

Brief Report

Integrating Collaborative Learning, Artistic Mediation, and AI to Enhance Midwifery Clinical Reasoning Based on the NANDA–NIC–NOC Framework

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Abstract

Background: Clinical reasoning is a core midwifery competency, yet adopting standardized NANDA–NIC–NOC frameworks remains challenging due to perceived abstraction. **Objective:** To explore the effectiveness of a pedagogical intervention combining collaborative learning, artistic mediation, and AI to enhance midwives' clinical reasoning. **Methods:** A convergent parallel mixed-methods study with 40 practicing midwives at Hassan I Hospital, Morocco, involving a structured workshop with a learning game, symbolic tree creation, and AI-facilitated reflection. Inductive thematic analysis was applied to qualitative data, complemented by descriptive pre/post rubric scores assessed by two independent raters. **Results:** Four themes emerged: (1) improved structuring of clinical reasoning; (2) deeper conceptual appropriation of the NANDA–NIC–NOC framework; (3) enhanced reflexivity and metacognition via AI; (4) high engagement and pedagogical acceptability. **Conclusions:** Integrating collaborative gaming, artistic mediation, and AI showed high pedagogical acceptability and supported immediate structuring of clinical reasoning in midwifery, offering a promising and feasible model for initial and continuing training in resource-limited settings. Longitudinal studies are needed to confirm long-term clinical impact. Clinical reasoning; NANDA–NIC–NOC; artificial intelligence; simulation-based learning; collaborative learning; educational innovation.

Keywords: clinical reasoning; NANDA–NIC–NOC; artificial intelligence; simulation-based learning; collaborative learning; educational innovation



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1. Introduction

Midwifery practice relies on rigorous clinical reasoning, focused on the woman, the newborn, and the family throughout the maternal and neonatal health continuum. This reasoning is a major determinant of the quality, safety, and humanization of care, especially in complex clinical contexts such as high-risk pregnancy, labor and delivery, postpartum, and obstetric emergencies. Training midwives in structured, reflective, and evidence-based clinical reasoning is thus a major pedagogical challenge for health sciences training institutions [1].

In this context, the use of standardized conceptual frameworks, such as NANDA (diagnoses), NIC (interventions), and NOC (outcomes) classifications, provides a common

language to structure clinical analysis, guide professional decisions, and evaluate care outcomes. However, among midwives in training or in practice, adopting the NANDA–NIC–NOC model is often difficult. These classifications are frequently perceived as abstract, decontextualized, or distant from the dynamic and emotional reality of obstetric practice, limiting their effective integration into daily clinical reasoning [2].

Traditional pedagogical approaches, mainly lecture-based and focused on memorization, show their limits in addressing the complexity of situations encountered in midwifery. Midwife training requires methods capable of simultaneously engaging the cognitive, practical, relational, and reflective dimensions of care. In this regard, active learning methods, including serious games, simulation, and creative approaches, have proven effective in promoting learner engagement, collaborative work, and the development of clinical judgment [3].

Moreover, integrating artistic approaches into health education has gained growing interest. Art allows the mobilization of sensory experience, emotion, and symbolism—dimensions central to midwifery practice, where support, presence, and relationship are essential. By fostering expression and collective reflection, artistic mediation contributes to a more embodied understanding of theoretical concepts and better assimilation of the meaning of care [4].

Alongside these pedagogical developments, the emergence of artificial intelligence (AI) in health education opens new perspectives for learning. Conversational AI systems offer unprecedented possibilities for personalized support, immediate feedback, and stimulation of metacognitive reflection. Used ethically and under supervision, AI can act as a pedagogical facilitator, supporting midwives in analyzing complex clinical situations without replacing human expertise or the pedagogical relationship [5].

In midwifery education, few studies have explored the combined integration of gaming, artistic mediation, and artificial intelligence to support learning clinical reasoning based on standardized classifications. This gap is particularly notable in low-resource countries, where pedagogical innovation must balance feasibility, moderate cost, and high educational impact [6].

Thus, this article aligns with a pedagogical innovation approach aimed at addressing the specific needs of midwifery education. It proposes and analyzes an integrated approach combining collaborative learning games, symbolic artistic creation, and the use of conversational AI to enhance the adoption of clinical reasoning based on the NANDA–NIC–NOC model. This approach was implemented with midwives at Hassan I Hospital within an academic framework at the Higher Institute of Health Sciences, aiming to contribute to the development of active, reflective, and contextualized pedagogical practices in midwifery.

2. Materials and Methods

2.1. Type and Design of the Study

This study is a convergent parallel mixed-methods study, combining an inductive thematic qualitative approach with descriptive quantitative measures (pre/post scores and frequencies), within a formative evaluation framework. It aims to analyze the contribution of an innovative pedagogical intervention integrating a learning game, artistic mediation, and artificial intelligence (AI) to the development of midwives' clinical reasoning based on the NANDA–NIC–NOC model.

A convergent parallel mixed-methods design was chosen due to the innovative nature of the intervention and the desire to understand learning processes, pedagogical interactions, and participants' perceptions. Quantitative descriptive measures (pre/post rubric scores and response frequencies) were collected concurrently to provide complementary evidence on immediate learning gains, while thematic analysis captured the depth and

meaning of participants' experiences. Both strands were analyzed independently and then integrated at the interpretation stage. This approach allows a more comprehensive evaluation than either method alone, while acknowledging that the absence of a control group and the use of voluntary sampling limit causal inference. The decision not to implement a quasi-experimental or randomized controlled design was driven by pragmatic and ethical constraints: the workshop was embedded in a continuing professional development programme where random assignment to a control condition was not feasible without withholding potentially beneficial training from practicing clinicians. Future studies should consider waitlist-control or stepped-wedge designs to enable stronger causal inference while respecting practitioners' access to professional development.

2.2. Study Setting

The study was conducted in an academic setting at the Higher Institute of Health Sciences (ISSS), in collaboration with Hassan I Hospital. The pedagogical activity took the form of a structured workshop (master class) in an environment promoting collaborative learning, reflection, and creative expression.

2.3. Target Population and Participants

The target population consisted of 40 midwives practicing at Hassan I Hospital. Participants were recruited on a voluntary basis (Table 1). It should be noted that voluntary sampling may introduce selection bias, as more motivated practitioners are more likely to enroll; the findings should therefore be interpreted with caution. The absence of a control group also precludes definitive attribution of observed gains to the specific combination of game, art, and AI rather than to general peer interaction or time-on-task effects. These methodological constraints are acknowledged as limitations of this exploratory study. Additionally, all 40 participants were female midwives from a single institution. While this homogeneity reduces confounding variation, it restricts the generalizability of findings to other hospitals, regions, or mixed-gender midwifery cohorts. Future replications in multi-site, mixed-gender, or lower-resourced settings would be required before broader transferability can be claimed.

Table 1. Participant Characteristics.

Variable	n (40)	%
Female	40	100%
Clinical experience < 5 years	14	35%
Clinical experience 5–10 years	16	40%
Clinical experience > 10 years	10	25%
Completed full intervention	40	100%
Positive perception of AI (post-intervention)	37	92.5%

Inclusion Criteria:

- Being an active midwife at Hassan I Hospital;
- Participating in the entire pedagogical workshop;
- Providing informed consent for participation.

Exclusion Criteria:

- Absence from any phase of the workshop;
- Refusal to participate in pedagogical data collection.

2.4. Detailed Description of the Pedagogical Intervention

2.4.1. Collaborative Learning Game

The game, titled “The Midwifery Diagnosis Treasure Hunt,” was designed to promote active learning of the NANDA–NIC–NOC classifications. Participants, divided into groups of 3–5 midwives, received cards representing applicable nursing diagnoses in maternal and neonatal health, corresponding interventions, and expected outcomes (Table A1).

The activity occurred in three successive phases:

- Identification and sorting of cards according to the three classifications;
- Reasoned association between diagnoses, interventions, and outcomes, based on obstetric clinical scenarios;
- Collective clinical justification, promoting verbalization of reasoning and professional debate (Table A2).

2.4.2. Artistic Mediation: Creation of the Symbolic Tree

Participants were invited to create a collective symbolic tree of midwifery clinical reasoning. Roots represented diagnoses (NANDA), the trunk and branches as hands symbolized interventions (NIC), and leaves illustrated expected outcomes (NOC).

This activity aimed to engage the emotional, symbolic, and reflective dimensions of care, linked to professional midwife identity, and to foster an embodied understanding of theoretical concepts.

2.4.3. Integration of Artificial Intelligence

A conversational AI was integrated as a pedagogical support tool. Specifically, the AI tool used was GPT-4 (OpenAI), accessed via web interface on participants’ smartphones and tablets provided for the workshop. To minimize the risk of AI-generated errors (hallucinations), all AI prompts were pre-designed and validated by the supervising clinical educator. The instructor monitored all AI interactions in real time, and any clinically inaccurate suggestions were immediately corrected and used as teachable moments. Participants were explicitly instructed that AI outputs required critical evaluation and could not substitute for validated clinical guidelines or instructor expertise. To ensure consistency of AI responses across participant groups, a standardized set of 15 pre-validated prompts was used (see Appendix C), and the same session configuration (model version, temperature setting: 0.3) was maintained throughout. Ethical safeguards included full participant information about the AI tool’s nature and limitations prior to use, and all interactions were logged for post-session review by the research team. The AI intervened at different moments of the workshop to:

- Question the clinical coherence of proposed associations;
- Provide reasoned and contextualized feedback;
- Stimulate participants’ metacognitive reflection;
- Suggest alternative options adapted to midwifery practice.

AI was used as a reflective facilitator, without replacing the instructor or peer interactions.

2.5. Data Collection

Data were collected from multiple sources:

- Observations of interactions during activities (Table A4);
- Group productions (NANDA–NIC–NOC associations);
- Verbal descriptions and interpretations of the collective drawing;
- Reflective feedback and participants’ perceptions at the end of the workshop.

2.6. Analysis Method

A thematic qualitative analysis was conducted. Data were examined inductively to identify recurring themes related to clinical reasoning (Table 2). To strengthen methodological transparency and minimize researcher bias, the thematic coding process followed a structured procedure: two researchers independently coded the full dataset, then met to compare and discuss discrepancies until consensus was reached. Peer debriefing sessions with a third researcher were conducted throughout the analysis to challenge emerging interpretations. A reflexivity log was maintained by the lead researcher to document potential positionality effects. These measures support the credibility and dependability of the qualitative findings. To strengthen methodological transparency and minimize researcher bias, the thematic coding process followed a structured procedure: two researchers independently coded the full dataset, then met to compare and discuss discrepancies until consensus was reached. Peer debriefing sessions with a third researcher were conducted throughout the analysis to challenge emerging interpretations. A reflexivity log was maintained by the lead researcher to document analytical decisions and potential positionality effects. These measures collectively support the credibility and dependability of the qualitative findings. In parallel, four dimensions of clinical reasoning were assessed using before and after the intervention by two trained assessors independently (Cohen's kappa > 0.75 for all dimensions). Pre/post scores are reported descriptively in Table 3; given the small, non-randomized sample, these scores should be interpreted as indicative rather than conclusive evidence of learning gains.

Table 2. Summary of Main Themes Identified.

Theme	Participants (n)	Frequency (%)	Key Outcome
Structuring of clinical reasoning	36	90%	Improved decision-making coherence
Conceptual appropriation	34	85%	Deeper understanding of NNN model
AI-supported reflexivity	32	80%	Enhanced critical thinking
Engagement and collaboration	38	95%	Strong active participation

Table 3. Effects on Clinical Reasoning.

Dimension	Before Intervention	After Intervention	Improvement
Diagnostic identification	2.6/5	4.3/5	+1.7
NANDA–NIC linkage	2.4/5	4.4/5	+2.0
NIC–NOC alignment	2.5/5	4.5/5	+2.0
Clinical justification	2.3/5	4.2/5	+1.9

3. Results

Inductive thematic qualitative analysis of data from 40 participating midwives identified four main analytical themes describing the impact of the pedagogical intervention integrating the game, artistic mediation, and AI on the development of midwives' clinical reasoning based on the NANDA–NIC–NOC model.

3.1. Theme 1: Structuring Midwifery Clinical Reasoning

Data show improved participant ability to organize clinical reasoning in a sequential logic linking diagnoses, interventions, and outcomes. Midwives demonstrated better prioritization of maternal and neonatal health issues and greater coherence in proposed NANDA–NIC–NOC associations (Table 3).

The learning game facilitated identification of causal links between the woman's clinical condition, professional interventions, and expected outcomes, reflecting a shift from fragmented to structured reasoning.

3.2. Theme 2: Conceptual and Symbolic Appropriation of the NANDA–NIC–NOC Model

Artistic mediation promoted deeper conceptual appropriation of the model through symbolic processes. The collective tree visually represented the dynamics of clinical reasoning, enhancing understanding of the roles of diagnoses, interventions, and outcomes in midwifery care.

This visual representation facilitated integration of relational, preventive, and educational dimensions specific to midwifery, supporting more contextualized and professional understanding of standardized classifications.

3.3. Theme 3: Development of Reflexivity and AI-Assisted Metacognition

Integration of conversational AI-supported professional reflexivity. AI-generated feedback facilitated the explicit articulation of clinical reasoning, critical analysis of diagnostic choices, and exploration of clinical alternatives suited to obstetric contexts.

Data indicate AI-supported metacognitive processes, including awareness of reasoning strategies used and assessment of the internal coherence of clinical decisions, without creating dependency on technology (Table 4).

Table 4. Contribution of Artificial Intelligence.

AI Function	Participants Reporting Effect (n)	%	Educational Impact
Argumented feedback	35	87.5%	Improved reasoning clarity
Guided questioning	33	82.5%	Enhanced metacognition
Alternative suggestions	31	77.5%	Flexible clinical thinking
Non-evaluative support	36	90%	Reduced learning anxiety

3.4. Theme 4: Cognitive Engagement, Professional Collaboration, and Pedagogical Acceptability

Participants exhibited high levels of cognitive and collaborative engagement. Small-group work promoted confrontation of reasoning, negotiation of clinical decisions, and co-construction of professional knowledge. However, the high engagement rate (95%) should be interpreted with caution, as it may partly reflect a novelty effect linked to the introduction of unfamiliar tools (game-based learning and AI). It cannot be confirmed whether such engagement levels would be maintained in repeated or routine applications of the intervention. A follow-up evaluation several months after the workshop would be necessary to determine whether conceptual appropriation and motivation are sustained over time. Furthermore, given that outcomes were largely based on self-reported perceptions (Appendix E), the risk of social desirability bias must be acknowledged: participants may have rated the intervention more favourably due to awareness of being evaluated. Future studies should complement self-reports with objective measures such as performance in simulated obstetric scenarios, validated clinical competency assessments, or peer observation in real clinical settings.

AI integration was well accepted. Midwives perceived AI as a relevant pedagogical support tool, complementary to human expertise, and respectful of professional autonomy.

4. Discussion

This study highlights the value of a pedagogical intervention integrating a learning game, artistic mediation, and AI for developing midwives' clinical reasoning. Results show this approach promotes a more rigorous structuring of reasoning, aligned with the demands of midwifery practice characterized by complexity, rapid decision-making, and relational dimensions of care. These results are in line with earlier research by Behmanesh et al. [7].

The structuring observed aligns with contemporary models of health reasoning, suggesting that active and contextualized learning enables better knowledge integration and more effective mobilization of cognitive schemas. The learning game acted as a catalyst for clinical analysis, facilitating the transition from theoretical knowledge to obstetric clinical situations; similar results have been reported by Lin et al. [8].

Artistic mediation, through symbolic tree representation, allowed embodied conceptual appropriation of the NANDA–NIC–NOC model. This approach aligns with studies emphasizing the value of creative methods in promoting experiential learning, long-term retention, and understanding the meaning of care—central to midwifery. This is consistent with the work of Cheng et al. [9].

AI integration enhanced the reflective dimension of the intervention, supporting metacognition, encouraging explicit reasoning, critical analysis of decisions, and exploration of alternatives. Rather than replacing human expertise, AI complemented it and respected midwives' professional autonomy. Our findings are consistent with those of Sengul et al. [10]. However, the well-documented risks of LLMs in clinical training, including hallucinations and algorithmic biases, must be acknowledged. In this study, these risks were mitigated through expert-designed prompts, real-time instructor supervision, and immediate correction of any erroneous AI outputs. Future implementations should systematically document AI outputs and institute a formal validation protocol to ensure patient safety is not compromised.

High levels of engagement and acceptability suggest this intervention is compatible with initial and continuing midwifery education, even in resource-limited contexts. This approach provides an innovative pedagogical response to contemporary challenges in midwifery education [11]. Nevertheless, several limitations must be acknowledged. The entire intervention spanned only 180 min (one 3-h workshop); outcomes measured reflect immediate pedagogical acceptability and short-term conceptual clarity, not long-term clinical behavioral change. The self-reported nature of qualitative feedback and the absence of validated objective clinical performance assessments further limit the conclusions. Future studies should employ longitudinal designs with follow-up clinical audits, objective competency assessments, and where feasible, a comparison group exposed to standard didactic training.

5. Conclusions

This study highlights the potential of an integrated pedagogical approach combining a learning game, artistic mediation, and AI to support midwives' clinical reasoning based on the NANDA–NIC–NOC model. Within the scope of a single structured workshop, results suggest improved immediate structuring of reasoning, greater conceptual appropriation of classifications, and enhanced professional reflexivity. These gains should be interpreted as promising short-term outcomes rather than evidence of durable clinical behavioral change, given the study's single-group pre/post design and the lack of longitudinal follow-up.

AI, when used as a pedagogical support tool rather than a decision-making substitute, is a relevant lever for promoting personalized, metacognitive learning in midwives. Creative and playful approaches also humanize learning and strengthen the connection between theory and clinical practice.

These findings open promising perspectives for pedagogical innovation in midwifery. Future research should employ multi-site, mixed-gender designs with control or waitlist-control groups, objective clinical performance indicators (e.g., simulation-based assessments), longitudinal follow-up to distinguish sustained learning from novelty effects, and formal AI safety monitoring protocols. Such studies would more rigorously evaluate the sustained impact of this type of intervention on maternal and neonatal care quality.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Structure of the Pedagogical Intervention.

Phase	Activity	Objective	Duration
Phase 1	Collaborative learning game	Identify NANDA–NIC–NOC elements	45 min
Phase 2	Group discussion	Justify clinical reasoning	30 min
Phase 3	Artistic mediation (symbolic tree)	Facilitate conceptual understanding	45 min
Phase 4	AI interaction	Enhance reflective thinking	30 min
Phase 5	Debriefing	Consolidate learning	30 min

Appendix B

Table A2. Sample Learning Materials Used in the Game.

NANDA Diagnosis	NIC Intervention	NOC Outcome
Acute pain	Pain management	Pain level reduced
Risk of infection	Infection control	Infection prevention
Anxiety	Emotional support	Anxiety level decreased
Ineffective breastfeeding	Lactation support	Effective breastfeeding

Appendix C

Table A3. Examples of AI-Guided Questions.

No.	AI-Guided Question
1	Can you justify the link between this diagnosis and intervention?
2	What alternative interventions could be considered?
3	Is the expected outcome measurable and realistic?
4	How does this decision apply to obstetric practice?
5	What risks should be considered in this scenario?

Appendix D

Table A4. Observation Grid Used During the Workshop.

Dimension	Indicator	Observation Criteria
Participation	Active involvement	Verbal contribution
Collaboration	Group interaction	Shared decision-making
Clinical reasoning	Logical connections	Coherent NNN linkage
Reflexivity	Justification ability	Critical thinking

Appendix E

Table A5. Post-Workshop Reflective Questions.

No.	Reflective Question
1	How did the activity help you understand clinical reasoning?
2	What did you learn about NANDA–NIC–NOC?
3	How did the AI support your learning?
4	What challenges did you encounter?
5	Would you apply this method in practice?

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