Problem-based learning (PBL) allows students to address knowledge deficits by providing them with a clinical case so that they explore all aspects of patient care. The advantages of PBL for students include improving critical thinking skills, increased clinical reasoning, and exposure to self-directed learning. Although PBL is commonly used in medical education, it seems to be seldom used in nurse anesthesia education. An evidence-based review was conducted to identify barriers to implementing PBL and methods to address these barriers. Common barriers to PBL implementation were categorized as faculty resistance, student concerns, and resource limitations. Interventions to help address these barriers were presented to aid nurse anesthesia educators in incorporating PBL into the curriculum.

Keywords: Active learning, nurse anesthesia education, problem-based learning.

T

Training future Certified Registered Nurse Anesthetists (CRNAs) presents the nurse anesthetist educator with many challenges, including limited resources, staffing limitations, and time constraints. These factors limit the CRNA educator’s ability to offer alternative teaching methods that foster development of critical thinking. Not only do educators face the demands of preparing students for the doctorate-level entry-to-practice, they also must consider the effectiveness of their educational methods. Despite these challenges, it may be possible to incorporate more innovative practices for teaching student registered nurse anesthetists (SRNAs).

McMaster University’s medical school in Hamilton, Ontario, Canada, introduced the problem-based learning (PBL) method in 1969, in response to reports of unsatisfactory clinical performance by medical students. Educators desired to improve their students’ critical thinking skills and used this question-based problem processing to achieve that end. Before the utilization of PBL, medical education focused on memorization of fragmented facts, which left many students unable to address pertinent clinical issues. In the PBL setting, learners evaluate multiple factors in a patient scenario including the differential diagnosis, laboratory testing, interventions, and selecting pharmacologic agents, which allows them to elicit connections earlier in their training.

Active learning techniques such as small-group discussion, case presentation, and high- and low-fidelity simulation scenarios are included in the framework of PBL. For example, a short case of an adult patient with a potentially difficult airway presenting for a laparoscopic cholecystectomy could be presented to the class (Figure 1). The class then could form into small groups and formulate an approach to this case. The groups would then present their approach to the entire class. Nurse anesthesia practice requires acute critical problem solving, and PBL offers students a way to develop this skill. The authors examined the potential barriers to successful implementation of PBL in nurse anesthesia education and methods to address these barriers.

Materials and Methods

• **PICO Question.** The PICO (problem, intervention, comparison, outcome) question was: “What barriers exist (P) to implementing PBL (I) in a traditional nurse anesthesia curriculum (C), and how can these barriers be addressed (O)?”

• **Search Strategy.** The search for evidence (1990-2017) examined PubMed, the Cochrane Database of Systematic Reviews, the Education Resources Information Center (ERIC), Google Scholar, and the Cumulative Index of Nursing and Allied Health Literature (CINAHL). The search terms applied both individually and in combination were: PBL, problem-based learning, barriers, problems, implementation, nurse anesthesia education, and medical education. Inclusion criteria included research studies, systematic reviews, and case reports involving human participants published in English in a full-text form in peer-reviewed journals addressing the PICO question. We anticipated there would be little evidence describing implementation of PBL in nurse anesthesia programs, so we included evidence from other graduate-level health education specialties.

Individual studies included in an appraised systematic review were not individually appraised. Studies included in more than 1 systematic review were noted. Reference lists of the included evidence were examined.
for other evidence sources. Sources were included based on a review of the title, abstract, and finally the full text. The evidence was appraised using the method described by Melnyk and Fineout-Overholt. Attributes such as inclusion criteria and appraisal method were noted for systematic reviews and randomization and sample size determination for clinical trials. Evidence levels ranged from Level I (systematic review of randomized controlled trials) to Level VII (expert opinion).

**Results**

The search resulted in 47 potential evidence sources, with 23 sources meeting the inclusion criteria. The disciplines represented included medical education,6-8,11-13,15,16,18-20,22,24,25,27 dental education,8,14,16,19 nursing,8,14,16,19 physician assistant studies,12 biomedical engineering,28 pharmacy,15 and occupational therapy/physiotherapy.11,13 One source evaluated PBL comprehensively and provided insight into the wide applicability of PBL in many educational settings.22

Mixed-methods studies were useful in identifying barriers to implementing PBL and ways to address the barriers.11,12,18 This shared experience across studies reveals that these barriers could be anticipated by leaders of similar programs when implementing PBL.10,14,16,18,20,22,23 Moreover, case reports provided valuable insight into the experiences of programs, educators, and students as they underwent the initial implementation of PBL curriculum.6,7,15,17,24,26,38 The inclusion of these sources provided valuable and applicable evidence regarding methods to overcome barriers encountered along the process.6,7,15,17,24,26,28 Table 2 summarizes the potential barriers to successful implementation of PBL and ways of addressing those barriers, which are discussed in detail in the Discussion.

**Discussion**

The evidence suggested that there are several barriers to successful implementation of PBL, including faculty, resources, and students.

• **Faculty Barriers.** Faculty engagement and enthusiasm about the implementation of PBL is a crucial first step. Faculty often resist change, as some individuals may not want to deviate from the lecture approach. Equipping faculty with the skills to facilitate PBL is a vital part of successful change.6,7,10,14,16,26,27 The benefits of PBL are limited unless learners are guided by faculty who are skilled in PBL and its knowledge acquisition.21

Table 2: Potential Barriers

<table>
<thead>
<tr>
<th>Category</th>
<th>Barriers</th>
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<tbody>
<tr>
<td><strong>Faculty Barriers</strong></td>
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<td><strong>Student Barriers</strong></td>
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<td><strong>Curricular Barriers</strong></td>
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<td><strong>Organizational Barriers</strong></td>
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</table>

Table 1: Problem-Based Learning Case Script Template

**Patient Name:** John Smith (fictitious name)

**Patient Profile:** 55-year-old man

**Reason for Visit:** Mr. Smith presents for a laparoscopic cholecystectomy.

**History of Present Illness:** Mr. Smith presented to the emergency department 36 hours ago with nausea, vomiting, and right-sided abdominal pain.

**Weight:** 88 kg

**Surgeries:** Anterior cervical discectomy 2 years ago

**Anesthetic/Surgical Complications:** Postoperative nausea and vomiting with prior surgery

**Serious Injuries:** None

**Medications:** Aspirin, 81 mg every day

**Medication Allergies:** No known medication allergies

**Food Allergies:** No known food allergies

**Transfusions:** None

**Social History:** Mr. Smith is an insurance salesman in Raleigh, North Carolina. He lives at home with his wife. He has 2 children, ages 21 and 24.

**REVIEW OF SYSTEMS**

**Head/Neuro:** No seizures, strokes, or epilepsy

**Eyes:** No changes in vision, no eye pain or discharge

**Ears:** No pain, ringing, or change in hearing

**Throat/Mouth:** No trouble swallowing. No sores or dental problems

**Skin, Hair, and Nails:** No rashes, itching, or skin/nail changes

**Respiratory:** No arrhythmias, or heart murmur

**Cardiovascular:** No arrhythmias, or heart murmur

**Liver:** No history of jaundice, hepatitis, or liver failure

**Gastrointestinal:** No history of kidney disease or failure

**Endocrine:** No heat/cold intolerance or excessive sweating. No diabetes, thyroid, pituitary, or adrenal problems.

**Hematologic:** No bleeding

**Musculoskeletal:** No history of muscle disease

**PHYSICAL EXAMINATION**

**Airway:**

Mallampati class 3

TM Distance (FB): 3

Neck ROM: Very limited ROM (flexion/extension/rotation)

Oral Aperture (FB): 2

**Vital Signs:**

BP 120/80 mm Hg; Pulse 88/min; Temperature 36.7°C (98°F);

Height 180.3 cm (5 ft 11 in); SpO₂ 98%

**CASE OBJECTIVES**

1. Review Mr. Smith’s preoperative assessment and consider other questions to prepare for him during your preoperative visit.

2. Consider Mr. Smith’s history and scheduled surgery. Develop an anesthetic plan with rationale for each step.

3. What are your postoperative concerns for Mr. Smith?
<table>
<thead>
<tr>
<th>Evidence source, evidence type/level of evidence, country</th>
<th>Number</th>
<th>Barriers to PBL implementation</th>
<th>Other findings</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand'Maison &amp; Des Marchais, Qualitative case report-Level VI Canada</td>
<td>1 medical school (follow-up of faculty who attended PBL workshops); 207 members</td>
<td>Faculty did not acknowledge need for change; Need for faculty development</td>
<td>Faculty satisfaction higher after implementation of PBL; Increased faculty interest in educational development</td>
<td>Response rate=80%; Data collection tool not evaluated for reliability or validity</td>
</tr>
<tr>
<td>Des Marchais et al, Qualitative case report-Level VI Canada</td>
<td>1 medical school (faculty attended 2-day PBL workshop before implementation)</td>
<td>Students found PBL demanding but stimulating; Additional faculty time and training required</td>
<td>Improved teacher attitude toward PBL; Promoted independent learning; No additional cost incurred</td>
<td>Before PBL, this program suffered from excessive course content, lecture-only, and poor congruence between evaluation and course objectives</td>
</tr>
<tr>
<td>Creedy &amp; Hand, Qualitative survey-Level VI Australia</td>
<td>1 program (14 nurse educators who attended PBL professional development)</td>
<td>Faculty and students’ prior beliefs about effective teaching methods</td>
<td>PBL implementation improved when educators participated in reflection and had adequate support</td>
<td>Survey response rate=21%; With support, educators adopted student-centered approach more easily</td>
</tr>
<tr>
<td>Bernstein et al, Quantitative pretest, posttest survey-Level VI Canada</td>
<td>1 medical school; 250 second-year medical students, 15 faculty tutors</td>
<td>Students concerned about knowledge acquisition; Time-consuming</td>
<td>More students agreed that PBL was more effective than traditional teaching (38% pretest vs 52% posttest, P&lt;.02)</td>
<td>Survey response rate=78% for pretest; 83% for posttest</td>
</tr>
<tr>
<td>Doring et al, Qualitative survey-Level VI Australia</td>
<td>3 programs; 84 faculty members from schools of arts, nursing, and education</td>
<td>Insufficient time for PBL session; Support needed to teach PBL</td>
<td>Faculty agreed students attain sufficient knowledge through PBL</td>
<td>Survey response rate=25%</td>
</tr>
<tr>
<td>Reynolds, Mixed-methods survey-Level VI United Kingdom</td>
<td>1 graduate medical education program; 157 occupational therapy and physiotherapy students</td>
<td>Higher level of student anxiety with PBL</td>
<td>Students reported positive PBL experiences (mean=62, SD=5.6, maximum score=80)</td>
<td>Survey response rate=83%; PBL Attitudes Questionnaire used; Students were more comfortable with the subject matter after PBL implementation</td>
</tr>
<tr>
<td>Scott et al, Mixed-methods survey-Level VI United States</td>
<td>All PA programs accredited by ARC-PA</td>
<td>Financial support required; Faculty resistance; Lack of administrative support</td>
<td>76.2% of PA programs using PBL at the time of the survey</td>
<td>Survey response rate=75.4%; Assessment showed strong survey tool validity</td>
</tr>
<tr>
<td>Foor &amp; May, Qualitative survey-Level VI United States</td>
<td>1 physical therapy education program (7 faculty members)</td>
<td>Peer support needed; Need for leadership support; Administrative support required</td>
<td>Curricular change to PBL had been established, and the transition was occurring</td>
<td>100% response rate; Study noted change must accommodate individual needs</td>
</tr>
<tr>
<td>Matthew-Maich et al, Qualitative survey-Level VI United States</td>
<td>3 undergraduate nursing programs; 30 nursing faculty members attending faculty development workshop</td>
<td>Resistance to change; Need for faculty training</td>
<td>Faculty excited to develop nursing PBL; PBL helps promote lifelong learning</td>
<td>Survey response rate=100%; Faculty development programs include ongoing evaluation</td>
</tr>
<tr>
<td>Ross et al, Case study-Level VI United States</td>
<td>1 program (third-year pharmacy students); PBL curriculum implemented in 1996</td>
<td>Significant costs; Increased teaching space and time</td>
<td>A linear improvement on assessments was noted following PBL implementation</td>
<td>Faculty used PBL to promote competency and improve critical thinking and problem solving</td>
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</table>

continues on page 120
<table>
<thead>
<tr>
<th>Evidence source, evidence type/level of evidence, country</th>
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| Vahidi et al., Iran 2007 Qualitative, pretest posttest survey/Level VI | 1 undergraduate nursing program; 53 nursing faculty members | • Faculty role changes from teacher to facilitator  
• Changes could cause student stress  
• Cost  
• Faculty staffing  
• Lack of management support | • Majority of staff believed PBL effective method for building practical skills  
• Capacity building and creating supportive environment are prerequisites to PBL | • Survey response rate=100%  
• The questionnaire was pilot-tested and validated assessed  
• Could be used as a tool in future research |
| Gwee, Singapore 2008 Qualitative case report/Level VI | 4 medical schools in various parts of Asia | • PBL requires additional resources  
• Paradigm shift to student-centered learning | • Strong appeal to Asian governments searching for a new educational paradigm | • PBL implementation requires careful planning and dedication |
| Maudsley et al., United Kingdom 2008 Mixed-methods survey/Level VI | 1 program (junior medical students enrolled in 5-y PBL curriculum); 224 students | • Students uncertain about breadth and depth of learning (43.4%)  
• Concern about missing information (18.4%) | • PBL encourages independent, active learning (21.2%)  
• Cognitive benefits (17.5%)  
• Cooperative learning (15.3%)  
• Responsibility and control given to students (12.4%) | • 2 surveys given to 1999 and 2001 year cohorts at different points in their training; response rates=60%-70% |
| Williams & Beattie, Australia 2008 Systematic review of qualitative studies/Level V | 5 qualitative studies focusing on the clinical setting of nursing education | • Faculty do not understand PBL  
• High staff turnover  
• Lack of coordination with clinical and PBL teaching | • Researchers noted improvement in attitudes, understanding, and tolerance of clinicians toward students | • Critical analysis completed using Joanna Briggs Institute Qualitative Assessment and Review Instrument  
• Total sample size unknown |
| Al Kadri et al., Saudi Arabia 2009 Qualitative phenomenological study/Level VI | 1 medical education program | • Students’ perception of learning was lower without use of summative assessments | • Anxiety levels lower without summative assessment  
• Overall student performance improved | • Survey response rate=100% |
| Papinczak et al., Australia 2009 Qualitative survey/Level VI | 1 medical education program | • Role confusion by tutors  
• Tutor “style” affects PBL success | • Tutor has large role in experiences with PBL  
• Impacts enjoyment, motivation and achievement | • Survey response rate=42.4%  
• Need for tutor training and professional development |
| Walker et al., United States 2009 Quantitative systematic review meta-analysis/Level V | 201 outcomes across 82 studies; addressed instituting PBL across science education disciplines | • Time-consuming  
• Required more effort from students and faculty | • PBL students did as well or better than their lecture-based counterparts  
• 68 positive outcomes and 21 negative; in favor of PBL (P<.001) | • Search consisted of meta-analyses and reviews |
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<td>7 qualitative articles included in this review; primary focus was on IPE experience within context of PBL</td>
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<td>Dixit et al.</td>
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### Table 1. Systematic Reviews and Descriptive Studies Examining Barriers to Implementation of Problem-Based Learning

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### Abbreviations
- ARC-PA: Accreditation Review Commission on Education for the Physician Assistant
- IPE: Interprofessional Education
- PA: Physician Assistant
- PBL: Problem-Based Learning

### Evidence Appraised and Levelled
- Evidence appraised and levelled using the method described by Melnyk and Fineout-Overholt. Evidence levels range from Level I (Systematic review of randomized controlled trials) to Level VII (Expert opinion).

### Notes
- Percent of student respondents.
- 1999 cohort survey response rate=61.2% (n=137) end of year 1; 77.9% (n=159) midyear 3; 2001 cohort survey response rate=71.0% (n=201) start of year 1, and 71.0% (n=198) end of year 1.
- Types of faculty support provided: workshops, peer-to-peer instruction in PBL, providing assessment tools and expertise, increasing staff, reducing reliance on student course evaluations.
There may be a need for supplemental support and administrative oversight when considering an increased faculty workload. Each small group will also need space, and this can result in limited space availability. There is often an increase in cost associated with adding facility space, faculty, and staff members to facilitate PBL sessions.

- **Potential Resource Interventions.** The physical resources required for a successful PBL program include providing faculty facilitators for each group, as well as room space. Program leaders could consider using clinical faculty to facilitate PBL sessions. A key benefit of using clinical instructors in this process is that these CRNAs will be eligible for Class B continuing education credits. Education credits could serve to motivate involvement by staff CRNAs. Once CRNAs have been trained in the process of facilitation, they could serve as a valuable asset in this process.

It is important to seek institutional support at the start of this process. Educating the administrative leaders on the benefits and process of PBL will likely improve access to additional resources. Providing a proposal estimating staffing and space needs may lead to increased support provided throughout this implementation process. Systematically evaluating the impact of PBL can convince administration of the value of allocating additional resources to PBL.

**Conclusion**

Nurse anesthesia students and educators may gain many benefits from employing PBL, such as increased student engagement, improved performance, and rapid improvement in development of critical thinking skills. Although PBL has been successful in medical education, we found no evidence of its widespread use in nurse anesthesia education. This review helps educators by identifying common barriers and describes possible interventions to help ensure the successful implementation of PBL.

There are many opportunities for future research in this active learning style, which was pioneered in medical education. Although PBL has been in use since the 1960s, there are many avenues yet to explore, including the learner experience and the use of PBL in CRNA education. Problem-based learning can become an important tool in training the future generations of nurse anesthetists.

**REFERENCES**


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DISCLOSURES
The authors have declared no financial relationships with any commercial entity related to the content of this article. The authors did not discuss off-label use within the article. Disclosure statements are available for viewing upon request.