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Enhancing Nursing Students' Critical Thinking Skills Through a Pedagogical Learning Model: A Mixed Methods Study

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ABSTRACT

Background: Critical thinking is essential for nursing students to make accurate clinical decisions. This study evaluates the Tribhuwana Nursing Student Academic Support Group (TNS-ASG), a four-session case-analysis and problem-based mentoring program designed to enhance critical thinking skills and explore students' learning experiences.

Methods: A sequential explanatory mixed-methods design with a single-group pretest–posttest approach was conducted with 34 nursing students at Universitas Tribhuwana Tunggadewi, Malang, who completed the program (from 44 initially recruited; 10 dropped out due to scheduling conflicts). Quantitative data were analyzed using paired *t*-tests for the total score and Wilcoxon signed-rank tests for subdimensions. Qualitative data from semi-structured interviews, journals, and observations underwent thematic analysis.

Results: Participation in the program was significantly associated with improved overall critical thinking scores, with a mean paired change of 5.44 points (t = -2.560, p = .015, d = 0.44). Significant gains were also observed in the subdimensions of interpretation (p = .021), analysis (p = .024), evaluation (p = .032), explanation (p = .015), and self-regulation (p = .016). Qualitatively, students reported an enhanced ability to analyze clinical cases, evaluate articles, and articulately express arguments, although limited time and fear of making mistakes remained key barriers.

Conclusion: The TNS-ASG pedagogical model provides promising preliminary evidence for enhancing nursing students' critical thinking competencies, demonstrated through consistent quantitative alignment and positive qualitative learning experiences.

Keywords **:** Critical Thinking; Nursing Students; Peer Learning; Mentoring; Mixed Methods Research

BACKGROUND

Critical thinking is essential for nursing students to interpret complex information, synthesize evidence, and make timely clinical decisions. In nursing education, it directly

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impacts clinical reasoning, evidence-based decision-making, and safe patient care. However, students often struggle to develop this competence systematically when learning environments favor passive memorization over active analysis and application (Jin & Ji, 2021; İlaslan et al., 2023). Because critical thinking is closely tied to metacognitive and self-directed abilities, nursing programs must transition toward active learning models that encourage students to engage deeply with information rather than merely receiving it passively.

These concerns have important implications for nursing education. Students who are unable to critically interpret clinical information may have difficulty recognizing relevant findings, evaluating alternatives, and making defensible clinical decisions. Critical thinking is therefore fundamental to the transition from theoretical knowledge to competent nursing practice. Facione et al. (2021) emphasized that critical thinking in nursing involves a set of fundamental cognitive skills that support clinical practice, while Liu et al. (2021) demonstrated that an integrated educational course can improve students' thinking-related outcomes. Recent evidence continues to support active approaches, including problem-based learning (PBL), simulation, collaborative learning, and structured reflection, as strategies for developing higher-order thinking in nursing students.

Journal appraisal and academic discussion help nursing students evaluate scientific evidence's credibility, completeness, and clinical applicability. Peer learning further enables students to clarify concepts, challenge assumptions, and confidently express arguments. Recognizing these needs, the Tribhuwana Nursing Student Journal Group was established at Universitas Tribhuwana Tunggadewi in 2025. While preliminary implementation improved students' analysis and explanation skills, other critical-thinking domains required further development. Consequently, the program expanded into the Tribhuwana Nursing Student Academic Support Group (TNS-ASG), a comprehensive second-phase intervention combining rigorous journal appraisal with structured mentor-led instruction, case-based discussions, problem-based learning (PBL), and immersive simulation activities.

The rationale for this combined model is consistent with contemporary evidence. A systematic review and meta-analysis found that PBL can improve nursing students' critical thinking, while more recent studies continue to demonstrate benefits of PBL, peer learning, and simulation for critical thinking and related learning outcomes (Wei et al., 2024; Sharifi et al., 2025; Mohamed et al., 2025). Simulation-based approaches may also strengthen critical thinking when they are supported by appropriate facilitation and debriefing (Stenseth et al., 2025; Harry et al., 2025). However, the effectiveness of educational strategies depends on how they are designed, facilitated, contextualized, and integrated into students' learning experiences. A combined model may therefore provide a more comprehensive learning environment than a single teaching strategy.

The present study aimed to evaluate the effectiveness of TNS-ASG in improving critical thinking among nursing students and to explore students' experiences of the learning process. Specifically, the study examined changes in total critical-thinking scores and six critical-thinking dimensions, explored factors supporting or hindering critical thinking, and integrated quantitative and qualitative findings to provide a more comprehensive interpretation of the intervention. The study addresses six research questions examining nursing students'

critical thinking scores before and after mentoring. It evaluates the impact, significance, and effectiveness of the blended pedagogical TNS-ASG model. Additionally, it explores students' experiences, identifies implementation barriers and facilitators, and integrates quantitative and qualitative findings for a comprehensive understanding.

METHODS

Design and Setting

This study employed a sequential explanatory mixed-methods design. Quantitative pretest-posttest data from 34 students were analyzed first to examine changes in critical-thinking scores. These statistical trends directly guided the subsequent qualitative phase. Students demonstrating significant or unexpected score changes were purposively selected for interviews. The qualitative protocol was specifically developed to explore areas with the largest statistical variances. Finally, both datasets were integrated during interpretation to generate comprehensive meta-inferences, merging quantitative results with student narratives.

Participants and Sampling

The study was conducted in July 2026 at Universitas Tribhuwana Tunggadewi, Malang, targeting second-to-eighth-semester nursing students. Although initially planned as a two-group comparison requiring 44 students, the lack of an appropriate control group prompted a shift to a single-group pretest–posttest design. Ten students primarily from higher semesters withdrew due to clinical placement conflicts. This left 34 completers, which post-hoc analysis confirmed remains sufficient to detect moderate-to-large effect sizes. Attrition bias risk is low, as baseline critical-thinking scores did not differ significantly between completers and dropouts. Purposive sampling was utilized for the qualitative phase until information saturation was reached.

Instruments and Data Collection

The TNS-ASG intervention was implemented over two consecutive days, with one 120-minute session per theme. The 34 participants were divided into three small groups of 11–12 students to optimize engagement. Each group was facilitated by dedicated mentors who held Master's degrees in Nursing with clinical expertise in the respective field. TNS-ASG consisted of four sessions focused on nursing case-study articles from four areas: mental health nursing, community and family nursing, critical and emergency nursing, and medical-surgical nursing. Every session followed a standardized, five-step chronological sequence: (1) a 20-minute mentor-led explanation of the core clinical concepts, (2) a 20-minute critical appraisal of the assigned journal article, (3) a 35-minute group case discussion using problem-based learning (PBL) to low-fidelity simulation using specialized scenario scripts, and observation checklists, and (5) a 10-minute debriefing and reflection period. Each session incorporated mentor-led explanation, critical appraisal of a journal article, case discussion, problem-based learning, and simulation. Students independently completed a structured 16-item case-analysis form addressing article identity, patient profile and assessment findings, nursing diagnoses, interventions, implementation, evaluation, innovation, theoretical rationale, strengths, and limitations of the case report. Mentors guided students through the analysis and encouraged questioning, argumentation, and reflection. Attendance was strictly monitored, and

intervention delivery was standardized across all groups using a uniform facilitator manual and synchronized briefing sessions for the mentors.

Measures

Quantitative Phase: Instrument Specification

Critical thinking was assessed using the 20-item Critical Thinking Ability questionnaire developed by Maizar (2017). dichotomous "yes" or "no" response format, where a positive-type question answered with "yes" is scored 5 and "no" is scored 0, yielding a cumulative score range of 0 to 100. The tool operationalizes six core dimensions of critical thinking based on Facione's framework: interpretation, inference, analysis, evaluation, explanation, and self-regulation, with each domain comprising 3 to 4 items scored via summative aggregation. Prior psychometric evaluation of this instrument in a comparable population of Indonesian undergraduate nursing students demonstrated acceptable content validity and strong internal consistency with reported Cronbach's alpha of 0.85 and a content validity index (CVI) of 0.93 based on validation data from clinical nurse populations (Feng et al, 2010). These psychometric properties support the structural reliability of the evaluation tool used in quantitative nursing competence assessments. Regarding classification, a total score of ≥80 was categorized as good critical thinking, while a score <80 was defined as less good. This 80 cut-off was adopted from the original standard set by Maizar (2017), where it was previously validated to distinguish proficient clinical reasoning levels.

Qualitative Phase

Qualitative data were collected using semi-structured interviews addressing students' experiences, helpful learning activities, factors influencing critical thinking, barriers, confidence in presenting arguments, suggested improvements, and perceived changes in problem analysis. Reflective journal logs and participant observation were also used as complementary qualitative sources.

Data Collection and Analysis

Quantitative data collection

Prior to the intervention, students completed a critical-thinking questionnaire, followed by four TNS-ASG sessions, a posttest, and qualitative interviews. Quantitative difference scores were evaluated using the Shapiro-Wilk test. A paired *t*-test analyzed normally distributed total scores, while Wilcoxon signed-rank tests evaluated non-normal subdimensions ($p < .05$). Cohen's *d* estimated effect sizes.

Qualitative Data Collection and Triangulation

The primary researcher conducted semi-structured, 45-to-60-minute recorded interviews with 12 purposively selected participants. To minimize bias, a female faculty member with no evaluative authority interviewed the students. Data triangulation was operationalized during thematic coding by cross-referencing interview transcripts with students' reflective journals and the researcher's observation field notes.

Trustworthiness and Integration

The qualitative analysis followed an iterative thematic approach involving repeated reading, initial coding, grouping of codes, theme development, definition, and narrative

synthesis. Trustworthiness was supported through source triangulation, an audit trail, peer debriefing, and the use of rich participant quotations. Additionally, member checking was completed by 8 out of the 12 participants who reviewed and confirmed that the summarized analytical themes accurately reflected their lived experiences. Finally, quantitative and qualitative findings were integrated at the interpretation stage through the generation of meta-inferences.

Ethical considerations

Ethical approval was obtained from the Health Research Ethics Committee of Universitas Muhammadiyah Lamongan (No. 223/EC/KEPK-S1/06/2026) before data collection. This approved protocol comprehensively covered all qualitative and quantitative procedures, including the administration of questionnaires, semi-structured interviews, participant observations, and the collection of students' reflective journal logs. Independent recruitment and written guarantees ensured students' informed consent was entirely voluntary, anonymous, and free from institutional or academic pressure.

RESULTS

Participant characteristics

Table 1. Characteristic of Participant

Characteristic	Category	n	%
Age	19–23 years	34	100
Gender	Male	5	15
	Female	29	85
Semester	2	11	32
	6	22	65
	8	1	3
GPA	3.01–3.50	9	26
	>3.50	25	74

All 34 participants were aged 19–23 years. Most were women (29, 85%). Twenty-two students (65%) were in semester 6, 11 (32%) were in semester 2, and one (3%) was in semester 8. Twenty-five participants (74%) had a cumulative grade point average (GPA) above 3.50, while nine (26%) had a GPA of 3.01–3.50.

Table 2. Changes in total and domain-specific critical thinking

Outcome	Pretest mean (SD)	Posttest mean (SD)	Mean Paired Changed	95% CI of the Change	t	df	Good pre, n (%)	Good post, n (%)	p-value	Cohen's d
Total critical thinking	75.75 (14.25)	81.18 (11.01)	5.44	[1.11, 9.76]	-2.560	33	16 (47)	23 (68)	0.015*	0.44
Interpretation	62.5 (5.67)	70.50 (4.99)	8.00	[0.26, 4.38]	-1.807	33	15 (44)	21 (62)	0.021*	0.31
Inference	77.9 (3.84)	77.20 (3.56)	-0.15	[-1.54, 1.84]	-0.177	33	13 (38)	12 (35)	0.742	
Analysis	80.90 (3.70)	87.50 (3.94)	6.60	[0.28, 3.25]	-2.425	33	14 (41)	24 (71)	0.024*	0.42
Evaluation	80.30 (4.10)	81.40 (3.28)	1.10	[-1.37, 1.67]	-0.197	33	17 (50)	31 (91)	0.032*	0.03

Explanation	78.40 (3.22)	80.40 (2.78)	2.00	[-1.25, 1.84]	-0.387	33	14 (41)	33 (97)	0.015*	0.07
Self-regulation	80.3 (3.28)	83.30 (2.53)	3.00	[-0.33, 1.80]	-1.407	33	17 (50)	27 (79)	0.016*	0.24

Note: Values are from the study report. *p < .05. Total critical-thinking score was analyzed using a paired t-test; domain scores were analyzed using Wilcoxon signed-rank tests.

As detailed in Table 1, the TNS-ASG intervention elicited a statistically significant improvement in students' overall critical thinking. The total critical-thinking scores increased from a pretest mean of 75.75 (SD = 14.25) to a posttest mean of 81.18 (SD = 11.01). This advancement yielded a statistically significant mean paired change of 5.44 points (95% CI [1.11, 9.76], *t* (33) = -2.560, p = .015). The paired-samples effect size calculation revealed a moderate magnitude (Cohen's d = 0.44), supporting the educational and clinical relevance of the intervention. This statistical growth was accompanied by a noticeable upward shift in competence classification: the proportion of students categorized as having "good critical thinking" expanded from 47% (n = 16) at baseline to 68% (n = 23) following the intervention.

Across the individual subdimensions, significant post-intervention location shifts were observed in five out of six core domains. The largest structural improvements were demonstrated in Analysis (Mean Paired Change = 6.60, 95% CI [0.28, 3.25], (p = .024, d = 0.42) and Interpretation (Mean Paired Change = 8.00, 95% CI [0.26, 4.38], (p = .021, d = 0.31). Statistically significant gains were also confirmed for Self-regulation (Mean Paired Change = 3.00, 95% CI [-0.33, 1.80], p = .016, d = 0.24), Explanation (Mean Paired Change = 2.00, 95% CI [-1.25, 1.84], (p = .015, d = 0.07), and Evaluation (Mean Paired Change = 1.10, 95% CI [-1.37, 1.67], p = .032, d = 0.03). Conversely, the Inference subdimension did not exhibit a statistically significant change (Mean Paired Change = -0.15, 95% CI [-1.54, 1.84], *t*(33) = -0.177, p = .742, d = 0.03), indicating a stable baseline performance in this specific cognitive skill.

Qualitative findings

The qualitative analysis identified four broad categories of factors supporting critical thinking: internal factors, external factors, technical or pedagogical support, and other contextual factors. Internal factors included motivation, curiosity, and growing academic confidence, as illustrated by one student's drive to comprehend clinical research:

> "I want to know more deeply how to understand research articles... I am curious about this study" (P01).

Another participant highlighted their cognitive adaptation:

> "I learned by listening while taking notes on the lecturer's explanation during yesterday's activity" (P02).

External factors encompassed mentor support, peer interaction, and previous organizational experience. Peer engagement, in particular, stimulated academic curiosity, with a participant noting: "Several of my friends asked questions during the activity, making me curious to explore and understand the article further" (P36).

This pattern aligns with evidence that collaborative peer interactions in nursing education foster critical questioning, collaborative inquiry, and shared problem-solving dynamics (Abdullah & Chan, 2018).

Technical and pedagogical support included structured methods, information literacy, and opportunities to analyze articles in greater depth. Students repeatedly emphasized the value of discussion, simulation, and diverse topics for understanding nursing cases; as one student explained:

> "The material is interesting, especially since there are variations in topics presented by the mentor lecturers" (P34), while another stated, "I have read articles before but have never parsed the details like the activity I participated in yesterday" (P36).

Ultimately, interactive sessions proved most impactful, with a student reflecting:

> "The discussion and simulation sessions helped me to add new things and knowledge about nursing cases" (P28).

The qualitative analysis also revealed several multi-dimensional barriers that constrained students' critical thinking abilities during the program. Cognitive challenges arose primarily from rigid traditional learning habits and the complexity of advanced medical cases; as one student admitted,

> "The case on the second day was difficult, I didn't quite understand" (P28).

Psychological barriers were heavily prominent, characterized by evaluation anxiety, low academic confidence, and a profound fear of negative judgment. Multiple students expressed a shared hesitation to participate, stating:

> "I was afraid to answer because I was afraid of being wrong" (P23, P25, P27–P33) which was compounded by their junior standing: "I am still in the second semester, still observing and needing to learn more, so I remained quiet most of the time" (P24, P28).

This high prevalence of performance-related anxiety is consistent with nursing literature, which demonstrates that clinical simulation and active peer learning environments initially trigger substantial baseline anxiety and stress among undergraduate nursing students (Bahar et al., 2022).

Technical and pedagogical limitations further impeded their analysis, specifically regarding strict time constraints and structural delivery. Students noted that "the duration of each session was too short while the material discussed was a lot" (P29), expressing frustration that they "didn't quite understand but the time had already run out" (P23, P28, P30, P36). Furthermore, institutionalized academic culture acted as a barrier, as students struggled with passive learning tendencies:

> "I am used to waiting to be pointed out first before daring to express an opinion" (P28).

Lastly, pedagogical formatting caused disengagement during introductory phases; participants reported that "the time was too long, especially during the explanation session, making us sleepy and bored" (P27, P31–P36), highlighting a critical need for interactive elements such as energy-restoring icebreakers.

DISCUSSION

The present study indicates that participation in the TNS-ASG program was associated with a significant upward shift in nursing students' overall critical-thinking scores, accompanied by a moderate effect size. This observed improvement aligns with broader educational evidence suggesting that active, problem-oriented, and integrated learning

frameworks are linked to stronger higher-order thinking among nursing students. For instance, Wei et al. (2024) reported a standardized mean difference of 0.47 for PBL compared with control conditions, while Kong et al. (2014) and Sharifi et al. (2025) similarly observed positive associations between problem-based approaches and student critical-thinking development. However, given the single-group pretest–posttest design of this study and the absence of a parallel control group, these statistical gains cannot be definitively attributed to the intervention alone. Alternative explanations must be considered. Specifically, a test-retest effect may have occurred, wherein students' familiarity with the questionnaire structure during the posttest artificially inflated their scores. Although concurrent academic activities could confound results, similar single-group, short-term nursing education studies Aein et al. (2020) demonstrated a statistically significant increase in overall critical thinking skills following a short-term, problem-solving-based intervention without a parallel control group.

The qualitative findings help explain why the quantitative scores improved. Students described learning to question the article, examine whether the methods were appropriate, consider whether the data supported the conclusions, identify weaknesses, and relate evidence to nursing cases. Thus, TNS-ASG appears to operate through a learning-by-questioning process. Rather than receiving information passively, students were repeatedly required to justify interpretations and connect evidence with clinical reasoning. This is consistent with mixed-methods evidence showing that integrated critical-thinking education can improve thinking-related outcomes while students' experiences are shaped by social, cultural, and educational contexts (Liu et al., 2021).

Interpretation improved significantly, suggesting that students became better able to assign meaning to information in articles and clinical cases. This is pedagogically important because clinical judgment begins with recognizing and interpreting relevant information. Students' comments indicated that they increasingly understood that nursing diagnoses should not be based solely on patient complaints but should incorporate relevant assessment and examination data. The finding can be interpreted alongside Tanner's clinical judgment perspective, in which noticing and interpreting information are central to subsequent responding and reflection. The result also supports the broader argument that critical thinking should be developed through contextualized clinical learning rather than isolated factual recall.

Analysis showed one of the clearest quantitative improvements, increasing from 80.9 to 87.5. This finding is plausible because the TNS-ASG activities explicitly required students to separate relevant from irrelevant information, identify relationships among findings, and connect evidence with nursing problems. Recent evidence continues to support PBL and collaborative approaches for higher-order cognitive development in nursing students (Mohamed et al., 2025; Xue et al., 2025). In the present study, the qualitative evidence strengthened the interpretation by showing that students perceived a change in the way they approached nursing diagnoses.

Evaluation scores improved significantly. Critical appraisal of case-study articles forced students to treat scientific texts as objects of critical inquiry. This relevant learning experience directly aligns with evidence-based nursing, where clinicians must evaluate evidence before clinical application.

Explanation improved markedly, and the qualitative findings suggest that increased opportunities to articulate arguments may have contributed. Students reported greater confidence in expressing opinions after participating in discussions. This suggests that cognitive development and psychological conditions may interact: students may possess relevant knowledge but fail to demonstrate explanation skills when they fear making mistakes. The finding is consistent Turner et al. (2023) who showed that relationships between students and facilitators can influence psychological safety, while peer-based learning can provide opportunities for support and confidence-building.

Self-regulation also improved. Before the intervention, students described fear of being wrong, anxiety, uncertainty, and a tendency to remain silent until instructed to speak. After the intervention, students reported greater confidence and willingness to express arguments. This suggests that self-regulation in this context involves not only cognitive monitoring but also managing one's participation in learning. Peer learning may be particularly relevant because it creates repeated opportunities to test ideas, receive feedback, and adjust one's reasoning. Nakayama et al. (2021) reported that peer simulation can reduce anxiety-related burdens in nursing students, supporting the interpretation that social learning environments can influence students' readiness to engage.

Inference was the only domain that did not exhibit a statistically significant change in its mean score, nor did it show meaningful categorical growth. The proportion of students classified as having "good" inference skills remained stable, shifting marginally from 38% (n = 13) at pretest to (35%, n = 12) at posttest. This minimal categorical change is mathematically aligned with the stable mean score, which shifted non-significantly from 77.90 (SD = 3.84) to 77.20 (SD = 3.56, (p = .742). Several pedagogical factors support this plateau. First, inferential reasoning requires higher-order cognitive manipulation, demanding that students move beyond superficial data identification toward drawing defensible conclusions from ambiguous clinical evidence. Second, the brief four-session duration of the TNS-ASG intervention compounded by students' self-reported time constraints, likely provided insufficient exposure to foster complex structural adjustments in this specific competence. The role of mentors emerged as an important external factor. Students valued the way mentors explained concepts, varied topics, and guided analysis. This indicates that TNS-ASG is better conceptualized as facilitated peer learning rather than peer learning alone. The mentor's role is not simply to transmit information but to structure questions, provide clarification, model reasoning, and give feedback. Such facilitation is consistent with evidence that educators and mentors influence the quality of group learning and students' development of clinical reasoning.

Peer interaction was another important mechanism. Students described questions from peers as stimulating curiosity and helping them understand difficult material. This represents social scaffolding: students obtain clarification, alternative perspectives, prompts, emotional support, and models of academic behavior from their peers. The finding supports systematic evidence that peer learning can contribute to communication, competence, critical thinking, and confidence in undergraduate nursing education. TNS-ASG therefore appears to create a small academic community in which critical thinking is developed through interaction rather than solely through individual study.

An important contribution of this study is the integration of cognitive, social, and psychological mechanisms. TNS-ASG combines journal appraisal, case-based learning, PBL, peer learning, mentoring, discussion, simulation, and reflection. Recent reviews suggest that simulation can support critical thinking when pedagogical design, realism, engagement, facilitation, and debriefing are appropriate (Stenseth et al., 2025; Harry et al., 2025). Peer-led learning has also been associated with confidence and academic outcomes among nursing students in the pilot study. The present findings suggest that the combined model may be particularly useful because students receive repeated opportunities to interpret evidence, discuss alternatives, defend conclusions, and reflect on their reasoning.

The qualitative findings can be analyzed using Benner's novice-to-expert theory (Benner, 1982). Early-stage nursing students usually act as "advanced beginners" who have very limited clinical experience. Therefore, they need highly structured examples, guidance, continuous practice, and a safe learning environment where they can make and fix mistakes without fear. In this study, second-semester students described themselves as passive observers and were often afraid to speak during the sessions. The TNS-ASG program provided a safe transitional environment for these junior students to practice clinical reasoning before they enter actual clinical practice. However, because the sample size per semester was not balanced and this study was not designed to compare sub-groups, these differences between semesters are only a tentative interpretation, not a proven statistical finding.

Conversely, fear of making mistakes, anxiety, passive learning habits, limited time, and fatigue were identified as important barriers. The presence of these psychological and technical barriers underscores the complex academic landscape that nursing students navigate. A prevalence of burnout syndrome among undergraduate nursing students due to heavy academic workloads and clinical stressors, factors that could diminish their cognitive stamina and confidence during active learning interactions (Devi et al, 2013).

Overall, the results show that critical thinking is a skill that can be intentionally developed. However, these findings do not mean that Problem-Based Learning (PBL) alone caused the improvement. Instead, TNS-ASG should be seen as a supportive learning environment that combines teamwork, case studies, and evidence-based practice. This is an important interpretation because different educational strategies often produce different results. Ultimately, factors like the quality of mentoring, session duration, a safe learning environment, case difficulty, and time for reflection are just as important as the teaching method itself. The pivotal role of experienced facilitators is well-documented, as structured mentor support is essential to guide clinical reasoning and make accurate judgments regarding the professional development of student nurses (Burden et al., 2018).

Implications for nursing education

TNS-ASG should be integrated into core nursing courses focusing on case analysis and decision-making. Faculty require guidance to facilitate thinking effectively. Case studies must progress by complexity, while instructors must allocate time for reflection and foster psychological safety. Small-group discussions, constructive feedback, and broader faculty participation will further strengthen the model.

Limitations

This study presents several limitations. In regard internal validity, the small sample size and absence of a separate control group mean pre-post improvements cannot be exclusively attributed to TNS-ASG, as maturation, concurrent learning, and test-retest effects may have contributed. Methodologically, purposive sampling might have introduced selection bias toward more motivated students, while the attrition of ten participants introduces potential attrition bias despite baseline homogeneity. Furthermore, potential researcher or mentor effects exist; students may have provided socially desirable interview responses to faculty facilitators. Additionally, the sample was unbalanced by gender and semester, and the short intervention may have been insufficient to impact complex cognitive dimensions like inference. Finally, data from a single institution limits generalizability to broader nursing populations.

CONCLUSION

In conclusion, TNS-ASG significantly improved nursing students' critical thinking across multiple domains, excluding inference, with a moderate effect size. Qualitative themes identified key supportive mechanisms and prominent barriers. While providing valuable preliminary evidence within supportive environments, future controlled, large-sample, long-term studies are required to confirm the model’s definitive comparative effectiveness. Future implementation should extend the duration or frequency of TNS-ASG sessions, reduce content density per session, ensure consistent mentor attendance, provide graded case complexity, strengthen small-group discussion and constructive feedback, and incorporate structured reflection. Future research should use controlled or randomized designs with larger and more balanced samples and should examine whether sustained exposure improves inferential reasoning and clinical reasoning over time.

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AUTHOR CONTRIBUTIONS

HMD: Conceptualization, Methodology, Investigation, Formal analysis, Writing - original draft. YR: Methodology, Validation, Writing - review and editing. RMP: Investigation, Formal analysis, Writing - review and editing. GI: Investigation.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DECLARATION OF AI USE

During manuscript preparation, the authors used Google Gemini in order to paraphrase existing text, optimize word counts, and improve English grammatical structure and readability. The authors reviewed and edited the output and remain responsible for the content and integrity of the article.

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