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# Effectiveness of the Problem-Based-Learning (PBL) Approach to Teaching and Learning in Improving Students' Engagement in Learning Pharmacology

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## Abstract

Problem-Based Learning (PBL) has been widely recognised as an effective active learning strategy in health professions education. This action research study examined the effectiveness of integrating PBL with traditional lectures to enhance nursing students' engagement and learning in pharmacology. The study was conducted with a cohort of 90 Nursing Associate students, of whom 30 completed a perceived benefits questionnaire. The intervention involved a structured PBL approach using patient-centred case scenarios, small-group discussions, and facilitated presentations over one academic module. Data were collected using a researcher-developed five-point Likert-scale questionnaire with established internal consistency (Cronbach's alpha = 0.78), supplemented by facilitator observations and analysis of student presentations. Descriptive analysis indicated high levels of perceived engagement, motivation, teamwork, and perceived relevance to clinical practice. Additionally, academic performance improved compared to the previous cohorts, with a higher pass rate and mean scores. While findings suggest that combining lectures with PBL may enhance student engagement and applied understanding of pharmacology, the study is limited by reliance on self-reported data and a modest response rate. The study highlights the potential of PBL as a pedagogical approach in nursing pharmacology and underscores the need for future research incorporating multiple data sources and pre/post evaluation measures. The study's objectives are: 1) to boost nursing students' engagement and interest in pharmacology, 2) to deepen their understanding of medication management through PBL, and 3) to enhance patient safety by reducing medication errors.

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## Introduction

This is an Action Research enquiry to investigate the effectiveness of Problem-Based Learning (PBL) in enhancing undergraduate nursing students' engagement in learning pharmacology and improving learning outcomes. Education is to bring about changes in a student's life that would enable that person to adjust to their environment (Prabowo et al., 2020). Teaching is meant to direct this process of change. There is a lot of evidence that highlights the need for nurses to improve their knowledge of Pharmacology to promote safe patient care.

Medication management is becoming more complex, and nurses play a major role in clinical assessment, safe drug administration and monitoring of patients, which includes consideration of patient safety and avoidance of drug errors (Mardani et al.,2020). This great responsibility of medicines management demands nurses to be more knowledgeable about drugs, their actions, interactions, adverse effects and appropriate nursing responsibilities. It was noted that the main reason for medication errors is the lack of knowledge of medications among the nurses (Mardani et al.,2020). Becoming an efficient nurse begins with preparing a student nurse in Nursing school. Nursing students are required to be taught with an intense knowledge of drugs to promote safe medication administration and patient safety. It is the role of the nursing Lecturers to prepare nursing students with critical thinking skills and problem-solving abilities, enabling them to make correct decisions in clinical practice.

Falcó-Pegueroles (2021) describes critical thinking as a process that entails recognising problems, evaluating available resources, and formulating potential solutions. In nursing education, critical thinking involves applying theoretical knowledge to clinical contexts, reasoning through patient scenarios, the capacity to examine information critically, integrate ideas, make judgements about complex situations, and make safe and evidence-based decisions. Such skills should be developed and facilitated by the teachers by giving the students opportunities to solve real-world problems.

Pharmacology is taught in a nursing programme, considering the need for nurses to administer drugs safely to patients. It should be considered that students' engagement is crucial in learning pharmacology, as the theory learnt will have to be applied in practice. Student engagement can be understood as the extent to which students are actively and purposefully involved in all elements of the educational setting (Almarghani & Mijatovic,2017). In this study, student engagement is defined as the degree of active involvement in learning activities, encompassing behavioural, cognitive, and emotional participation in the learning process (Martin & Torres, 2016). Engagement is reflected through participation in discussions, collaborative learning, sustained attention, and perceived relevance of learning activities.

Gulco et al. (2024) argue that meaningful student engagement is fostered when learning environments promote motivation, inclusivity, and active learner participation, with responsibility shared among students, educators, and higher education institutions. However, engagement may be limited when educators lack the capacity to implement active learning strategies or when institutional support is insufficient (Almarghani & Mijatovic, 2021). Evidence also indicates that higher levels of student engagement are associated with improved learning outcomes, underscoring the value of learner-centred pedagogical approaches (Theobald & Ramsbotham, 2019).

Further, the lack of integration of theory and practice leaves students less engaged in their learning. Since Pharmacology is a hard science that consists of a plethora of information, it makes the students feel overwhelmed to understand and retain the information. Therefore, an innovative approach to teaching is essential for Nursing students to improve their engagement and skills. There are several teaching strategies followed by Nursing lecturers to reduce the theory and practice gap (Foster et.al., 2017). It is essential to implement teaching and learning strategies that allow students to engage with real-life scenarios, where they can apply higher-order thinking and self-directed learning to make appropriate clinical decisions in practice, which has proven to reduce the gap between theory and practice (Matlala, 2021). Real-life clinical situations rarely have definitive answers and are often navigated through experience (McNiff, 2016). The strategy must be intended to benefit learners by enhancing engagement and supporting the development of problem-solving and critical thinking abilities (Santos et al., 2018). Traditional teaching methods, though familiar, had not consistently demonstrated effectiveness in supporting student learning.

Hence, the implementation of an innovative strategy, such as Problem-Based Learning (PBL), was considered appropriate. PBL was initially introduced at Mcmaster University in Ontario, Canada, in 1969 by Barrows and Tamblyn (Gigselaers,1996). PBL is an Instructional strategy based on the constructivist theory that poses problems to the students, and they critically consider solutions utilising brainstorming discussions and independent learning. PBL is one of the best and most widely used approaches that has been proven to enhance students' self-directed learning, critical thinking, and problem-solving skills. This observation is supported by a study done by Prabowo et al. (2020). PBL approach can help students apply their knowledge in solving problems and make learning enjoyable. Education, when structured around active participation and feedback, facilitates behavioural change in learners and supports lifelong learning (Nahar, 2016, as cited in Prabowo, 2020). Students who learnt through the PBL process were able to retain the subject content more than their counterparts who were taught using the lecture-only method (Lu et al, 2022). It was evident through the study done by Sayyah et al. (2017) that teachers of medical education found a positive academic achievement using PBL. These insights served as the basis for implementing PBL as the central approach in this action research project.

## Theoretical Framework

This action research study is underpinned by John Dewey's inquiry model, which conceptualises learning as a systematic process of problem identification, hypothesis generation, analysis, and evaluation (Greer, 2016). Dewey (1916) emphasised the importance of reflective thinking and evidence-based decision-making, arguing that education should cultivate learners' capacity for critical inquiry to respond effectively to an evolving world. This model aligns closely with action research traditions, particularly Lewin's cyclical process involving problem identification, action, observation, and reflection (Lewin, 1946). This iterative model enables educators to reflect systematically on pedagogical interventions, generate new questions, and refine teaching strategies based on observed outcomes.

Dewey's inquiry-based approach also aligns with Knowles' theory of adult learning, which posits that adult learners are self-directed and draw heavily on prior experience to make sense of new knowledge (Knowles, 1992).

Adult learning is therefore most effective when it is problem-centred, experiential, and directly relevant to real-life contexts. From an action research perspective, this theoretical alignment supports the use of learner-centred pedagogies that encourage reflection, dialogue, and active participation (McNiff, 2016). Drawing on these theoretical foundations, Problem-Based Learning (PBL) was selected as the instructional strategy for this study. The decision emerged from reflective analysis of prior teaching and learning experiences and was further informed by action research theory, which advocates for context-responsive interventions aimed at improving practice (Alarcon & Prezotto, 2016). PBL was therefore adopted as an inquiry-driven method to promote active engagement, critical thinking, and meaningful learning in pharmacology, consistent with both adult learning theory and the reflective–action cycles central to action research.

## Methodology

### Research Design

This study employed an action research design, which is appropriate for examining and improving teaching and learning practices within a specific educational context. Action research is commonly described as a form of self-reflective enquiry that integrates action and reflection, intending to improve professional practice (Alarcon & Prezotto, 2016). Central to action research is the cyclical process of planning, acting, observing, and reflecting, through which practitioners critically examine their own practice and implement informed changes to enhance outcomes (Mcniff, 2016).

In educational contexts, action research supports lecturers in examining their instructional approaches and understanding students' learning experiences, thereby facilitating evidence-informed improvements in teaching practice. Consistent with this perspective, the present study adopted Coats' (2005) action research model to examine the impact of integrating Problem-Based Learning (PBL) into pharmacology teaching. Specifically, the study followed a cyclical process in which a teaching-related concern, limited student engagement in pharmacology, was identified, a PBL-based intervention was planned and implemented, learning processes and outcomes were observed through multiple data sources, and reflective evaluation informed interpretation of the findings and implications for future practice.

### Participants and Setting

The study was conducted with approximately 90 students enrolled on the Pharmacology Module of Level 5 Nursing Associate programme. This module was taught over a period of 10 weeks, with 1 day of teaching per week (3 hours per week). The student group was a mix of Apprenticeship students, who were sponsored by the hospital trusts they work for and the self-funders. According to the institutional timetable, students attended a 180-minute theory session each week.

### Data Collection Tool

The *Perceived Benefits Questionnaire* was developed by the researcher in a previous study examining the

effectiveness of Problem-Based Learning over the lecture method in nursing education and demonstrated acceptable internal consistency (Cronbach's alpha = 0.78). The questionnaire consisted of items rated on a five-point Likert scale ranging from *strongly agree* to *strongly disagree* (Kamalakumari,2015).

The questionnaire consisted of items assessing students' perceptions of motivation, engagement, critical thinking, teamwork, confidence, and perceived relevance to clinical practice. Sample items included: *"The PBL sessions motivated me to engage more actively in learning pharmacology"* and *"Learning through case-based group discussions improved my ability to apply pharmacological knowledge in clinical contexts."*

**PBL Implementation**

The PBL intervention represented the 'action' phase of the action research cycle, while facilitator observations, student feedback, and academic outcomes informed the observation and reflection phases. Teaching was delivered using a blended instructional approach comprising two distinct phases within each weekly session. The first 90 minutes were delivered using a traditional lecture method to introduce core pharmacological concepts. This was followed by a 90-minute PBL group discussion session. The integration of lectures with PBL was intentionally adopted to provide students with foundational knowledge prior to engaging in problem-solving activities. This approach is consistent with previous studies suggesting that a combination of lectures and PBL enhances conceptual understanding more effectively than PBL alone (Santos et al., 2018) and aligns with prior methodological models in nursing education (Solomon, 2020).

Before the commencement of the module, students were introduced to the principles, expectations, and processes of PBL. Students were divided into nine groups, each consisting of approximately ten members. Within each group, students selected a group leader and a scribe. Groups met periodically, either face-to-face or online, according to schedules agreed upon by group members. The group leader was responsible for coordinating meeting schedules and facilitating discussions, while the scribe documented group discussions, learning objectives, and outcomes.

Each group was assigned a physiological system as a focus area. The different systems allocated for the groups were the Cardiovascular system, Hypertension, Respiratory, Diabetic (Type 1), Diabetic (Type 2), Digestive, Neuro, Pain and Sepsis. Groups were given a patient case scenario related to their allocated system, and were required to follow the PBL steps, in consultation with the module lead. Given the large cohort size, PBL sessions were supported by an additional academic staff member to ensure effective facilitation and equitable engagement across groups.

Students followed a structured PBL process adapted from established PBL models. This process involved the following steps:

1. Identifying and clarifying key facts and concepts within the assigned topic
2. Working on a patient case scenario relevant to the physiological system under study
3. Analysing the clinical and pharmacological problem through group brainstorming

4. Identifying gaps in knowledge and generating specific learning objectives
5. Engaging in self-directed study using recommended and independent evidence-based resources
6. Reconvening for group discussion to synthesise findings and apply them to the case scenario
7. Presenting the case analysis to the wider class, followed by facilitated discussion.

During PBL sessions, groups presented their case scenarios using PowerPoint to support structured discussion and engagement.

***PBL Implementation- Illustrative Case Scenario***

To ensure consistency in the implementation of Problem-Based Learning (PBL) and to facilitate structured inquiry, each student group had a patient-centred case scenario aligned with the module learning outcomes. An example of a case scenario used during the PBL sessions is presented below to illustrate how PBL was operationalised within the study.

*Case Description*

A 55-year-old Caucasian male was diagnosed with Type 2 Diabetes Mellitus (T2DM) three years ago. Initial management focused on lifestyle modification, including dietary changes and increased physical activity; however, these measures were unsuccessful. The patient subsequently experienced progressive weight gain, with a current body mass index (BMI) of 40. Due to persistently elevated glycaemic levels, pharmacological management was initiated with Metformin 500 mg once daily, which was gradually titrated over six months to the maximum tolerated dose of 500 mg three times daily. Despite this, the most recent laboratory investigations revealed an HbA1c level of 81 mmol/mol, indicating suboptimal glycaemic control. In view of this, escalation to combination therapy was required. Potential pharmacological options included sulfonylureas, acarbose, pioglitazone, incretin mimetics, dipeptidyl peptidase-4 (DPP-4) inhibitors, and sodium–glucose co-transporter-2 (SGLT2) inhibitors.

*Application of the PBL Process*

The case scenario was explored using a structured PBL framework, adapted for pharmacology teaching, and implemented consistently across all groups.

*Learning Objectives:* Students should aim to:

(1) Review the Pathophysiology of Type 2 Diabetes and the role of pharmacological therapy.
    - Examine the mechanisms of action, side effects, contraindications, and nursing responsibilities associated with: Sulfonylureas, Acarbose, Pioglitazone, Incretin mimetics, DPP-4 inhibitors, and SGLT2 inhibitors
(2) Analyse patient-specific factors influencing drug selection, including comorbidities, BMI, and risk of hypoglycaemia.
(3) Discuss monitoring parameters before, during, and after drug administration (e.g., blood glucose,

liver/kidney function, HbA1c).

*PBL Steps for Students*

1. *Identification of Key Facts and Concepts:* Students initially were required to identify the essential clinical facts presented in the case, including patient demographics, diagnosis, current treatment regimen, laboratory findings, and clinical indicators of poor disease control.
   Identifying the facts: * Patient: 55-year-old male, *BMI 40, Diagnosis: T2DM for 3 years, *Lifestyle: Attempted diet and exercise modifications, limited success, *Current therapy: Metformin 500 mg TDS for 6 months, *Latest HbA1c: 9.6%
2. *Problem Definition and Learning Objectives:* Groups were required to define the central problem-ineffective glycaemic control despite maximum-dose Metformin therapy - and formulate learning objectives related to pharmacological management, including mechanisms of action, indications, contraindications, side effects, and nursing responsibilities associated with second-line antidiabetic agents.
   Formulate Learning Questions-Example
   - Why is monotherapy with Metformin no longer sufficient?
   - What are the potential adverse effects and contraindications of each drug class?
   - How can nursing assessment support safe administration and monitoring of therapy?
   - How would combination therapy affect patient adherence and long-term outcomes?
3. *Analysis and Brainstorming* Through guided discussion, students analysed the clinical problem, considering patient-specific factors such as obesity, duration of disease, and potential risks (e.g., hypoglycaemia). Brainstorming facilitated the identification of knowledge gaps requiring further investigation.
   Analyse the Problem (Brainstorm):
   - Group discussion of pathophysiology and drug mechanisms
   - Risk-benefit analysis for each medication class
   - Consideration of patient-centred factors (age, BMI, lifestyle, comorbidities)
4. *Self-Directed Learning* Students engaged in independent and group-based research to address identified learning needs. This included reviewing pharmacology textbooks, clinical guidelines, and evidence-based resources related to combination therapy in T2DM.
   - Research each drug class
   - Identify key nursing assessments and patient education points
   - Explore clinical guidelines for combination therapy in T2DM
5. *Group Discussion and Synthesis*: Findings were shared within groups, enabling comparison of pharmacological options and synthesis of evidence to justify an appropriate combination therapy plan. Emphasis was placed on nursing assessment, monitoring requirements before and after drug administration, and escalation of care.
6. *Presentation and Whole-Class Discussion*: The group presented their case analysis using PowerPoint presentations, incorporating patient scenarios and clinical reasoning.

- Present the case, proposed drug regimen, and rationale
- Discuss potential monitoring strategies and nursing responsibilities
- Respond to peer questions and facilitator prompts

Presentations were followed by whole-class discussion facilitated by the academic facilitator using open-ended questions such as:

- What rationale informed your choice of pharmacological agent?
- What assessments are required prior to administering this medication?
- How does this drug choice align with nursing responsibilities and patient safety?
- Why might certain drug classes be preferred for obese patients?
- How do comorbidities influence drug selection?
- What nursing interventions are required to prevent and manage hypoglycaemia?
- How can patient education improve adherence to combination therapy?

*Roles of Facilitators and Students*

Academic facilitators supported the PBL process by guiding discussion, prompting critical thinking, and ensuring alignment with learning outcomes, rather than providing direct solutions. Students assumed active roles within their groups, with designated group leaders coordinating discussions and scribes documenting learning objectives and key outcomes. This structure promoted collaborative learning, accountability, and reflective inquiry.

## Findings and Discussion

### Findings

Following the implementation of the Problem-Based Learning (PBL) intervention, students' perceptions of its effectiveness were evaluated using a structured *Perceived Benefits Questionnaire*. Data analysis was conducted using a mixed descriptive and reflective approach consistent with action research methodology. Quantitative data from the perceived benefits questionnaire were analysed descriptively using percentages to summarise trends in students' perceptions. A total of 30 completed questionnaires were returned and included in the analysis. Descriptive analysis of the responses indicated generally positive perceptions of the combined lecture–PBL approach.

To strengthen analytical depth, these findings were triangulated with additional data sources, including facilitator observations during PBL sessions, informal student feedback, and analysis of students' group presentations. Methodological rigour was strengthened through transparent documentation of the intervention process, triangulation of data sources, and alignment with established action research principles. Reflective field notes maintained by the facilitator captured observations related to student engagement, collaboration, and application of pharmacological reasoning. Reflexive observations informed ongoing refinements to teaching practice, consistent with the cyclical nature of action research. Reflective analysis was guided by the cyclical action research framework of planning, acting, observing, and reflecting, enabling systematic interpretation of how the PBL intervention influenced teaching and learning processes (Alarcon & Prezotto, 2016).

# PERCEIVED BENEFITS OF PROBLEM BASED LEARNING (PHARMACOLOGY)

30
Responses

03:52
Average time to complete

Act
Sta

1. I was motivated to work on the assignment (0 point)

| | |
|---|---|
| Strongly Agree | 20 |
| Agree | 9 |
| Uncertain | 1 |
| Disagree | 0 |
| Strongly Disagree | 0 |

2. I had more learning opportunities for searching for information on drugs (0 point)

| | |
|---|---|
| Strongly Agree | 20 |
| Agree | 9 |
| Uncertain | 1 |
| Disagree | 0 |
| Strongly Disagree | 0 |

3. I was able to think critically (0 point)

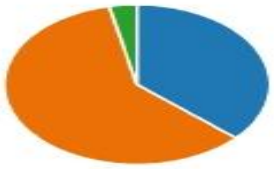
| | |
|---|---|
| Strongly Agree | 15 |
| Agree | 13 |
| Uncertain | 2 |
| Disagree | 0 |
| Strongly Disagree | 0 |

4. I was able to work as a team effectively (0 point)

| | |
|---|---|
| Strongly Agree | 20 |
| Agree | 9 |
| Uncertain | 1 |
| Disagree | 0 |
| Strongly Disagree | 0 |

5. Learning through Problem Based group Learning fostered my confidence (0 point)

| | |
|---|---|
| Strongly Agree | 11 |
| Agree | 18 |
| Uncertain | 1 |
| Disagree | 0 |
| Strongly Disagree | 0 |



6. Learning in a group enabled me to gain better understanding of drugs (0 point)

| | |
|---|---|
| Strongly Agree | 15 |
| Agree | 12 |
| Uncertain | 2 |
| Disagree | 1 |
| Strongly Disagree | 0 |

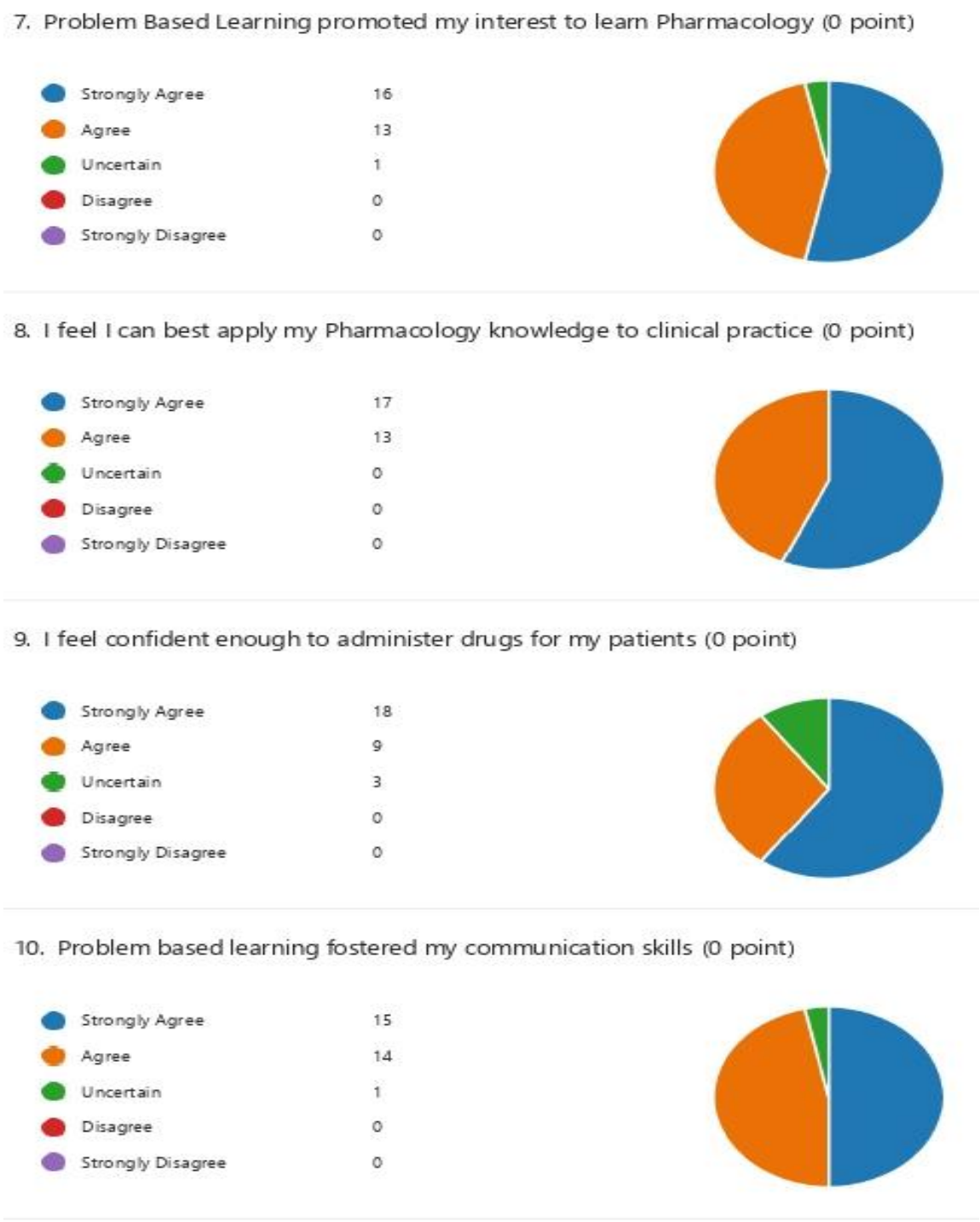



Figure 1. The Perceived Benefits of Students on the PBL Approach to Learning

Figure 1 shows the Perceived Benefits of students on the PBL approach to learning. This figure reveals a favourable perception of the learners having undergone the PBL method of learning

*Perceived Benefits of PBL*

The majority of respondents reported enhanced engagement and learning following participation in the PBL

sessions. Specifically, 67% of students strongly agreed that the approach motivated them to complete learning activities and provided greater opportunities to independently research drug-related information. Improvements in higher-order skills were also evident: 50% of respondents strongly agreed and 43% agreed that engagement in PBL enhanced their critical thinking abilities, while 67% strongly agreed and 30% agreed that working in PBL groups promoted teamwork and collaborative learning.

Perceived gains in confidence were more variable. Although 37% of students strongly agreed and 60% agreed that PBL improved their confidence, these findings suggest that confidence development may require sustained or repeated exposure to inquiry-based learning approaches. Students also reported improved understanding of pharmacology, with 50% strongly agreeing and 40% agreeing that PBL enhanced their understanding of drugs; only one respondent expressed disagreement.

Notably, interest in pharmacology increased substantially following the intervention, with 96% of respondents either agreeing or strongly agreeing that their interest in the subject had improved. Furthermore, all respondents (100%) indicated that the knowledge gained through PBL would support their future clinical practice, including medication administration and clinical decision-making. A majority of participants (60% strongly agreed and 30% agreed) reported feeling confident to administer medications, and 97% either strongly agreed or agreed that PBL enhanced their communication skills.

*Qualitative Indicators of Engagement*

In addition to questionnaire data, qualitative indicators supported the perceived benefits of PBL. Facilitator observations and unsolicited student feedback highlighted increased participation, inclusivity, and engagement during group discussions. Positive feedback from students with specific learning needs suggested that the structured, collaborative nature of PBL may support diverse learning styles.

*Academic Performance Outcomes*

Academic performance data provided further evidence of improved learning outcomes following the implementation of the PBL intervention. The cohort achieved an overall pass rate of 93%, with a mean assessment score of 65% and a highest recorded score of 98%. These outcomes represent a substantial improvement when compared with the previous cohort, which achieved a mean score of 53% and a highest score of 80%. Notably, the results obtained by the PBL cohort were the strongest observed within this programme to date, surpassing the performance of approximately four preceding cohorts who had completed the same module.

The marked improvement in assessment outcomes may be attributed, at least in part, to the adoption of a PBL approach to teaching pharmacology, which emphasises active engagement, self-directed learning, and the application of theoretical knowledge to clinical scenarios. By encouraging students to analyse problems collaboratively and independently seek evidence-based drug information, PBL may have facilitated deeper conceptual understanding and improved knowledge retention, thereby enhancing assessment performance.

While it is acknowledged that contextual factors, particularly pandemic-related disruptions, may have adversely affected the academic performance of one or two of the earlier cohorts, the consistent and notable improvement observed following the introduction of PBL suggests a positive association between this instructional approach and student achievement. Although causality cannot be definitively established, the findings provide preliminary support for the effectiveness of PBL as a pedagogical strategy in improving pharmacology learning outcomes among nursing students.

*Summary of Findings*

Overall, the findings indicate that the integration of PBL with traditional lectures was associated with enhanced student engagement, increased interest in pharmacology, perceived development of critical thinking and teamwork skills, and improved academic performance. These findings are consistent with previous studies reporting that PBL promotes active learning, deeper understanding, and improved academic outcomes in health professional education (Greer, 2016).

## Discussion

This action research examined the implementation of Problem-Based Learning (PBL) integrated with traditional lectures in a pharmacology module for nursing students. While students' self-reported perceptions indicated enhanced engagement, confidence, and perceived learning, these findings were interpreted alongside observational evidence from PBL sessions and improvements in academic performance. Facilitator observations suggested increased student participation, deeper questioning, and improved ability to link pharmacological concepts to clinical scenarios during group discussions and presentations. These outcomes are consistent with recent evidence indicating that PBL enhances active learning, self-directed learning, critical thinking, and satisfaction in nursing education (Xue et al., 2025).

Student perceptions of increased motivation and engagement resonate with studies showing that PBL supports deeper involvement in learning and greater satisfaction compared to traditional methods. For example, Xue et al. (2025) reported that nursing interns exposed to PBL demonstrated higher post-test scores in self-directed learning ability, critical thinking, and satisfaction compared with a traditional teaching group. Similarly, smaller cohort studies have found that PBL fosters improvements in critical thinking and clinical reasoning in undergraduate nursing students (Rabbi,2025). These findings align with adult learning theory, which posits that learning is most effective when students engage actively with relevant problems and apply knowledge to real-world contexts.

The positive perceived impact on collaborative skills and teamwork supports broader literature on PBL as a facilitator of cooperative learning. Meta-analyses and systematic reviews in healthcare education have documented the effectiveness of PBL in promoting critical thinking and collaborative problem-solving beyond traditional approaches. A recent systematic review on PBL for evidence-based practice education in nursing and midwifery found improvements in knowledge, attitudes, critical thinking, and clinical decision-making (Rabbi, 2025). In line with this, another meta-analysis demonstrated that PBL interventions yielded significant gains in

critical thinking skills among nursing students compared with control groups (Wei et al, 2024). These findings reinforce the value of PBL for metacognitive and higher-order learning outcomes in health professions curricula. Although improvements in confidence and critical thinking were present, these gains appeared more variable across students. This variation may reflect differences in prior learning experiences, readiness for self-directed learning, or cohort characteristics. Evidence suggests that the development of critical thinking through PBL may require sustained exposure over time rather than a single intervention, and that student support and facilitator scaffolding play important roles in maximising gains (Lu et al, 2022).

Improvements in academic performance relative to a previous cohort provide additional context for the potential benefits of PBL. However, consistent with recent literature, these gains must be interpreted with caution. Confounding factors such as differences in cohort ability, assessment difficulty, and timing of data collection can influence outcomes. A systematic review has highlighted the heterogeneity of PBL implementations and the need for rigorous comparative designs to better isolate instructional effects. Nevertheless, the convergence of positive student perceptions, facilitator observations, and performance data suggests that integrating PBL with lectures may enhance overall learning experiences in pharmacology (Wei et al, 2024).

Reflective evaluation throughout the action research cycle informed iterative refinements to facilitation strategies and group support mechanisms. Consistent with action research principles, reflection was not merely descriptive but guided instructional adjustments based on emerging evidence from practice. This reflective process exemplifies the praxis orientation of action research, where reflection and action continually inform each other (McNiff, 2016).

Overall, recent evidence supports the adoption of PBL as a strategy to foster engagement, autonomy, and applied learning in nursing education. However, continued research using longitudinal, mixed-method designs with larger and more representative samples will strengthen the evidence base and clarify the mechanisms through which PBL contributes to specific educational outcomes in pharmacology and other nursing disciplines.

## Limitations

This study has several limitations that should be considered when interpreting the findings. Although the PBL intervention was implemented with a cohort of approximately 90 students, only 30 participants completed the perceived benefits questionnaire. This modest response rate may limit the representativeness of the findings and introduces the possibility of response bias, as students who were more engaged or held stronger opinions may have been more inclined to provide feedback. The timing of data collection may have contributed to the reduced response rate, as students were invited to complete the questionnaire after commencing their subsequent module, during a period of increased academic workload.

The study also relied partly on self-reported measures of engagement, confidence, and perceived learning gains. While these measures offer valuable insight into students' learning experiences, they are inherently subjective and may be influenced by social desirability or recall bias. Although this limitation was partially mitigated through

facilitator observations, analysis of group discussions, and review of assessment outcomes, the absence of pre- and post-intervention measures restricts the ability to attribute observed improvements exclusively to the PBL intervention.

Furthermore, the evaluation focused primarily on students' perceptions of engagement, interest, and perceived benefits of PBL in pharmacology, rather than capturing broader dimensions of learning such as long-term knowledge retention, clinical reasoning transfer, or objective measures of critical thinking. The combined use of traditional lectures alongside PBL also makes it difficult to determine the independent contribution of PBL to the observed outcomes.

The large cohort size also presents a limitation. While PBL is traditionally most effective in small-group settings, its implementation within a large cohort required adaptations that may have influenced the depth of discussion and individual participation. Ideally, PBL is facilitated with one tutor supporting small groups of approximately five to seven students. In the present study, the limited availability of facilitators meant that fewer tutors were responsible for supervising multiple groups, which may have reduced opportunities for close facilitation, timely feedback, and individualised support.

Finally, the study was conducted within a single programme and institution, with a relatively small evaluation sample, limiting the generalisability of the findings to other educational contexts. Future research would benefit from larger samples, increased facilitator support, multi-site designs, and mixed-methods approaches incorporating validated outcome measures, structured observations, and longitudinal follow-up to strengthen the evidence base for the effectiveness of PBL in nursing pharmacology education.

## Conclusion

The Problem-Based Learning (PBL) approach has been shown to be an effective strategy for improving student engagement and learning outcomes in pharmacology, a subject often considered challenging. By promoting active participation, teamwork, and independent learning, PBL encourages students to take responsibility for their own learning and apply their knowledge in clinical contexts. Students responded favourably to the method, reporting increased interest, confidence, understanding of drug concepts, and ability to apply pharmacological knowledge in practice. These outcomes indicate that PBL is a valuable teaching strategy, particularly for professional courses like nursing. For successful implementation, appropriate resources, including sufficient teaching staff, are necessary. However, the benefits of adopting a PBL-based curriculum far outweigh the logistical challenges. Therefore, it is concluded that PBL is a powerful and effective approach to improve engagement, develop critical thinking, and support students in translating theory into clinical practice.

## Implications of the Study

### Implications for Nursing Practice

The findings of this study suggest that the integration of Problem-Based Learning (PBL) into pharmacology

education may support the development of critical thinking and clinical reasoning skills essential for managing complex patient care situations. By engaging with realistic case scenarios, nursing students are encouraged to apply pharmacological knowledge to clinical decision-making, which may contribute to improved medication safety and patient-centred care. The emphasis on analysing patient conditions, anticipating adverse effects, and determining appropriate escalation pathways aligns closely with the competencies required in contemporary nursing practice.

**Implications for Nursing Education**

Preparing nursing students to function as competent and confident decision-makers is a central responsibility of nurse educators. The results of this action research indicate that PBL can enhance student engagement and facilitate the integration of theoretical knowledge with clinical application, thereby helping to reduce the theory–practice gap frequently reported in nursing education. Furthermore, the collaborative and inquiry-driven nature of PBL supports the development of reflective and self-directed learners, skills that are increasingly recognised as essential for lifelong learning in healthcare. Educators may therefore consider incorporating structured PBL activities alongside traditional teaching methods, particularly in conceptually challenging subjects such as pharmacology.

**Implications for Nursing Administration**

From an organisational perspective, the use of PBL-based strategies has potential applications beyond pre-registration education. Nurse administrators and education leads may consider adopting PBL approaches within continuing professional development and staff training programmes to support the interpretation and application of clinical guidelines, medication updates, and patient safety initiatives. Periodic PBL-based learning sessions may also serve as effective tools for skills refreshment, interdisciplinary learning, and fostering a culture of reflective practice within clinical settings.

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