

Problem-Based Learning as a Strategy to Enhance Metacognitive Skills in Midwifery Education

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ABSTRACT

Introduction: Metacognitive skills are essential for midwifery students as they support critical thinking, clinical decision-making, and lifelong learning. Problem-Based Learning (PBL) has been widely used to encourage active and self-directed learning; however, its impact on metacognitive skills among students in vocational midwifery education has not been well established. This study aimed to evaluate the effect of the PBL model on the metacognitive skills of midwifery students in a Maternity and Newborn Care course.

Method: A quasi-experimental, two-group post-test-only study was conducted in 2021. Total sampling was used to recruit all 37 eligible second-semester midwifery students, who were randomly allocated by lottery to the PBL group ($n = 20$) or the discussion group ($n = 17$). Metacognitive skills were assessed after the intervention using a researcher-developed 30-item questionnaire rated on a five-point Likert scale (possible score range, 30-150; Cronbach's $\alpha = 0.940$). Group means were compared using an independent-samples t -test in SPSS version 24.0.

Results: The PBL group had a higher mean post-intervention metacognitive-skill score than the discussion group (128 ± 12.1 vs. 112 ± 19.3). The 16-point between-group difference was statistically significant ($t(35) = -3.100, p = 0.004$).

Conclusion: Problem-Based Learning was associated with significantly higher post-intervention metacognitive-skill scores than discussion-based learning among midwifery students. These findings support the integration of PBL as a student-centered instructional approach for strengthening metacognitive learning in maternity and newborn care education.

Keywords: Problem-based learning, metacognitive skills, midwifery education



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Introduction

The key to the realization of a professional midwife is starting from the education process. Students must develop not only clinical knowledge but also the capacity to make reasoned decisions, solve problems, and continually update their competence throughout professional practice.¹ Therefore, educational institutions must implement learning strategies that promote active learning and cognitive development. Learning is a central component of education because it provides students with meaningful opportunities to acquire knowledge and develop relevant competencies. The model used during this process plays an important role in shaping the learning experience and supporting the achievement of intended outcomes.

One of the key competencies that supports these processes is metacognition. Metacognition is a fundamental ability that underpins these learning processes. It refers to a learner's capacity to plan, regulate, and assess their own learning and is increasingly regarded as an important competency in health-professions education.² Students with strong metacognitive skills are better able to identify their learning needs, regulate their learning strategies, and critically reflect on their performance. These competencies are especially relevant in midwifery education, where students must connect theoretical understanding with clinical judgment and the application of evidence-based care.³

Metacognitive skills are closely linked to clinical reasoning, a core competency in midwifery practice. Students who can effectively monitor and evaluate their thinking processes are better prepared to make clinical judgments, identify knowledge gaps, and adapt their decision-making in complex healthcare situations. Therefore, educational strategies that strengthen metacognition may contribute to the development of competent future healthcare professionals.⁴

Lecturer-centered instruction remains common in many classrooms, with greater emphasis often placed on final outcomes than on the learning process itself. This approach may limit student engagement and make learning feel repetitive or less interactive.⁵ Given the importance of metacognitive development, learning approaches should provide opportunities for students to actively engage in problem-solving, reflection, and self-directed learning. Problem-Based Learning (PBL) is a learner-centered teaching method in which real-world problems serve as the starting point for learning. Through collaborative discussions, independent inquiry, and reflective activities, PBL encourages students to construct knowledge actively while monitoring and evaluating their own understanding.⁶ These learning processes align closely with the core dimensions of metacognition, suggesting that PBL may be an effective strategy for enhancing metacognitive skills among midwifery students.

PBL is grounded in constructivist theory, which considers learning an active process in which students build knowledge through experience rather than simply receive information.⁷ By engaging students in authentic problems and collaborative inquiry, PBL promotes deeper cognitive processing and encourages learners to reflect on their understanding and learning strategies.⁸

Previous studies have generally shown that PBL has been reported to support a broad range of educational outcomes in health-professions education. By engaging students in the analysis of authentic problems, collaborative discussion, independent information seeking, and reflective decision-making, PBL may contribute to better academic performance while also strengthening critical thinking, problem-solving ability, and self-directed learning skills.^{9,10} However, the findings have not been entirely consistent. Some reviews have reported meaningful improvements, particularly in critical thinking, whereas others have found no significant advantage over conventional teaching for knowledge, problem-solving, or self-directed learning outcomes.^{9,11} These variations indicate that the success of PBL may be shaped by the educational context, learner characteristics, intervention design, and outcome measures. Moreover, improvements in academic performance or critical thinking do not necessarily demonstrate improvement in metacognitive skills, which specifically encompass the capacity to plan, monitor, control, and assess one's own learning process.²

Direct evidence concerning the effect of PBL on metacognition remains limited and has largely been obtained from nursing or general health-professions education rather than vocational midwifery settings.^{12,13} Although some studies have reported improved metacognitive abilities following PBL-based interventions, differences in student populations, course content, and instructional formats limit their applicability to midwifery education. Evidence is particularly scarce in maternity and newborn care courses and within Indonesian vocational health institutions.¹⁴ Accordingly, this study examined whether PBL, relative to conventional discussion-based instruction, was associated with the metacognitive skills of midwifery students taking a Maternity and Newborn Care course.

Methods

This study employed a quasi-experimental two group post-test only design, targeting second-semester midwifery students (N = 37) at Poltekkes Kemenkes Pangkalpinang. The research was conducted over a eight months period from January to August 2021. Ethical approval was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Pangkalpinang (Approval No. 26/EC/KEPK-PKP/VII/2021, July 12, 2021). All participants gave informed consent before taking part, and their information was kept confidential

throughout the research. Participants were eligible if they were second-semester midwifery students enrolled at Poltekkes Kemenkes Pangkalpinang, registered in the Maternity and Newborn Care course during the study period, and willing to participate by providing informed consent. Students were excluded if they were on academic leave, withdrew from the study, did not complete the learning intervention or post-intervention assessment, or submitted incomplete metacognitive-skill data. All students who met the eligibility criteria were recruited using total sampling. All second-semester students who satisfied the eligibility requirements were invited to participate, resulting in a sample of 37 students. The participants were then assigned by lottery to either the PBL group ($n=20$) or the discussion group ($n=17$). The structural workflow of the study enrollment, allocation, and analysis is visually detailed in in **Figure 1**.

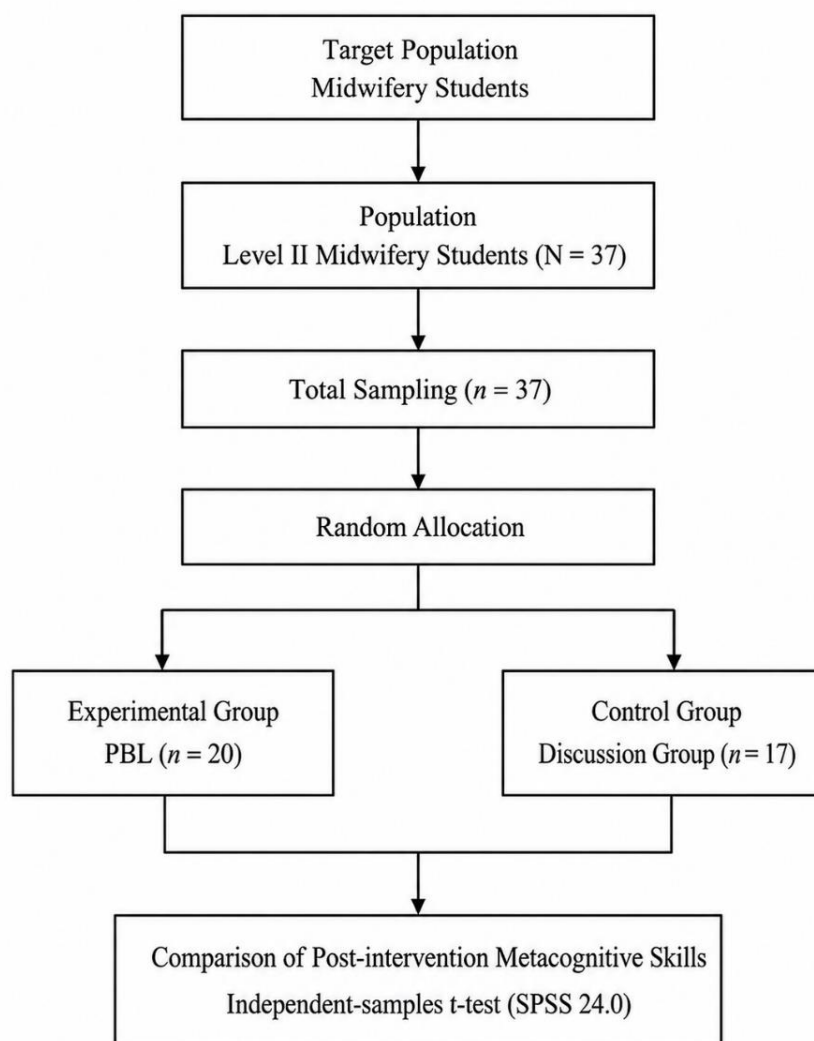


Figure 1. Flow of participant recruitment, random allocation, intervention groups, and statistical analysis.

This study used a two groups post-test only design. Metacognitive skills were assessed only after completion of the instructional intervention; therefore, no baseline metacognitive-skill scores were available for either group. Random allocation was used to reduce the likelihood of systematic baseline differences between the groups; however, baseline equivalence in metacognitive skills could not be directly verified. Metacognition was evaluated using a researcher-developed questionnaire containing 30 items. Responses were recorded on a five-point scale, producing total scores between 30 and 150; higher values represented stronger metacognitive skills. Internal consistency in the present sample was excellent (Cronbach's alpha coefficient of 0.940).

Before conducting the independent-samples t-test, the assumptions of normality and homogeneity of variance were examined. Normality was assessed separately for each group using the Shapiro–Wilk test because of the relatively small sample size, while homogeneity of variance was evaluated using Levene's test. The Shapiro–Wilk results indicated that metacognitive-skill scores were normally distributed in both the group. Therefore, the normality assumption for the independent-samples t-test was satisfied. Statistical significance was set at $p < 0.05$.

Result

Participant characteristic

Table 1 summarizes the participants' characteristics. All 37 participants were female second-semester midwifery students aged 19–21 years. The mean cumulative GPA was 3.52 ± 0.12 in the PBL group and 3.45 ± 0.08 in the **discussion group**.

Table 1. Participants characteristic.

Characteristic	PBL group	Discussion group	Total
Female, n (%)	20 (100.0)	17 (100.0)	37 (100.0)
Cumulative GPA (Grade Point Average), mean $\pm$ Standard Deviation	3.52 ± 0.12	3.45 ± 0.08	3.49 ± 0.11

Means differences

Figure 2 illustrates the distribution of metacognitive skill scores among students in the PBL and Discussion Group learning methods. Students in the PBL group demonstrated higher metacognitive skill scores (mean = 128 ± 12.1) than those in the Discussion Group (mean = 112 ± 19.3). The between-group comparison showed a statistically significant difference

($p=0.004$), with higher post-intervention scores observed among students who received PBL.

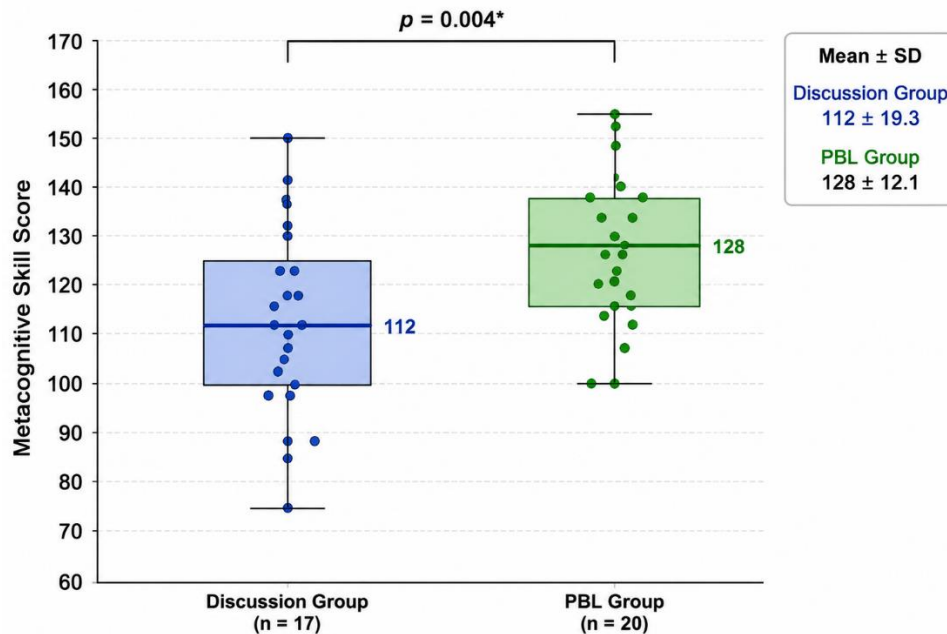


Figure 2. Metacognitive score by learning group.

Metacognitive skill difference test

To evaluate the impact of the instructional interventions, an independent samples t-test was conducted to compare the post-test metacognitive skill scores between the two cohorts. As illustrated in **Figure 2** and detailed in **Table 2**, students who participated in the PBL model achieved significantly higher metacognitive skill scores compared to those in the traditional Discussion Group ($t(35) = -3.100, p = 0.004$). This statistically significant divergence indicates that the structured, student-centered inquiry of PBL was considerably more effective at fostering metacognitive development than conventional discussion-based instruction.

Table 2. Results of the difference test metacognitive skills

Group	Independent Sample T-Test				
	n	Mean	SD	T (df)	p-value
PBL Group	20	128	12.1	-3.100 (35)	0.004*
Discussion Group	17	112	19.3		

Abbreviations: PBL, Problem Based Learning; SD, standard deviation

*Significant at $p<0.05$

Discussion

Students in the PBL group had significantly higher post-intervention metacognitive-skill scores than those in the discussion group, with mean scores of 128 ± 12.1 and 112 ± 19.3 , respectively. The mean between-group difference was therefore 16 points. This finding is consistent with Millanzi and Kibusi, who reported a significant improvement in metacognition among nursing students exposed to a problem-based facilitative teaching approach.¹² In contrast, Son reported no statistically significant pre–post change in metacognition following a short simulation-based PBL intervention ($p=0.063$), suggesting that longer and repeated exposure to PBL may be required to produce measurable metacognitive development.¹⁵ These differing findings suggest that the effect of PBL on metacognition may vary according to the duration and structure of the intervention, the educational setting, student characteristics, and the instrument used to measure metacognitive skills.

The observed 16-point between-group difference may be explained by the structured learning processes incorporated into PBL. Students in the PBL group were required to identify clinical problems, activate prior knowledge, determine their learning needs, search for relevant information, discuss alternative solutions, and evaluate their understanding.¹⁶ These activities correspond closely to the principal components of metacognitive regulation, including planning, monitoring, and evaluating one's own learning.^{2,16} Earlier studies have also suggested that PBL can strengthen metacognitive awareness and self-directed regulation by helping learners recognize gaps in understanding, manage their learning activities, and review their own progress.¹⁷

However, because no baseline assessment was conducted, the 16-point difference cannot be interpreted as a measured improvement or attributed solely to PBL. It represents only the difference observed between the two groups after the intervention. Baseline equivalence in metacognitive skills could not be directly established, and the possibility that pre-existing differences contributed to the findings cannot be excluded. The slightly higher cumulative GPA in the PBL group may also reflect differences in prior academic performance, although its influence on the outcome was not examined in this study.

In health-professions education, metacognitive competence is especially valuable because learners must connect theoretical understanding with clinical judgment and decision-making.¹⁸ The ability to recognize knowledge gaps, evaluate information critically, and adjust learning strategies is essential for effective professional practice. Learning environments that encourage active participation and reflection may therefore contribute to the development of these competencies.¹⁹ In midwifery education, where students must apply theoretical concepts

to diverse maternal and neonatal care scenarios, the ability to monitor and regulate one's thinking is crucial for safe and effective practice. Furthermore, healthcare professionals are expected to engage in lifelong learning to keep pace with advances in evidence-based practice, making metacognitive competence an important foundation for continuous professional development and high-quality patient care.

Another possible explanation is that PBL creates opportunities for continuous reflection during learning activities. As students analyze problems, discuss alternative solutions, and evaluate evidence, they become more aware of their thinking processes. This reflective practice enables learners to develop greater control over their cognitive strategies and learning behaviors, ultimately strengthening metacognitive competence.²⁰

The results of this study provide valuable insights for curriculum development in midwifery education. As healthcare systems increasingly demand practitioners who can engage in evidence-based decision-making and lifelong learning, educational approaches that promote metacognitive competence should be prioritized. Integrating PBL into professional courses may provide students with opportunities to develop reflective, self-directed, and inquiry-based learning habits that extend beyond the classroom.²¹ Higher post-intervention scores observed among students in the PBL group suggest that this approach may support the development of higher-order thinking skills required for effective clinical reasoning and professional practice. Consequently, PBL may serve as a valuable pedagogical strategy for preparing future midwives to become independent learners and competent healthcare professionals.

Despite the promising results, this study is constrained by its execution at a single institution, involving a relatively small sample size of 37 students and used a post-test-only design. Future studies should employ validated metacognitive instruments, adopt a pre-test–post-test design, use clearly defined random allocation procedures, recruit larger multicenter samples, and control for relevant baseline characteristics, including prior academic achievement.

Conclusion

Problem-based learning was associated with significantly higher post-intervention metacognitive-skill scores among midwifery students compared with discussion-based learning. These findings suggest that PBL may strengthen students' capacity to organize, oversee, and assess their own learning. However, because the study used a post-test-only design, the findings should be interpreted as a between-group association rather than definitive evidence of improvement from baseline.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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