students need to research the topics.

The convention for researching learning needs is that individual research a subset of the learning needs and generate a learning packet that is circulated to all members of the group. Since the group size is typically eight students, there will be eight learning packets generated with each part of the case. Learning needs are written in a word document containing a summary in the beginning in which the students explain how this learning need is relevant to the case and how it furthers the understanding of the patient’s presentation in the case. The hypothesis assigned to that learning need topic is also covered and explained by the student. The hypotheses are either accepted or rejected based on research.

Faculty objectives are not provided to students before the case is studied. The number of faculty objectives varies from eight to eleven, depending on the case. Each small-group facilitator is experienced and fully credentialed, having completed a faculty development workshop program in PBL. For our study, these facilitators saved all the learning need reports from their groups for all five sessions. At the completion of each session, students generated an Excel document that contained the facts, ideas, and learning need topics related to that session and sent it to every group member and the facilitator. These Excel sheets were deidentified and then collected from the facilitators.

The student-generated learning needs for each case were compared to the faculty’s written specific objectives. Two faculty members (M.O. and N.H.) independently evaluated all of the learning needs and rated whether each student-generated learning need matched a specific faculty objective for each case. These results were analyzed by individual case and by comparing differences among the four small groups. This involved counting how many learning need reports (percentage of total) by case were matched to one of the specific stated case objectives.

In a second analysis, we calculated the number of learning need reports per case that could not be matched to any specific faculty objective. If the learning need matched a faculty written objective, it was considered a relevant learning need. If the learning need did not match, it was relegated as a peripheral learning need. With regard to group differences per case, we used the ANOVA F-test to compare the differences between groups for each case. We ran a repeated measures test with cases as the between-subjects factor to test for differences between cases and to look for an interaction between groups and cases (groups * cases).

Results

Regarding matched learning need reports (relevant), data from our four cases (numbers 032, 096, 098, 118) revealed that the groups generated learning need reports that were matched to the faculty-identified learning objectives 96.6 percent of the time (Table 1). Only 3.4 percent (6/148) of the specific case objectives across all four cases by all four groups were not covered by the students’ learning need reports. This means that, in 96.6 percent of all cases, all the stated objectives were covered and usually more than once. A single learning need usually covered what a group needed on a topic. However, in many instances, a topic was covered more than once by a group. Thus, while there appeared to be variation in the student achievement on each case, this was primarily linked to students doing learning on topics not included in the faculty-specified learning objective list.

Regarding non-matched learning need reports (peripheral), PBL is based on open inquiry for evaluating the case being analyzed. Consequently, a student group will often require additional information related to topics that the faculty has not identified as central to the learning objectives of the case. Thus, there will be learning achieved by a student group that is not matched to the faculty-specified learning objectives. The range of non-matched learning need reports to the faculty-stated objectives varied from 31.4 percent to 45.5 percent of the total learning need packets generated by the students.

The average variability for each of the four groups by case was measured. Only one of the four cases presented statistically significant group dif-
ferences (case 096: F=4.85; p=.007) in percentage of matched learning need reports. The other three PBL cases had no significant differences between groups: case 032: F=1.07 (p=.384); case 098: F=2.25 (p=.105); and case 118: F=.22 (p=.884). The cases were not significantly different in terms of percentage of matched learning reports (test of between-subjects effects F=2.45; p=.068). There was no statistical interaction between groups and cases (group * cases) (F=1.25; p=.272). Over 96 percent of all the objectives were covered by the groups, often more than once during the small-group learning sessions.

Discussion

Several studies have examined the achievement of student groups with respect to the learning objectives defined by faculty that were linked to specific PBL cases. There is a range of findings in these studies between about 40 percent and nearly 80 percent; however, the approaches used are variable and it is difficult to determine the meaning of such differences. The conclusion of these studies was that students do complete the intended learning objectives in a PBL case and thereby achieved the progress that was intended by the course developers. In our analysis of student investigation of PBL cases, we found that the student groups do investigate the learning objectives identified by the faculty for the PBL cases, which is in agreement with the outcome summaries from the previous studies.

In our cases, 96.6 percent of all faculty-stated objectives were covered by all groups investigated. The validation of this type of outcome is important with any new case and is central to the use of an inquiry-based PBL to deliver a dental curriculum.

In addition to achieving the faculty-intended learning outcomes, students identified learning issues in areas that were peripheral to the central themes of the case (31.4 percent to 45.5 percent of learning needs were judged as peripheral topics). PBL is student-centered, and each small group determined the areas of content required for them to effectively analyze the signs and symptoms presented by a case. This means that every student group assessed its level of knowledge on all areas related to their investigation, and if they determined a need for additional material on a certain theme, they added it to their work on the case. The topics they chose to explore may have been a review of areas previously covered or topics of interest unrelated to patient presentation. However, the fact that students followed a path peripheral to the case did not mean that their time was lost or wasted since many of these topics were featured for the students as an initial introduction to topics they would encounter later. Students were encouraged to assess the limits of their knowledge and develop a process to extend their understanding.

Some topics were covered more than once by the group members during the case. This is further demonstration that the small group continued to identify gaps in knowledge as they assessed the case. If a small group did not have sufficient information to test a hypothesis, members elected to generate more information in the area. Since some learning objectives addressed more complex topics, frequently more learning need reports were required to cover the topic at the depth required for the small group to fully analyze the case. Some learning objectives

| Table 1. Percent of learning needs generated congruent with faculty-stated objectives |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Case 032 | 8/8 (100%) | 8/8 (100%) | 6/8 (75%) | 8/8 (100%) | 94%±12.5 |
| Case 096 | 11/11 (100%) | 9/11 (82%) | 11/11 (100%) | 10/10 (100%) | 96%±9 |
| Case 098 | 10/10 (100%) | 10/10 (100%) | 10/10 (100%) | 10/10 (100%) | 100%±0 |
| Case 118 | 8/8 (100%) | 7/8 (88%) | 8/8 (100%) | 8/8 (100%) | 97%±6.3 |
| Mean±s.d. (by group) | 100%±0 | 92.5±9 | 94%±12.5 | 100%±0 |

Note: Mean of means±1 s.d. (by case)=96.6%±2.6; (by group)=96.6%±6.4.
were more focused and therefore adequately covered by the completion of a single learning packet. Some specific objectives were addressed as minor learning objectives in previous cases, so this previous learning provided a more advanced stage of understanding of the current topic.

We found the first-year dental students in their first trimester (PBL naïve) were skilled at generating learning needs congruent with faculty objectives. Further analyses are planned to assess the way that more experienced students progress through a PBL case and their adherence to the faculty-specified learning objectives.

While faculty guidance towards the stated objectives through the use of guiding questions is considered appropriate, it did not appear to stifle the important student-centered learning aspects of PBL. The student groups pursued a large number of topics that were not included in the faculty-specified learning objectives. Our data demonstrated that only in one case were minor differences observed between groups in how well they matched their learning need reports with the stated case objectives, yet even in that case the student group covered the majority of all the intended objectives. The underlying assumption in a PBL curriculum is that the students will be guided towards the intended learning objectives through the PBL cases and cover the intended specific objectives for each case. Our analysis of the learning objectives covered by the students in the small groups supports the premise that the case will lead students to learn the material identified by the faculty as necessary to achieve competence. It is important to emphasize that the faculty-defined learning objectives for a specific case are not given to the student groups at the completion of the case; thus, there is no institutional memory of the correct learning objectives that should be investigated by the student group for any specific case. The generation of learning needs occurs following the generation of ideas/hypotheses and is uniquely approached by the students in every case. These ideas are truly the generator of learning and are always unique for each group. The tutors do track the progress of the group, and if there are areas that do not appear to be covered, the tutors may use guiding questions to facilitate the group’s investigations of important concepts. Additional data are required to evaluate the contributions of faculty facilitator style and facilitation experience in the achievement of students towards completing all the faculty-specified learning objectives.

REFERENCES


