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Effect of Problem-Based Learning Combined with Graphic Organizers on Third-Year Nursing Students' Information Analysis Ability

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Abstract

Background and Aims: In contemporary nursing education, students are required to locate, evaluate, and apply large volumes of medical information to support evidence-based practice. However, many third-year undergraduate nursing students experience difficulties in critically evaluating sources, synthesizing findings, and applying information to clinical decision-making. Problem-Based Learning encourages inquiry and collaboration, while graphic organizers provide visual scaffolding to structure complex information. This experimental research aimed to: 1) compare the students' information analysis ability before and after receiving Problem-Based Learning combined with Graphic Organizers. 2) compare the students' information analysis ability with the criteria set at 70%, and 3) assess the students' satisfaction with Problem-Based Learning combined with Graphic Organizers.

Methodology: The sample consisted of 40 third-year undergraduate nursing students from Kangda College of Nanjing Medical University, selected by cluster random sampling. Students participated in eight PBL sessions (16 hours) integrated with graphic organizers. The graphic organizers used in the lessons included concept maps, mind maps, and evidence-synthesis charts to provide visual scaffolding for organizing, comparing, and synthesizing medical information. Data were collected using an Information Analysis Ability Test and a satisfaction questionnaire. Only 32 completed the satisfaction questionnaire. Data were analyzed by mean, standard deviation, dependent t-test, and one-sample t-test.

Results: The results indicated that students' information analysis ability after learning through Problem-Based Learning combined with Graphic Organizers ($M = 82.23$, $SD = 7.20$) was significantly higher than before learning ($M = 63.58$, $SD = 10.10$) ($t = 38.135$, $p < .001$), suggesting that the intervention was associated with improved information analysis ability. In addition, students' post-test information analysis ability was higher than the determined criterion of 70 percent at a

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significance level of .01 (M = 82.23, SD = 7.20, t = 10.746, p < .001). Students were satisfied with the learning management using Problem-Based Learning combined with Graphic Organizers (M = 4.62, SD = 0.16).

Conclusion: Problem-Based Learning combined with Graphic Organizers on nursing students' information analysis ability uses 5 steps: 1) First, create problem situations to stimulate students' learning interest. 2) Cultivate students' ability to organize prior knowledge using graphic organizers. 3) Cultivate students' ability of searching, evaluate, and analyze medical information. 4) Exercise students' ability to synthesize and visualize information. 5) Guide students to present, reflect, and apply information to clinical situations. Overall, the findings suggest that integrating Problem-Based Learning with Graphic Organizers may be beneficial for improving nursing students' information analysis ability and supporting evidence-based learning in medical information literacy courses.

Keywords: Problem-Based Learning; Graphic Organizers; Information Analysis Ability; Nursing Education; Medical Information Literacy

Introduction

In medical and nursing education, students are increasingly required to develop self-directed, cooperative, and inquiry-based learning abilities to meet the needs of evidence-based practice. With the rapid growth of digital medical resources, nursing students must move beyond information retrieval to effective evaluation and clinical application. Therefore, enhancing students' information literacy and higher-order information processing has become an important task in nursing education (Sezer, 2020; Wang et al., 2025).

However, in China, Medical Information Literacy or information retrieval courses in many institutions are still mainly delivered through teacher-centered instruction, focusing on procedural searching skills and basic knowledge explanation. As a result, students may lack opportunities to practice source evaluation and information synthesis in authentic tasks (Wang et al, 2023).

Although previous studies have reported positive effects of Problem-Based Learning and graphic organizers when used separately, limited research has examined their integration in medical information literacy education, particularly among nursing students. In the context of rapidly expanding digital medical resources, nursing students often experience information overload and cognitive challenges when evaluating sources, synthesizing evidence, and applying information to clinical decision-making. Graphic organizers may reduce cognitive load by visually structuring complex information, while Problem-Based Learning promotes inquiry, collaboration, and higher-order thinking. However, empirical evidence on the effectiveness of combining these two approaches in medical information literacy courses in China remains limited. Therefore, this study investigated the effects of Problem-Based Learning combined with Graphic Organizers on

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third-year nursing students' information analysis ability and students' satisfaction at Kangda College of Nanjing Medical University.

Objectives

1. To compare the students' information analysis ability before and after receiving Problem-Based Learning combined with Graphic Organizers.

2. To compare the students' information analysis ability with the criterion set at 70%.

3. To assess the students' satisfaction with Problem-Based Learning combined with Graphic Organizers.

Literature Review

This literature review examines key concepts related to Medical Information Literacy, Problem-Based Learning, Graphic Organizers, their integration, information analysis ability, and students' satisfaction.

Medical Information Literacy Course

Sezer (2020) reported that an information literacy course for medical students could improve their ability to search, evaluate, and use medical information for learning and clinical decision making. The study emphasized the importance of analytical and interpretive skills beyond technical searching.

Wang et al. (2025) found that evidence-based medicine curricula significantly enhanced medical students' information literacy, especially in evaluating and applying research evidence in academic and clinical contexts.

Kim and Lee (2015) showed that Problem-Based Learning could improve students' information processing ability by encouraging them to analyze problems and search for relevant information independently.

In summary, Medical Information Literacy courses aim to develop students' abilities to retrieve, evaluate, and apply medical information, and prior studies support inquiry-oriented approaches for enhancing information analysis ability.

Problem-Based Learning

Barrows (1986) proposed Problem-Based Learning as an instructional approach that uses problems as the starting point for learning, allowing students to actively construct knowledge through inquiry and problem solving. This approach emphasizes student-centered learning and learner responsibility.

Yew and Goh (2016) explained that Problem-Based Learning involves students working collaboratively to identify learning issues, search for information, and propose solutions to real-

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world problems. Their study indicated that this approach can promote deeper understanding, self-directed learning, and critical thinking.

Qin et al. (2016) reported that Problem-Based Learning significantly improved the educational environment in medical education, making learning more active and meaningful. Similarly, Kong et al. (2014) found that Problem-Based Learning was effective in enhancing nursing students' critical thinking and learning outcomes.

Wei et al. (2024) further confirmed that Problem-Based Learning could effectively improve nursing students' higher-order thinking skills and learning performance when applied in nursing education.

In summary, Problem-Based Learning promotes inquiry, collaboration, and critical thinking, and has demonstrated effectiveness in medical and nursing education.

Graphic Organizers

Rahmat (2020) explained that graphic organizers help learners to process information by visually organizing ideas and relationships among concepts, which supports comprehension and retention. The study showed that using visual structures can improve students' ability to analyze and organize information.

Samba et al. (2020) found that graphic organizers could enhance students' critical thinking and academic achievement by helping them structure their ideas and connect different pieces of information during learning activities.

Odegaard (2015) reported that the use of graphic organizers in instructional activities supported students' problem solving and reflective thinking by making their thinking processes more explicit and systematic.

Pimdee and Seechaliao (2025) showed that integrating graphic organizers into instructional models could improve students' learning performance and engagement, especially when used together with problem-based learning activities.

In summary, graphic organizers provide visual support for organizing, analyzing, and synthesizing information.

Problem-Based Learning Combined with Graphic Organizers

Jansawang (2023) studied the integration of Problem-Based Learning with graphic organizers and found that this approach could improve students' collaborative problem-solving ability and learning engagement. The use of visual organizers helped students clarify problems, organize information, and share ideas during group discussions.

Pimdee and Seechaliao (2025) reported that a blended instructional model using Problem-Based Learning combined with graphic organizers could significantly enhance students' learning achievement and participation. Their study indicated that graphic organizers functioned as

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cognitive scaffolds that supported students in organizing and synthesizing information while solving problems.

Makrakis and Kostoulas-Makrakis (2016) suggested that combining problem-oriented learning with supportive learning tools could improve students' ability to process information and apply knowledge in meaningful contexts. The authors emphasized that appropriate instructional support is important for helping students manage complex learning tasks.

Kim and Lee (2015) also found that when Problem-Based Learning was supported by structured tools, students showed better information processing and problem-solving performance.

In summary, Problem-Based Learning combined with Graphic Organizers refers to an instructional approach in which students learn through solving problems while using visual tools to organize, analyze, and integrate information. Previous studies indicate that this combined approach enhances engagement, information processing, and academic achievement in nursing education.

Information Analysis Ability

Sezer (2020) investigated the effect of an information literacy course on medical students and found that students' ability to evaluate, analyze, and use medical information was significantly improved after instruction. The study emphasized the importance of developing students' skills in judging information quality and applying evidence in learning and practice.

Wang et al. (2025) reported that evidence-based medicine curricula could enhance medical students' information literacy, particularly in searching, evaluating, and synthesizing research evidence for clinical decision making.

Makrakis and Kostoulas-Makrakis (2016) pointed out that information analysis ability involves not only retrieving information, but also processing, interpreting, and applying knowledge to solve problems in meaningful contexts.

Kim and Lee (2015) showed that problem-based instructional approaches could improve students' information processing and analytical abilities by requiring learners to engage actively with information during problem solving.

In summary, information analysis ability refers to the capacity to evaluate, synthesize, and apply information effectively, and appropriate instructional approaches can support its development.

Students' Satisfaction

Popham (2008) explained that students' satisfaction reflects perceptions of instructional quality and alignment among objectives, activities, and assessment.

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Sezer (2020) reported that students who participated in an information literacy course showed a high level of satisfaction with the learning process, especially when instruction supported active learning and meaningful engagement with information.

Makrakis and Kostoulas-Makrakis (2016) suggested that problem-oriented and technology-supported learning environments could improve students' learning experience and satisfaction by promoting interaction, autonomy, and engagement.

Students' satisfaction is an important indicator of instructional effectiveness, and learner-centered approaches positively influence learning perceptions.

Theoretical justification for integrating Problem-Based Learning and Graphic Organizers

The integration of Problem-Based Learning combined with Graphic Organizers in this study is supported by several learning theories. Constructivism emphasizes that learners actively construct knowledge through meaningful learning experiences and social interaction; thus, problem-centered learning activities can promote deeper understanding and critical thinking. Cognitive Load Theory suggests that learners' working memory is limited, and visual tools such as graphic organizers can reduce extraneous cognitive load by organizing complex information into structured representations. Information Processing Theory further explains that organizing information into meaningful structures facilitates encoding, retention, and retrieval. Therefore, combining Problem-Based Learning with Graphic Organizers provides active inquiry and structured cognitive support that may facilitate nursing students' information analysis ability.

Conceptual Framework

According to the content of this study, the independent variable is Problem-Based Learning combined with Graphic Organizers, and the dependent variables are students' information analysis ability and students' satisfaction. Problem-Based Learning combined with Graphic Organizers is implemented through five instructional steps to improve students' information analysis ability and learning performance, and to enhance students' satisfaction with the learning process (Barrows, 1986; Bunloisong & Jansawang, 2023).

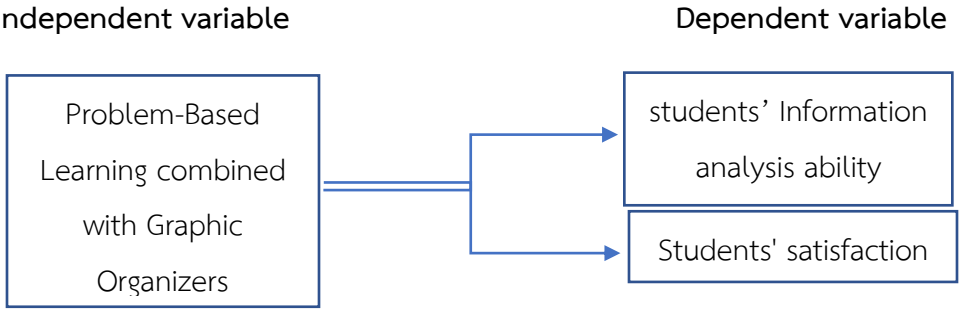


Figure 1 Conceptual Framework

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Methodology

Population and Sample: The population of this study was third-year undergraduate nursing students at Nanjing Medical University Kangda College, China, in the academic year 2024–2025. The sample of this study consisted of 40 students from one third-year nursing class, derived from the cluster sampling method. This class was selected as the experimental group for implementing Problem-Based Learning combined with Graphic Organizers.

Research Instruments: The research instruments used in this study were as follows:

Instruments for the experiment:

1) Lesson plans using Problem-Based Learning combined with Graphic Organizers.

Instruments for collecting data:

1) Information Analysis Ability Test. This test was designed to assess students' competencies in searching, evaluating, synthesizing, and applying medical information. The reliability of the test was confirmed using Cronbach's alpha coefficient, which was .77, indicating acceptable internal consistency.

2) Students' Satisfaction Questionnaire toward learning through Problem-Based Learning combined with Graphic Organizers. This questionnaire was designed to assess students' perceptions of learning effectiveness, engagement, and instructional design. The reliability of the questionnaire was confirmed using Cronbach's alpha coefficient, which was .86, indicating high internal consistency.

The research instruments were evaluated by two Thai experts and three Chinese experts in education and nursing education. After the experts provided suggestions, the researchers revised and improved all instruments before using them for data collection in this study.

Data Collection: The procedures of data collection were as follows:

1) The samples were given the Information Analysis Ability Test as a pre-test.

2) The samples learned through Problem-Based Learning, combined with Graphic Organizers, using the prepared lesson plans. In each lesson, students worked in small groups to analyze a clinical or information-retrieval problem, identify learning issues, search for relevant evidence, and record key information using graphic organizers (e.g., concept maps and evidence-synthesis charts). The graphic organizers were used throughout the Problem-Based Learning cycle to support comparing sources, summarizing evidence, and presenting synthesized conclusions during group discussion and reflection.

3) After completing the instruction, the samples were given the Information Analysis Ability Test again as a post-test.

4) The samples were asked to complete the Students' Satisfaction Questionnaire.

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Data Analysis: In this study, data were analyzed by using statistical methods according to the research objectives as follows:

1) To compare students' information analysis ability before and after learning through Problem-Based Learning combined with Graphic Organizers, a t-test for dependent samples was used. 2) To compare students' information analysis ability after learning, with the criterion set at 70%, a t-test for one sample was used. 3) To assess students' satisfaction with learning through Problem-Based Learning combined with Graphic Organizers, descriptive statistics (mean and standard deviation) were used.

Results

1. Comparison of Information Analysis Ability Before and After Learning

Table 1 shows the comparison of students' information analysis ability before and after learning through Problem-Based Learning combined with Graphic Organizers.

Table 1 The result of comparing information analysis ability before and after learning through Problem-Based Learning combined with Graphic Organizers

Group	n	Pretest scores		Posttest scores		*t*	*p*
		M	*SD*	*M*	*SD*		
Experimental group	40	63.58	10.10	82.23	7.20	38.135***	.000

***p< 0.001

As presented in Table 1, the mean score of the pre-test of students' information analysis ability was 63.58 (SD = 10.10), and the mean score of the post-test was 82.23 (SD = 7.20). The results show that students' information analysis ability after learning through Problem-Based Learning combined with Graphic Organizers was higher than before learning, with statistical significance at the .01 level.

2. Comparison with the Criterion Set at 70%

Table 2 presents the comparison of students' post-test scores with the criterion set at 70%.

Table 2 The result of comparing post-test scores of information analysis ability with the criterion set at 70%

Group	n	Full score	Criteria score	Mean	*SD*	*t*	*p*
Experimental group	40	100	70	82.23	7.20	10.746***	.000

***p< 0.001

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As shown in Table 2, the mean score of students' information analysis ability after learning was 82.23, which was higher than the criterion score of 70, with statistical significance at the .01 level.

3. Students' Satisfaction with Learning

Table 3 shows the overall students' satisfaction with learning through Problem-Based Learning combined with Graphic Organizers in the Medical Information Literacy course.

Table 3 Overall students' satisfaction toward learning through Problem-Based Learning combined with Graphic Organizers

n	M	SD	Satisfaction level
32	4.62	0.16	Very high level

As presented in Table 3, the overall mean score of students' satisfaction was 4.62 (SD = 0.16), which was at a very high level. This indicates that students who completed the questionnaire were highly satisfied with learning through Problem-Based Learning combined with Graphic Organizers in the Medical Information Literacy course. Eight students did not complete the satisfaction questionnaire due to absence on the day of data collection.

Discussion

Students' information analysis ability significantly improved after learning through Problem-Based Learning combined with Graphic Organizers. The pre-test mean score was 63.58 (SD = 10.10) and the post-test mean score was 82.23 (SD = 7.20), with statistical significance at $p < .001$ ($t = 38.135$), suggesting that this instructional approach may have contributed to improvements in students' information analysis ability. This improvement may also be interpreted through Cognitive Load Theory, as structured visual scaffolding can reduce extraneous cognitive load and facilitate schema construction. The notable increase in post-test scores and the reduced standard deviation may suggest more consistent performance after the intervention and potential restricted variance. One possible explanation is that the structured use of graphic organizers provided common scaffolding that helped most students follow similar analytical steps, thereby reducing performance dispersion. In addition, although the post-test mean did not reach the maximum score, future studies may further examine potential ceiling effects by using more challenging items or analyzing score distributions. The five instructional steps may have contributed to promoting students' active learning and information processing. Through these steps, students were

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encouraged to learn independently, collaborate in groups, and organize information more systematically, which is consistent with the characteristics and learning processes emphasized in Problem-Based Learning (Barrows, 1986; Yew & Goh, 2016).

In addition, students' post-test scores were significantly higher than the 70% criterion ($M = 82.23$, $SD = 7.20$, $p < .001$), indicating that the learning outcomes met and exceeded the expected standard. This finding supports previous studies showing that Problem-Based Learning can enhance higher-order learning outcomes in medical and nursing education (Qin et al., 2016; Kong et al., 2014; Wei et al., 2024).

Regarding students' satisfaction, the survey results showed that the overall satisfaction with the Medical Information Literacy course was at a very high level ($M = 4.62$, $SD = 0.16$, $n = 32$), with item mean scores ranging from 4.50 to 4.72 and SDs from 0.52 to 0.67. Eight students did not complete the satisfaction questionnaire due to absence on the day of data collection. These findings indicate that students were highly satisfied with learning through Problem-Based Learning combined with Graphic Organizers. The use of graphic organizers may have helped students organize and analyze medical information more clearly, contributing to positive learning experiences and satisfaction (Rahmat, 2020; Samba et al., 2020).

This study employed a one-group pretest–posttest design without a control group, which may limit internal validity. Improvements in post-test performance may have been influenced by testing effects (e.g., familiarity with the test format), maturation, or instructor guidance during the intervention. Therefore, future research should consider quasi-experimental or randomized controlled designs with comparison groups to strengthen causal inference and to reduce potential confounding effects.

Conclusion

This study investigated the effects of Problem-Based Learning combined with Graphic Organizers on third-year nursing students' information analysis ability and students' satisfaction in a Medical Information Literacy course. The results indicated that students' information analysis ability significantly improved after learning, that post-test scores were higher than the 70% criterion, and that students' satisfaction was at a very high level, suggesting that this instructional approach may be beneficial for nursing education.

Recommendation

1. Recommendation for implication

Following the results of this study, the following suggestions are proposed:

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1) Personalized learning support. In future teaching, instructors should provide targeted guidance according to nursing students' different levels of information analysis ability, and flexibly adjust the use of graphic organizers and teacher guidance to support students' learning progress.

2) Transformation of the role of teachers. Instructors should transform their role from traditional knowledge transmitters to facilitators and mentors, who guide students in problem solving, information analysis, and the effective use of Problem-Based Learning combined with Graphic Organizers.

2. Recommendation for further research

Problem-Based Learning combined with Graphic Organizers may be an effective instructional approach for improving nursing students' information analysis ability. In future research, the following directions may be considered:

1) Expand the sample and learning context. Future studies may include more nursing students from different classes or institutions to further examine the effectiveness of this instructional approach.

2) Interdisciplinary application. Future research may apply Problem-Based Learning combined with Graphic Organizers to other nursing and health-related courses to explore its impact in different disciplinary contexts.

3) Process-oriented evaluation. Future studies should focus on students' learning processes during problem solving and information analysis, and provide continuous feedback rather than relying only on final test results.

4) Integration of learning resources. Future research may explore the integration of digital resources and learning platforms with Problem-Based Learning combined with Graphic Organizers to further enhance students' learning experience.

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