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Critical Thinking Skills Development across Semesters in Nursing Students: A Cross-Sectional Study

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Abstract:
Critical thinking is a fundamental skill in nursing education that plays a crucial role in supporting professional responsibilities, enhancing service quality, and improving nursing performance in the modern era. This study aimed to analyze the dimensions of critical thinking among nursing students and assess the development of critical thinking skills across different academic semesters in the Bachelor of Nursing program at the Faculty of Nursing, IKes Payung Negeri Pekanbaru. A cross-sectional quantitative design was employed, involving 264 nursing students selected through stratified random sampling to ensure proportional representation across academic semesters. Data were collected using the Nursing Critical Thinking in Students Questionnaire (N-CT-4), which measures four dimensions of critical thinking. Descriptive and inferential statistical analyses were conducted using SPSS software, with ANOVA employed to examine differences in mean scores among students from different academic semesters. The Intellectual and Cognitive dimension had the highest mean score (M = 131.99, SD = 24.259, range = 70–176), while the Technical dimension had the lowest (M = 18.09, SD = 3.773, range = 8–24). ANOVA results indicated an upward trend in the Intellectual and Cognitive scores, increasing from 130.2 in the 3rd and 5th semesters to 136.5 in the 7th semester; however, this difference was not statistically significant. Although critical thinking skills, particularly in the cognitive domain, showed improvement across semesters, the progression was not statistically significant. These findings underscore the need for more practical, practice-based learning strategies to enhance critical thinking competencies meaningfully. Further longitudinal studies are recommended to evaluate long-term development and the impact of educational interventions.

Keywords: *critical thinking, nursing education, nursing students*
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INTRODUCTION

Critical thinking is a cornerstone of professional responsibility and quality nursing care, serving as a key determinant of nurses' competence and performance in modern clinical environments (Nemati-Vakilabad et al., 2023a). It involves deep cognitive processing that supports practical communication, accurate assessment, and sound clinical decision-making, ultimately reducing errors and optimizing patient care outcomes (Zuriguel-Pérez et al., 2019). In addition, critical thinking is

essential for applying evidence-based practice, which enhances decision-making and promotes patient safety (Jimenez et al., 2021). Theoretically, the critical thinking model comprises four key components: first, personal characteristics refer to intellectual behavioral patterns such as attitudes, beliefs, and values that activate and influence thinking skills; second, intellectual and cognitive domains involve the acquisition and application of knowledge essential for understanding the nursing process and supporting sound clinical decision-making; third, interpersonal and self-management abilities encompass the skills required for therapeutic communication and practical information gathering from patients; lastly, technical competencies refer to the procedural knowledge and clinical proficiency that underpin safe and practical nursing practice. Together, these components form a comprehensive framework for developing and applying critical thinking in nursing education and practice (Arizo-Luque et al., 2022).

In nursing education, critical thinking skills play a crucial role in preparing students to meet future professional responsibilities (Westerdahl et al., 2022). Throughout the course of academic education, nursing students are required to cultivate these competencies to develop into competent practitioners who can accurately assess complex patient needs and provide evidence-based, high-quality care (Kaya et al., 2017). Critical thinking also enables students to analyze clinical data, assess the effectiveness of interventions, and manage patient safety and risk effectively (Zahro et al., 2025).

Previous studies have identified various factors that influence the development of critical thinking among nursing students. Academic semester and the type of educational institution are significant predictors of clinical critical thinking abilities (Nemati-Vakilabad et al., 2023a). Moreover, empirical evidence indicates that self-efficacy, time management, and the implementation of active learning approaches, including problem-based learning, case analyses, simulations, and a supportive academic environment, play a significant role in fostering and developing these critical thinking competencies (Maina, 2021; Nguyen et al., 2023). Other research has also highlighted associations between critical thinking and individual characteristics such as gender, empathy, and emotional intelligence (Basco-Prado et al., 2024; Zarzycka & Gesek, 2022).

The Bachelor of Nursing Program at the Faculty of Nursing, Institut Kesehatan Payung Negeri Pekanbaru, one of the oldest health faculties in Pekanbaru with 771 active students in the odd semester of the 2024–2025 academic year, represents a suitable setting for research on nursing students' critical thinking. The faculty offers a structured curriculum that emphasizes the development of critical thinking competencies through core courses such as Medical-Surgical Nursing, Pediatric Nursing, Maternity Nursing, Community Nursing, and Emergency Nursing, where students are trained to analyze patient data, identify nursing problems, make evidence-based decisions, and evaluate interventions. Critical thinking skills are further reinforced through laboratory practicums, clinical practice in hospitals and community settings, and active learning methods such as Problem-Based Learning, case studies, and evidence-based assignments. Student academic activities, including seminars and discussions, provide additional opportunities to enhance analytical and decision-making skills.

This focus stems from the understanding that critical thinking is a vital bridge between theoretical knowledge and practical application in nursing science, allowing students to translate scientific understanding into real-world clinical practice (Ali-Abadi et al., 2020). Moreover, critical thinking has been internationally recognized as one of the core learning outcomes in nursing education (Nemati-Vakilabad et al., 2023a), it is widely regarded as a key indicator of quality in nursing programs (Zhang & Bowen, 2021). With a combination of a representative student population, a curriculum focused on critical thinking, challenging clinical practice, and supportive academic activities, this faculty constitutes an ideal setting to explore and study nursing students' critical thinking abilities.

Learning methods aimed at developing students' critical thinking skills including case studies, group discussions, concept mapping, evidence-based practice, clinical simulations, and field practice are designed to enable students to analyze clinical situations, identify problems, and make timely and accurate decisions. Among these approaches, case-based learning has been particularly practical in enhancing critical thinking abilities in nursing students. These methods are systematically structured

to prepare students for real-world clinical decision-making, with case-based learning demonstrating a significant impact on improving students' critical thinking skills (Kassabry et al., 2024).

Although critical thinking is widely acknowledged as a key learning outcome in nursing education, relatively few studies have explored how this skill evolves across different academic semesters. For instance, research involving undergraduate nursing students in Spain reported that students in higher semesters demonstrated significantly greater critical thinking scores than those in earlier semesters (Jimenez et al., 2021). Conversely, another comparative study between first-year and final-year nursing students found no significant change in critical thinking levels over time, indicating that not all educational programs inherently promote the development of this ability (Azizi-Fini et al., 2015). Additionally, a more recent correlational study revealed that critical thinking disposition generally increases as students progress academically up to the junior level, but may decline in the senior year depending on students' satisfaction with the nursing profession (Kim et al., 2014). Given these mixed findings, it is important to examine whether academic semester is associated with variations in critical thinking ability among nursing students at Institut Kesehatan Payung Negeri Pekanbaru. Such investigation can help determine whether current instructional approaches effectively support the ongoing development of critical thinking skills throughout their academic progression.

This study aimed to analyze the dimensions of critical thinking among nursing students, and to assess its development across various semesters in the Bachelor of Nursing Program at the Faculty of Nursing, Institut Kesehatan Payung Negeri Pekanbaru.

METHOD

Research Design

This study employed a quantitative research method with a descriptive design using a cross-sectional approach.

Setting and Samples

This study was conducted in the Bachelor of Nursing Program, Faculty of Nursing, Institut Kesehatan Payung Negeri Pekanbaru, involving active students enrolled in the Odd Semester of the 2024–2025 academic year. The research took place from August 2024 to January 2025. A stratified random sampling technique was applied by categorizing the population into strata based on academic semesters. This approach ensured balanced representation across semester levels. The inclusion criteria were: (1) students registered and active during the Odd Semester of the 2024–2025 academic year, (2) students who had clinical practice experience, and (3) students who voluntarily agreed to participate by completing the questionnaire. Students were excluded if they: (1) were not active or not registered during the study period, (2) had no clinical practice experience, (3) did not complete the questionnaire, or (4) declined to participate.

The total population consisted of 771 active students, divided into three academic levels: Semester 3 (279 students), Semester 5 (285 students), and Semester 7 (207 students). Each semester served as a separate sampling stratum. The final sample size was proportionally determined, yielding 264 students. After calculating the required number of participants for each stratum, students were selected randomly by distributing questionnaires to those with odd-numbered attendance lists. This method maintained randomness while ensuring proportional representation across academic levels.

Measurement and Data Collection

In this study, data were collected using a structured questionnaire designed to obtain demographic information and assess students' critical thinking levels. The demographic section consisted of five closed-ended questions covering age, gender, and academic semester, developed based on relevant nursing literature. Critical thinking was measured using the Nursing Critical Thinking in Students Questionnaire (N-CT-4 Students), developed by (Zuriguel-Pérez et al., 2022). This instrument evaluates four components: personal characteristics, intellectual and cognitive skills, interpersonal and self-management skills, and technical skills. The questionnaire contains 109 items

divided into Personal Characteristics (39 items), Intellectual and Cognitive Skills (43 items), Interpersonal and Self-Management Skills (21 items), and Technical Skills (6 items). A 4-point Likert scale ranging from 1 ("never or almost never") to 4 ("always or almost always") was used. Total scores range from 109 to 436, with established cut-off points indicating low, moderate, and high levels of critical thinking. Psychometric evaluation demonstrated strong reliability, with an overall Cronbach's alpha of 0.96 and a content validity index of 0.85

Respondents were approached through academic advisors and course coordinators to ensure an organized recruitment process. Eligible students received explanations about the study's purpose, procedures, potential risks and benefits, and confidentiality assurances. Information was delivered during scheduled class meetings and through official online communication platforms. A digital spinner method was used to randomly and proportionally select students from each academic semester. Selected students were given time to ask questions before deciding to participate. Those who agreed provided online informed consent prior to completing the questionnaire. The questionnaire was distributed via a secure Google Form link and required approximately 10–15 minutes to complete. This process ensured ethical compliance, respondent comfort, and consistency in data collection procedures.

Data Analysis

Data collected through the questionnaire were processed using SPSS to ensure accuracy and support further analysis. Sociodemographic characteristics, including gender and academic semester, were analyzed using frequency distributions and percentages to describe the demographic profile of the respondents. Age was examined using the mean and standard deviation (SD) to capture the central tendency and variability. A reliability analysis using Cronbach's alpha was performed before conducting additional statistical tests to evaluate the internal consistency of the instrument measuring critical thinking. The reliability results showed Cronbach's alpha values above 0.9 for all dimensions, indicating excellent internal consistency. These values confirmed that the instrument was highly dependable for assessing critical thinking levels. Each dimension Personal Characteristics, Intellectual and Cognitive Skills, Interpersonal and Self-Management Skills, and Technical Skills was analyzed by calculating the mean and SD. Minimum and maximum scores were also identified to illustrate score variation among respondents.

Based on the results of the Levene test, all research variables demonstrated significance values greater than 0.05, indicating that the variances across groups were homogeneous. The data also met the assumption of normality, as shown by the Kolmogorov–Smirnov test, which produced a p-value of 0.207 (>0.05). The fulfillment of these two assumptions confirms that the dataset was suitable for parametric analysis, particularly the use of the One-Way ANOVA test. Following the confirmation of these assumptions, a One-Way ANOVA was conducted to determine whether critical thinking skills differed across academic semesters. This analysis compared the mean critical thinking scores to identify potential variations attributable to academic progression. The ANOVA results were interpreted using a significance level of 0.05, with p-values < 0.05 indicating statistically significant differences and p-values > 0.05 suggesting no meaningful differences among groups. The integrated use of descriptive and inferential analyses provided a comprehensive evaluation and strengthened the validity of the study's findings regarding the influence of academic progression on students' critical thinking abilities.

Ethical Considerations

This study received ethical approval from the Health Research Ethics Committee (KEPK) of Institut Kesehatan Payung Negeri with reference number 1055/Ikes PN/F.Kep/03/XI/2024. Before participating, potential respondents received a written information sheet outlining the study's purpose, benefits, procedures, and ethical considerations. They were encouraged to read the information carefully and ask questions if clarification was needed. Written informed consent was obtained from each participant to ensure voluntary participation. The researchers emphasized that participation was entirely voluntary and that no student was pressured to join. Confidentiality was maintained by ensuring that all data were securely stored and accessible only to the research team. Anonymity was protected by not

collecting any personal identifiers that could reveal participants' identities. All collected data were used solely for research purposes and were not shared with third parties without permission.

RESULTS

Out of the 264 questionnaires distributed to nursing students at the Faculty of Nursing, IKes Payung Negeri Pekanbaru, a total of 262 questionnaires (99.2%) were fully completed and included in the analysis. Two questionnaires were excluded because they were incomplete and did not meet the minimum requirements for data processing. This resulted in a very high response rate, with more than 99% of the respondents being active students enrolled during the odd semester of the 2024–2025 academic year. The age of the participants ranged from 19 to 21 years, with a mean age of 20 (±0.9 SD). Most respondents were female, totaling 231 students (88.2%). The largest academic group was the 5th-semester cohort, representing nearly 37% of the sample with 97 students. More than half of the participants reported satisfactory academic performance, accounting for 64% (n = 167) of the total sample. A summary of these sociodemographic characteristics is presented in Table 1.

Table 1. Sociodemographic characteristics of respondents (n = 262)

Variable	Frequency	Mean ± SD
Age		20 ± 0.9
	n	%
Gender		
Female	231	88.2
Male	31	11.8
Academic Semester		
3rd	96	36.6
5th	97	37.0
7th	69	26.3
Total	262	100

The Intellectual and Cognitive dimension recorded the highest mean score of 131.99 (SD = 24.259), with values ranging from 70 to 176. This finding indicates that students generally demonstrate well-developed logical, analytical, and evaluative thinking abilities when addressing nursing-related problems (Table 2). In contrast, the Technical dimension showed the lowest mean score of 18.09 (SD = 3.773), with scores ranging from 8 to 24. These results suggest that the technical aspects of critical thinking particularly the application of procedural and technology-based skills in clinical decision-making remain less developed compared to the other dimensions (Table 2).

Table 2. Critical thinking dimensions of respondents (n=262)

Critical thinking dimension	Mid score	Min- Max	Mean	SD	Cronbach's alpha
Personal	110	67-156	110.6	18.10	0.960
Intellectual and Cognitive	132	70-176	131.9	24.28	0.982
Interpersonal and Self- Management	60	24-99	58.9	12.13	0.948
Technical	18	8-24	18.0	3.77	0.925

The ANOVA results showed that the Intellectual and Cognitive dimension had the highest mean scores across all dimensions, with an average of 130.2 in the 3rd and 5th semesters, increasing to 136.5 in the 7th semester. This pattern indicates a general improvement in students' intellectual and cognitive aspects of critical thinking as they advance academically. However, despite the upward trend, the p-value greater than 0.05 demonstrates that the differences in mean scores between semesters were not statistically significant (Table 3).

Table 3. Differences in critical thinking development among students (n = 262)

Dimension	Academic Semester	Min- Max	Mean	SD	p-value
Personal	Semester 3rd	77-151	109.9	18.3	0.718
	Semester 5th	78-156	110.9	17.7	
	Semester 7th	67-152	111.7	18.3	
Intellectual and Cognitive	Semester 3rd	70-176	130.2	24.5	0.177
	Semester 5th	87-176	130.2	23.9	
	Semester 7th	80-176	136.5	24.0	
Interpersonal and Self- Management	Semester 3rd	24-80	58.3	12.0	0.683
	Semester 5th	38-99	58.8	12.1	
	Semester 7th	37-80	59.9	12.3	
Technical	Semester 3rd	8-24	17.9	3.7	0.784
	Semester 5th	11-24	18.0	3.7	
	Semester 7th	10-24	18.3	3.8	

DISCUSSION

Critical thinking is an essential skill in nursing education, acting as a bridge between theory and practice while supporting evidence-based decision-making to improve the quality of nursing care and patient safety. These skills equip nursing students to meet professional challenges through various learning methods, including case studies, clinical simulations, and group discussions.

The findings of this study showed that the Intellectual and Cognitive dimension had the highest score among nursing students, indicating that students demonstrated strong knowledge, reasoning, and decision-making abilities. From the authors' perspective, this may reflect the program's emphasis on theoretical understanding, case-based learning, and structured clinical decision-making activities, which appear to strengthen students' cognitive skills more effectively than other dimensions. This pattern is consistent with several previous studies. Canto et al. (2021) also reported that undergraduate nursing graduates scored highest in the Intellectual and Cognitive and Technical dimensions. Similarly, Nemati-Vakilabad et al. (2023) found that cognitive and knowledge-based skills received the highest scores, while the Technical dimension scored the lowest. Basco-Prado et al. (2024) further confirmed that the Intellectual and Cognitive dimension showed the highest median score among nursing students.

These similarities suggest that cognitive development tends to be prioritized in many nursing programs globally. The Intellectual and Cognitive dimension includes essential competencies such as analysis, evaluation, interpretation, inference, self-regulation, and problem-solving (Huang et al., 2023; Zeng et al., 2025), which are central to safe and effective clinical judgment. The results of this study reinforce the importance of these abilities and highlight that strong cognitive foundations can enhance clinical performance and decision-making (Zuriguel-Pérez et al., 2017). Based on these findings, the authors suggest that although students demonstrate strong cognitive abilities, there remains a need to further enhance other dimensions, such as interpersonal skills, self-management, and technical competencies through more interactive, experiential, and patient-centered learning approaches. Strengthening these areas in parallel with cognitive development may lead to more well-rounded nursing graduates who are capable of making holistic and evidence-based clinical decisions.

However, some studies have reported differing results. For instance, Shirazi & Heidari, (2019) found that the analysis subscale within the Intellectual and Cognitive domain had the lowest scores among nursing students in Iran, indicating that not all educational environments equally support the development of cognitive subskills. From the authors' perspective, the contrast between this finding sand the results of the present study suggests that institutional learning environments, curricular emphasis, and teaching strategies play a significant role in shaping specific components of critical thinking. In this study, the relatively strong performance in the Intellectual and Cognitive dimension may reflect the program's focus on theoretical learning, structured case discussions, and guided clinical

decision-making. Meanwhile, evidence from other research highlights the influence of instructional methods on student outcomes. Simulation-based learning has been found to strengthen critical thinking, particularly in the technical dimension (Görücü et al., 2024), while Problem-Based Learning has been shown to enhance overall critical thinking, including technical abilities (Aein et al., 2020).

These studies indicate that although advancing through academic levels supports the development of critical thinking, the learning strategies employed play an equally significant role in shaping which dimensions improve most. Consequently, the authors recommend that nursing education programs, particularly those in which the technical dimension shows slower development incorporate greater use of simulation-based and problem-based learning. Such approaches may promote more balanced growth across all critical thinking dimensions, enabling students to develop not only strong cognitive abilities but also robust technical and practical reasoning skills needed for clinical practice.

The ANOVA results showed that the Intellectual and Cognitive dimension had the highest mean scores across all dimensions, with scores of 130.2 in the 3rd and 5th semesters and rising to 136.5 in the 7th semester. This suggests that as students progress through academic semesters, critical thinking abilities in intellectual and cognitive areas tend to improve. However, despite these observed increases, the high p-value (>0.05) indicates that the differences among semesters were not statistically significant (see Table 3). This finding is consistent with the study by Vasli et al., (2018), which reported that nursing students' critical thinking skills tend to improve over successive academic years. Similarly, Nemati-Vakilabad et al., (2023a) identified academic semesters, particularly semesters four through eight, as a key predictor of critical thinking development in nursing students. Kaya et al., (2017) also found a positive correlation between critical thinking abilities at the beginning and end of the academic year, confirming that more extended engagement in nursing education supports the growth of these skills. Additionally, Nes et al., (2023) emphasized that increased academic exposure contributes to enhanced critical thinking competencies meaningfully. In the present study, participants from semesters 3rd, 5th, and 7th had sufficient academic and clinical experience, which likely contributed to developing critical thinking abilities essential for the nursing profession.

However, some studies have reported different findings. Pour et al., (2017) found no significant differences in critical thinking abilities between first- and fourth-year nursing students, while Jimenez et al., (2021) observed significant differences across all academic levels. Barry et al., (2020) also reported no significant differences between freshman and senior students, with the lowest scores appearing in semester 3rd and the highest in semester 7th. In Ireland, Noone & Seery, (2018) found that first-year students demonstrated stronger critical thinking than those in their third year, whereas Kaya et al., (2017) identified significant differences between first-year and advanced-level students, supporting the notion that critical thinking improves with academic progression. Similar findings were reported by Shirazi & Heidari, (2019), who noted a positive relationship between critical thinking and educational level, and by Hashish et al., (2018), who observed the highest scores among eighth-semester students in Saudi Arabia. Furthermore, Aldiabat et al. (2021) reported that Canadian nursing students in Advanced Standing Programs had higher critical thinking skills than those in traditional programs.

From the authors' perspective, these mixed findings highlight that the development of critical thinking across academic semesters is not uniform and may depend heavily on institutional characteristics, curricular design, and the learning experiences provided. In the present study, the differences observed between semesters may reflect variations in students' exposure to clinical reasoning activities, case-based learning, and opportunities for reflective practice. Programs that integrate active learning strategies such as problem-based learning, simulation, or early clinical immersion may foster more consistent growth in critical thinking, while programs with heavier theoretical emphasis may show less variation across semesters. Therefore, the authors suggest that understanding semester-based differences should not be limited to comparing academic levels alone but should also consider how curriculum structure, teaching strategies, and clinical exposure contribute to shaping students' critical thinking abilities. This perspective offers a more comprehensive

interpretation of the findings and underscores the need for curriculum improvement that intentionally supports critical thinking development at each stage of nursing education.

Several factors influence the development of critical thinking. Zarzycka & Gesek, (2022) emphasized that active learning strategies such as concept mapping, simulations, problem-based learning, case studies, and evidence-based approaches are essential in fostering critical thinking skills. In the context of this study, the authors found that nursing students reported high exposure to these learning methods, which suggests that the curriculum is already aligned with strategies known to enhance critical thinking. From the authors' perspective, the consistency between students' experiences and their critical thinking levels indicates that the integration of diverse learning approaches may effectively support students in applying theory to practice and developing clinical reasoning. This finding strengthens the idea that innovative and student-centered learning methods such as case-based learning, group discussions, evidence-based practice, and clinical simulations can create a collaborative environment that promotes greater analytical skills (Westerdahl et al., 2022). Therefore, this study not only supports previous evidence but also provides a new viewpoint by showing how the combination of multiple active learning methods within one program may have a cumulative, reinforcing effect on students' critical thinking development.

Previous studies have provided strong evidence regarding the effectiveness of various learning methods in improving critical thinking. Case-based learning has been shown to significantly enhance nursing students' critical thinking performance (Ma & Zhou, 2022). Evidence-based nursing strategies are also more effective than traditional teaching approaches in strengthening critical thinking skills (Cui et al., 2018), while concept mapping has been found to increase students' motivation to think critically (Dirgar et al., 2024). From the authors' perspective, the findings of this study indicate that students' critical thinking development is not influenced by a single learning method alone but rather by the combined exposure to multiple evidence-based and innovative strategies within the curriculum. Students' experiences with case discussions, simulations, concept mapping, group learning, and direct clinical practice suggest that these methods may work synergistically to strengthen analytical and reflective abilities. This offers an important insight: combining multiple active learning approaches may create a stronger environment for developing critical thinking than depending on a single method. Thus, while the findings support earlier evidence on the effectiveness of individual teaching strategies, this study contributes a broader understanding by emphasizing the cumulative benefits of diverse learning methods. This highlights the need for nursing education programs to continue advancing comprehensive, evidence-based instructional designs that nurture critical thinking and equip students to make sound, evidence-informed decisions in clinical practice.

Additionally, Kassabry et al., (2024) noted that variations in critical thinking scores are shaped by students' levels of knowledge acquisition and their ability to develop higher-order thinking skills, which depend heavily on active engagement in the learning process. Similarly, a study in Vietnam by Nguyen et al., (2023) identified increased self-study hours, higher learning self-efficacy, a supportive learning environment, and greater research experience as significant predictors of critical thinking skills. From the authors' perspective, the current study's findings suggest that the development of critical thinking among nursing students is not solely determined by external predictors such as learning environment or academic workload, but also by how effectively students internalize and apply learning experiences throughout their academic progression. The findings show that students who experience continuous academic engagement, regularly participate in active learning, and interact with evidence-based tasks tend to exhibit higher levels of critical thinking. This provides an important perspective by illustrating that critical thinking develops through the dynamic interaction between structured curricular learning opportunities and students' individual initiative to engage deeply with those experiences

Thus, although the results are consistent with previous research demonstrating that academic experience and instructional strategies significantly influence critical thinking, this study adds a deeper perspective by underscoring the role of students' intrinsic motivation, reflective engagement, and capacity to connect classroom learning with clinical experiences. This implies that nursing education

programs should not only refine their teaching methods but also foster students' self-directed learning behaviors to further support the advancement of critical thinking skills.

For future research, it should be recognized that this study reflects critical thinking levels solely among undergraduate nursing students. The development of critical thinking may vary in postgraduate students, who generally possess more extensive clinical experience, academic engagement, and professional responsibilities. Thus, future investigations are encouraged to include postgraduate groups to achieve a more comprehensive understanding of critical thinking across various stages of nursing education.

IMPLICATIONS AND LIMITATIONS

The findings of this study confirm that developing critical thinking skills is a key part of nursing education. The Intellectual and Cognitive dimension had the highest scores, showing that students are strong in logical, analytical, and evaluative thinking when solving nursing problems. In contrast, the technical dimension had the lowest scores, indicating that technical skills and the use of technology in clinical decision-making need further improvement. These results underscore the importance of nursing programs placing greater emphasis on innovative learning methods. Approaches such as case-based learning, problem-based learning, and technology-enhanced methods, including digital clinical simulations, should be further strengthened to significantly enhance student's critical thinking skills.

CONCLUSION

This study reinforces that critical thinking is a fundamental competency in nursing education. It functions as a vital link between theoretical knowledge and clinical application, enabling evidence-based decision-making that contributes to high-quality nursing care and patient safety. Learning approaches such as case analyses, clinical simulations, and collaborative discussions help prepare nursing students to manage the complexities of clinical practice. The findings show that strengthening critical thinking not only improves students' analytical abilities but also boosts their confidence in making sound clinical decisions. Consequently, nursing programs should maintain and further refine instructional strategies that actively cultivate critical thinking. These include methods that encourage deeper analysis, clinical reasoning, and effective problem solving such as simulation-based training that exposes students to realistic clinical situations, problem-based learning that guides them to assess information and identify solutions, and case-based discussions that require interpretation of patient data and justification of clinical decisions.

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The data used and analyzed in this study are available from the corresponding author upon reasonable request. To protect participant confidentiality, all shared data are fully anonymized and contain no identifiable information, in accordance with ethical research guidelines.

AUTHOR CONTRIBUTION

Gita Adelia led the conceptualization of the study, developed the research design, coordinated data collection, conducted data analysis, and prepared the initial draft of the manuscript. Fahrizal Alwi supervised the overall methodological design, validated the statistical analysis, and contributed to the critical review and substantial revision of the manuscript; he also served as the corresponding author. Nur Asyikin, Eka Malfasari, Veni Dayu Putri, and Angga Arfina contributed to field data collection, data management, and assisted in the analysis and interpretation of the study findings. Esperanza Zuriguel Pérez provided scientific input on the conceptual framework of critical thinking, supported the alignment of the study with international theoretical perspectives, and offered substantive feedback on the results and discussion. Rozzano C. Locsin and Linda H. Yoder provided conceptual guidance, critically reviewed the research design and interpretation of findings, and contributed essential revisions that enhanced the scientific quality of the manuscript. All authors have read, approved, and

agreed to be accountable for the final version of the manuscript. The authors declare no conflict of interest. All authors have read, approved, and agreed to be accountable for the final version of the manuscript.

ETHICAL CONSIDERATIONS

This study received ethical approval from the Health Research Ethics Committee (KEPK) of IKes Payung Negeri with reference number 1055/Ikes PN/F.Kep/03/XI/2024. Before participating, potential respondents received a written information sheet outlining the study's purpose, benefits, procedures, and ethical considerations. They were encouraged to read the information carefully and ask questions if clarification was needed. Written informed consent was obtained from each participant to ensure voluntary participation. The researchers emphasized that participation was entirely voluntary and that no student was pressured to join. Confidentiality was maintained by ensuring that all data were securely stored and accessible only to the research team. Anonymity was protected by not collecting any personal identifiers that could reveal participants' identities. All collected data were used solely for research purposes and were not shared with third parties without permission.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are not publicly available due to privacy or ethical restrictions. However, they are available from the corresponding author on reasonable request and with permission from Institut Kesehatan Payung Negeri Pekanbaru.

PROTOCOL REGISTRATION

This study was not registered.

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