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Nursing clinical reasoning cognitive strategies used in a learning-by-concordance modality: A qualitative descriptive study

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ABSTRACT

Aims: The primary aim of this study is to describe the cognitive strategies employed by nursing students during a Learning-by-Concordance (LbC) activity. A secondary aim is to compare these strategies with those used by experienced nurses.
Background: Technological advancements have facilitated the integration of diverse pedagogical modalities into nursing education. However, the mechanisms by which digital modalities support the development of cognitive strategies for clinical reasoning remain insufficiently understood.
Design: A descriptive qualitative design was adopted.
Methods: Content analysis was used to identify and describe the cognitive strategies mobilized during the LbC activity. This was complemented by a frequency analysis to compare the strategies used by students and experienced nurses.
Results: A total of 46 participants were recruited: 10 novice students, 16 intermediate students and 20 experienced nurses, including 13 rehabilitation nurses and 7 nurse educators. Findings revealed that some cognitive strategies—such as identifying salient data, seeking additional information and forming relationships between data—were more frequently employed. Student responses varied in precision and length, while nurses' responses tended to include detailed contextualization of nursing hypotheses. Educators' responses often emphasized procedural rules and provided clarifications related to the proposed hypotheses.
Conclusions: The results underscore the importance of adapting the LbC modality to better support the cognitive strategies essential for clinical reasoning in nursing. Three pedagogical variations are proposed: (1) structuring activities around illness and nursing scripts; (2) integrating think-aloud strategies; (3) fostering interactivity through individual and collaborative group work.

1. Introduction

As a core competency of nursing practice, clinical reasoning is "a complex process that uses formal and informal thinking strategies to gather and analyze patient information, evaluate the significance of this information and weigh alternative actions" (Simmons, 2010, p. 1155). This process helps nurses interpret clinical data, make decisions and establish an appropriate nursing care plan (Gonzalez et al., 2021; Simmons, 2010).

Integrating clinical reasoning instruction into nursing education is essential to ensure safe practice (Griffits et al., 2023). An effective education involves integrating judicious choices of pedagogical modalities into programs. Several of these modalities, such as schematization, clinical simulation, virtual reality and problem-based learning, have been identified as effective for the development of nursing clinical reasoning (Brown Tyo and McCurry, 2019; Neethling and Roets, 2025; Pérez-Perdomo and Zabalegui, 2024). However, understanding how digital pedagogical modalities can stimulate nurses' clinical reasoning

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and cognitive strategies remains difficult (Ellis et al., 2023). These modalities often provide feedback that relies primarily on the outcome of clinical reasoning and less on the cognitive strategies used by students (Deschênes et al., 2025; Hege et al., 2017).

1.1. Background

The cognitive strategies used during clinical reasoning represent complex thought and decision-making processes that require varying degrees of cognitive effort (Yu et al., 2024). Fonteyn (1998) identified 17 cognitive strategies used by experienced nurses in the clinical reasoning process: recognizing patterns, forming relationships, searching for information, generating hypotheses, setting priorities, making predictions, stating a proposition, asserting a practice rule, making choices, judging the value, drawing conclusions, providing explanations, pondering the value, posing a question, making assumptions, qualifying and generalizing. In addition to professional knowledge, cognitive strategies provide nursing students with resources to exercise clinical reasoning and promote its development (Yu et al., 2024).

Among digital pedagogical modalities, Learning-by-Concordance (LbC) is attracting increasing interest as an effective approach to enhance clinical reasoning in situations characterized by uncertainty. It is used in nursing education and other health education programs, such as kinesiology, physiotherapy and speech language therapy (Bouzeghrane et al., 2025; Charlin et al., 2021; Maftoul and Marcotte, 2023; Roche et al., 2025). The LbC modality is based on clinical vignettes. Each includes a short, frequently encountered situation in clinical practice that illustrates uncertainty. Each situation incorporates two or three items proposing clinical hypotheses (if you were thinking of), followed by new information (and then you observe). While answering, students are encouraged to consider the effects of the new information on the suggested hypothesis (see Fig. 1).

Students select a response from the options provided and are asked to justify their choice through written comments. They then benefit from automated feedback composed of the answers and comments of a panel of experienced nurses who have previously answered the same questions, along with a pedagogical synthesis that formalizes the essential knowledge required to resolve the situation and suggests additional resources for consultation (e.g., articles, practice guidelines, web links) (Charlin et al., 2021; Roche et al., 2025).

The LbC modality is anchored in script theory, which posits that scripts are structured units of meaning stored in long-term memory and activated to guide clinical reasoning (Charlin et al., 2000). An "illness script" comprises associative links between signs and symptoms, precipitating factors, clinical hypotheses related to an illness, appropriate interventions and potential consequences. This structure enables clinicians to compare the data from a clinical situation with their own scripts, recognize patterns or key elements and guide their clinical reasoning by seeking additional information to minimize, reinforce, or prioritize clinical hypotheses (Charlin et al., 2000). The study by Vreugdenhil et al. (2022) demonstrated that the core components of nurses' scripts align with "illness script", while also exhibiting domain-specific features unique to nursing practice. The "nursing script" additionally incorporates contextual factors. For instance, knowing the patient well and understanding how they respond to health conditions shape nurses' clinical reasoning, as does consideration of the impact of illness on patients' lives, health improvement and future functioning.

A recent scoping review conducted by Roche et al. (2025) identified the theoretical foundations, methodological frameworks and perceived gaps in the literature regarding the use of LbC in healthcare professional education programs. Twenty-eight articles were identified in the scoping review, 20 of which focused on the implementation of LbC and eight on its development process. The results show that learners perceive pedagogical modalities as engaging, interactive and beneficial in enhancing the development of clinical reasoning. Key elements were identified to guide the design of the LbC modality, including the authenticity of the situations, participation of experienced healthcare professionals in the panel and quality of feedback to guide learning. Researchers suggest investigating the cognitive processes underlying the learning of clinical reasoning when using LbC modalities and exploring their long-term influence on competency development. The use of longitudinal studies and those assessing the impact of the LbC modality is also recommended to support its reproducibility across diverse educational contexts (Roche et al., 2025).

To our knowledge, no study has addressed the cognitive strategies underlying nursing clinical reasoning used in LbC modalities. Identifying these cognitive strategies could refine our understanding of how clinical reasoning is learned, while also clarifying how the LbC contributes to its development. This could further support the exploration of variations of the pedagogical modality aimed at optimizing the activation of nursing-specific cognitive strategies.

The primary aim of the study is to describe the cognitive strategies of clinical reasoning mobilized by nursing students during an LbC activity. A secondary aim is to compare these strategies with those used by experienced nurses. Two specific objectives were pursued: (1) to describe the cognitive strategies mobilized by nursing students during an LbC activity and (2) to identify similarities and differences between students and experienced nurses.

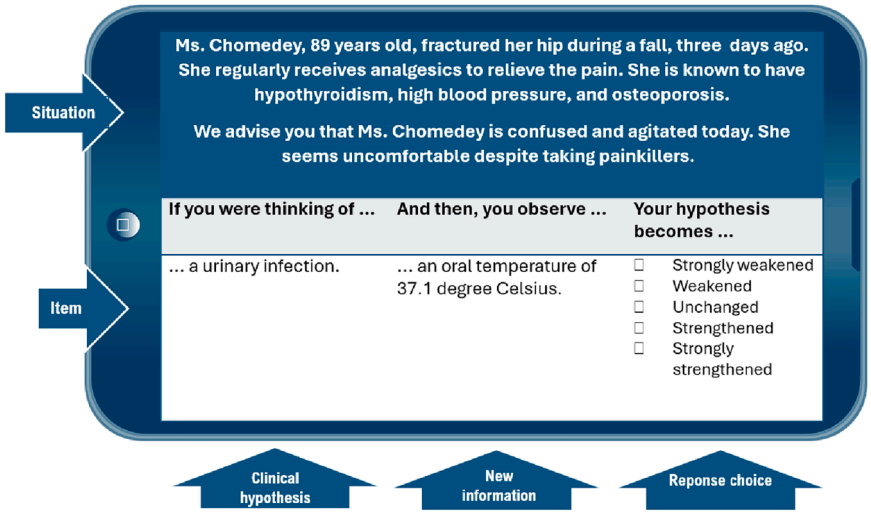

Fig. 1. Example of a vignette in a LbC activity using a smartphone.

2. Materials and methods

2.1. Design

A descriptive qualitative design was used (Bradshaw et al., 2017). This type of design is particularly useful for describing specific phenomena. A content analysis approach was primarily employed to describe the cognitive strategies mobilized during an LbC activity, complemented by a frequency analysis of strategy used to identify and describe similarities and differences between students and experienced nurses. Finally, communication of the results complied with the criteria for the dissemination of qualitative research mandated for reporting qualitative research (see Appendix A) (Tong et al., 2007).

2.2. Setting and population

The study was conducted in the nursing faculty department at a French-speaking Canadian university and a university hospital for physical rehabilitation. Four groups were formed. The first group consisted of novice students enrolled in an accelerated program that offered access to the Bachelor of Science in Nursing to students who already held university credits. These students had no clinical nursing experience but may have had experience in other health or social service fields, such as respiratory therapy and physical therapy. The second group consisted of intermediate students enrolled in another accelerated baccalaureate in nursing program, i.e., a two-year post-diploma program for those with previous technical nursing education. These students were licensed to practice nursing and had approximately one to two years of clinical experience. The third group consisted of nurses actively practicing in a clinical physical rehabilitation setting and the fourth group consisted of nurse educators. The third and fourth groups were thus composed of experienced individuals.

Undergraduate nursing students from the 2022–2023 and 2023–2024 cohorts were recruited using a convenience sampling method. As an inclusion criterion, students had to be enrolled in courses where the same LbC activity was used as a pedagogical modality, specifically medical nursing courses: one for novice students (SOI1998) and the other for intermediate students (SOI2103). Experienced individuals were recruited through a snowball approach (Naderifar et al., 2017), based on contact with members of the research team (academic settings) and a person responsible for clinical nursing education (clinical setting). The inclusion criteria for nurses and nurse educators were (1) possessing a permit to practice nursing for at least three years and (2) exercising professional activities in clinical settings (e.g., nurses, nursing clinical advisors) or academic settings (e.g., professors, lecturers, or teaching assistants). Nurse educators from academic settings also had to have a minimum of three years of experience as nurses in clinical settings. This study had no exclusion criteria. Given the descriptive nature of the study, a purposeful or theoretical sampling of 10–15 individuals per group (novices, intermediate and experienced) was targeted to achieve a detailed understanding of the phenomenon studied (Rendle et al., 2019; Villamin et al., 2025).

2.2.1. Learning-by concordance pedagogical modality

To meet the study objectives, an LbC modality was developed for undergraduate nursing training. All items were written by the principal investigator based on recommendations made in the scientific literature (Charlin et al., 2021). All items were reviewed for relevance and clarity by five collaborating lecturers and academic advisors. The three LbC vignettes targeted essential nursing practice content in a general practice setting and were consistent with educational content covered in the courses as well as nursing practice in physical rehabilitation. These vignettes included the following themes: clinical assessment in the context of caring for a group of patients; nursing assessment and intervention when a patient has a pressure injury; and nursing assessment and intervention when a patient falls. Each vignette contained 2 items, for a total of 6 items.

Fig. 2 presents the situation in the first vignette (At the beginning of your shift…). Two items proposing clinical hypotheses (if you were thinking of) are presented and followed by new information (and then you discover). In answering items, the participants made a response choice regarding the effect of the new information on the suggested hypothesis. Does the hypothesis become strongly weakened, weakened, unchanged, strengthened or strongly strengthened? Only one response was required. The participant must then provide a short explanation related to their response choice (2–3 lines), for all the items. The participants were invited to respond and comment on the spot without consulting their peers, reference books, or other articles. In this study, the object of interest was based on written comments from four groups of participants.

2.3. Data collection

Data were collected over a six-week period for the respective groups, namely from September 1 to December 15 (2022–23 and 2023–24 cohorts) for novice and intermediate students and from December 15, 2023, to January 10, 2024, for experienced participants (educators and nurses). Student data were collected digitally via the educational institution's learning platform (Moodle, Australia). Annotated responses to six LbC questionnaire items were obtained. During the asynchronous educational activity, students viewed the clinical vignettes on their computer screens (or smartphones) and were instructed to select an option and provide a written rationale for their choice. The study had no predetermined time for completing the activity; students could complete it at their own pace and according to their availability.

The LbC activity was an integral part of the courses for all enrolled students, but the research team retained only the item responses provided by the study participants. If students wanted to participate in the study, they clicked a link on the course management system and accessed the consent form. Students then completed a sociodemographic questionnaire on the LimeSurvey platform (Hamburg, Germany). It asked about gender, age and previous experience studying or practicing professionally in the healthcare field. The other instructional activities of the targeted courses included problem-based and clinical-reasoning learning sessions. In this latter activity, a clinical scenario requiring nursing assessment is presented to small groups of six to eight students during a 60 - to 90-minute session. Students perform the steps of clinical reasoning aloud. An instructor acts as the patient, responding to students' questions in real time. Based on the information gathered, students formulate clinical hypotheses and determine subsequent care planning (Chamberland, 1998).

Nursing educators also completed the LbC activity using the educational institution's learning environment (Moodle, Australia), whereas nurses completed it using a Word document. All had three weeks to complete the questionnaire at their own pace and, according to their availability, outside of working hours. They answered the same items from the three vignettes used with the students. The principal researcher and a research assistant answered questions during the process. Written instructions were provided for all groups, in addition to an explanatory video on how to answer and comment on the LbC items.

2.4. Data analysis

Descriptive statistical analyses were used for the data collected from the sociodemographic questionnaire.

Before analyzing the data collected in the LbC items, the three vignettes were subjected to content analysis by members of the research team to identify determining elements, such as prior knowledge essential to understanding situations, that guided the clinical reasoning of the participants. For example, the non-alarming recognition of low pulse saturation in a patient already suffering from chronic obstructive pulmonary disease or the recognition of the urgency of an assessment

At the beginning of your shift, you take care of three patients and carry out an initial assessment of their state of health. Here is the summary of information received during the inter-service report:

- Ms. Pouliot (Dx: stroke and wound stage II coccyx),
- Mr. Chiasson (Dx: COPD and type II diabetes),
- Ms. Nguyen (Dx: multiple falls, unbalanced diabetes, and positive Clostridium difficile).

You are working with a licensed practical nurse who is authorized to perform all procedures allowed by her professional status.

If you were thinking of …	And then you discover …	Your hypothesis becomes ...
1- … asking the licensed practical nurse to re-check Mr. Chiasson's blood sugar who presented hypoglycemia 15 minutes ago.	... Ms. Nguyen just fell in the bathroom.	☐ Strongly weakened ☐ Weakened ☐ Unchanged ☐ Strengthened ☐ Strongly strengthened

Comment on your response choice in the space below

If you were thinking of …	And then you discover …	Your hypothesis becomes ...
2- ... remaking Ms. Pouliot's coccyx dressing yourself because it was removed and now the wound is exposed.	... Mr. Chiasson's vital signs: Temperature: 37.9^0 C Blood pressure: 150/90 Heart rate: 98 bpm Respiratory rate: 26/min $SaPO_2$: 89 % in ambient air	☐ Strongly weakened ☐ Weakened ☐ Unchanged ☐ Strengthened ☐ Strongly strengthened

Comment on your response choice in the space below

Fig. 2. Example of a clinical vignette and its two items.

situation (e.g., recent fall) versus another less alarming situation (hypoglycemia in an alert patient known to be diabetic) were identified. At other times, the presentation of clinical signs (e.g., vital signs) could prompt participants to use specific medical terminology to comment on their response choices (e.g., the presence of fever or tachypnea).

Two research assistants (BMU, VHTM) were responsible for collecting data and transcribing it into Word documents, which were then imported into MAXQDA 2020 software (VERBI GmbH, Berlin, Germany). The participants' comments on the LbC items were subjected to qualitative content analysis (Hsieh and Shannon, 2005). If a participant partially completed the LbC items (i.e., selecting response options without providing the rationale for their choices), the participant's data were excluded from the analysis. The cognitive strategies of clinical reasoning developed by Fonteyn (1998) served as a framework for coding. Specifically, three members of the research team (MFD, YB, BMU) independently analyzed the data: the principal investigator and two research assistants, employing a double-coding process to minimize the likelihood of biased interpretations. They performed the initial coding based on comments from the two items of the first LbC vignette. Team meetings were held to ensure a shared understanding of the codes, including the description of each cognitive strategy and its manifestations in the comment responses to the items. The responses for all three vignettes were then analyzed. Some responses commented on in the FpC were not coded (not associated with a cognitive strategy), considering that these responses did not allow us to deduce a tangible mobilization of a cognitive strategy. To identify the similarities and differences observed in the groups studied, an analysis of the frequency of use of cognitive strategies detected in the written comments was conducted. These data were subjected to descriptive statistical analyses (percentage of use according to the items in the vignettes and groups studied).

Finally, the precision and density of the written comments as well as their levels of contextualization were subjected to content analysis. Data saturation was achieved when no additional interpretative themes emerged and subsequent participant responses offered no new insights.

2.5. *Ethical considerations*

This study was approved by the University Research Ethics Committee (no. 2023–4928) and Physical Rehabilitation Hospital Center (no. 2024–1994). Participants received comprehensive information, both verbally and in writing, about the study aim and objectives, procedures and data confidentiality measures. All participants provided informed consent before participation. Participation in the study was voluntary. To maintain confidentiality, students' participation in the study was not shared with the teachers of the targeted courses. Participating students received a $50 gift card for their time spent on study activities, while experienced participants (nurses and nurse educators) were compensated with 60 min of paid work at a standard hourly

rate

2.6. Scientific rigor

Several strategies have been employed to ensure the scientific rigor of projects (Elo and Kyngäs, 2008). The credibility and reliability of the reported data were enhanced by careful documentation of the research activities. To ensure the reliability of the coding process, three rounds of independent verification were conducted and discrepancies were resolved by consensus. The involvement of several members of the research team at each stage mitigated the influence of individual bias on the results. Confirmation of the data was maintained through field notes and meetings of the research team members, which facilitated constant critical reflection. The transferability of the data was also supported by a comprehensive description of the theoretical framework, pedagogical modality used, context of the study and information regarding the analysis process and results obtained. This research was supported by a multidisciplinary research team (i.e., nursing, medicine, speech therapy) versed in the field of pedagogy applied to the health sciences.

The research team was predominantly female (75 %), with a mix of Caucasian, Arab, European and African individuals. Most were researchers and professors in nursing, medicine, or speech therapy programs (63 %), while the rest worked as nurses (33 %). The researchers had extensive experience in nursing practice, in nursing and health professionals' education and in qualitative analysis, as well as theoretical foundations related to clinical reasoning in nursing. This provided a solid basis for conducting the study and ensuring rigor in the analysis and interpretation of the findings. In terms of reflexivity, the research and analysis processes were influenced by our knowledge and understanding of clinical reasoning, its teaching and LbC, particularly regarding recognition, through the responses, of nursing clinical reasoning cognitive strategies. Additionally, discussions took place among team members for several weeks after the coding was completed to refine the data presented in the results.

3. Results

A total of 46 participants were recruited: 10 novice students, 16 intermediate students and 20 experienced nurses, including 13 rehabilitation nurses and 7 nurse educators. Of the 30 eligible students who agreed to participate in the study, 26 (87 %) provided a justification for their chosen answers. Table 1 summarizes students' sociodemographic data. Among their previous studies and work experience, the students specified the following fields: biomedical sciences, athletic therapy, psychology, prehospital emergency care technology and radiology. The average duration of the training activity was 50.4 min + /- 21.7. Thirteen nurses working in clinical settings with hospitalized physical rehabilitation patients or nursing advisors participated in this study.

Table 1
Sociodemographic data of students participating in the study.

		Novices (n = 10)	Intermediates (n = 16)	Total (n = 26)
Gender	Men	1	1	2 (8)
	Women	9	15	24 (92)
Age	Under 20	6	2	8 (31)
	21–25	5	5	10 (38)
	26–30	5	3	8 (31)
Previous studies in health and social services (other than nursing)	Yes	7	9	16 (62)
	No	8	2	10 (38)
Work experience in health and social services	Yes	8	12	20 (77)
	No	2	4	6 (23)

NOTE. Data are frequencies, percentage is in parentheses.

Finally, seven faculty members participated in the study. They worked in an academic setting as career professors (n = 1), lecturers (n = 2), laboratory advisors (n = 1), or teaching assistants who were also graduate students in the Master of Nursing program in the field of nursing education (n = 3).

3.1. Cognitive strategies used in an LbC tool

We identified five cognitive strategies used during an LbC activity: identifying meaningful data, forming relationships, using medical terminology and semantic qualifiers that reflect the recognition of a pattern, searching for information and generating other hypotheses. Table 2 includes the identified cognitive strategies, their descriptions in the context of using an LbC and examples of the segments found in the vignette presented in Fig. 2.

3.2. Differences and similarities noted in the responses across groups with different expertise levels

Differences were observed during the qualitative content analysis of the written comments on the LbC items, particularly regarding the density (length) of comments and their levels of contextualization. For example, for the item below (see Fig. 3), the responses varied in content and form across groups (see Table 3).

Students' responses varied in terms of explanations and the precision of thought. Some were brief, while others raised additional explanatory elements or hypotheses regarding nursing interventions to be considered. These variations could be explained by the heterogeneity of the groups of students surveyed. Some had completed previous studies in the field of health and social services (n = 16; 62 %) and had work experience (n = 20; 77 %), whereas others had no experience or previous studies in the field. However, nurses' responses frequently presented details that contextualized or situated the hypotheses of nursing interventions in a concrete and pragmatic way. The responses of nurse educators often presented a statement of a rule or principle to be respected, as well as certain clarifications surrounding the hypotheses of nursing interventions. Analysis of the cognitive strategies used in the written comments on the LbC items allowed us to target certain similarities and differences between the groups surveyed, presenting different levels of expertise (see Table 4).

In terms of similarities, the results show that the strategy "Identify significant data" is by far the most used in written comments on LbC items, regardless of the groups, followed by the cognitive strategy "Investigate additional data." Conversely, the cognitive strategy "Use medical terminology and semantic qualifiers demonstrating the recognition of a pattern" is little used, regardless of the groups. However, it appears in item 2 of vignette 1, suggesting that this item's content more readily facilitated the translation of clinical data into professional terminology (e.g., cyanosis, tachypnea). Other cognitive strategies were either used or prompted only sporadically.

4. Discussion

This study aimed to describe the cognitive strategies of nursing clinical reasoning used by students during an LbC activity and to compare them with those of experienced nurses. The results reveal that certain cognitive strategies are used more than others, including identifying significant data, searching for additional information and forming relationships between data. Student responses varied in terms of precision and length, while nurses' responses provided details that concretely contextualized the nursing intervention hypotheses. Educators' responses often stated rules to be followed, as well as some clarifications surrounding the nursing intervention hypotheses.

Two main conclusions emerge from our study. First, the consistency between the results obtained in the study and script theory. Second, the need to incorporate variations in the use of the LbC modality to optimize

Table 2
Cognitive strategies used in the written comments of an LbC tool.

Cognitive strategy	Definition of the contextualized strategy for the LbC tool	Examples of responses to the item
Identifying meaningful data	Identify (extract) key features or salient data in situations to judge/ evaluate a clinical hypothesis.	"Mr. Chiasson's clinical picture isn't stable, so I'll assess him and leave the dressing to the nursing assistant…" "We need to determine why the patient is saturated at 89 % with a heart rate of 26 and a high temperature of 37.9."
Forming relationships between data	Group data to interpret and establish relationships between them.	"Mr. Chiasson's vital signs don't suggest anything alarming, given that he has COPD, so it would be consistent for him to be tachypneic and for his target saturation to be above 88 %." "Although he has COPD, the client's usual pulsatile saturation should be reviewed and, if necessary, oxygen administered to achieve a pulsatile saturation between 89 % and 90 %. Notify the physician and re-monitor vital signs."
Using medical terminology and semantic qualifiers (SQ) that reflect the recognition of a pattern	Use professional vocabulary (e.g., tachypnea vs. rapid respiratory rate, dyspnea vs. breathing difficulties, etc.) and semantic qualifiers (e.g., acute vs. chronic) to describe interpretation of the data.	"The patient has COPD, so it's not surprising to have a saturation of 89 % on room air; however, the target saturation may be higher. He also has mild tachypnea. I need to know if this is within his normal range. Has he exerted himself? Is he experiencing chest indrawing/cyanosis?"
Searching for information	Recognize inadequacies in data collection and seek the necessary information aiming to judge/evaluate a clinical hypothesis.	"Based on Mr. Chiasson's data, an assessment is needed, i.e., to see if the patient is already known to have a fever, if he is on antibiotics, and when was his last sepsis assessment." "Pulmonary auscultation in addition to assessing other signs and symptoms will be necessary."
Generating other hypotheses	Formulate a clinical hypothesis not proposed in the items, based on clues identified in the items or not.	"I suggest offering low-flow oxygen to achieve the physician's and/or empirical therapeutic target of $\leq$ 92 %. Help the patient slow their breathing through exercises, if they are able to follow." "Assess whether pain could be the cause of the elevated blood pressure and review their normal blood pressure curve in their chart. Intervene accordingly with a collective prescription and discuss it with the physician, if necessary."

the mobilization of cognitive strategies in nursing clinical reasoning.

The results highlighted the consistency of the observed data and script theory underlying the design of the pedagogical modality. This theory explains that nurses, like all healthcare professionals, activate their scripts to understand and process clinical information and plan appropriate care (Vreugdenhil et al., 2022). This activation was illustrated by the mobilization of cognitive strategies for identifying significant data in situations and forming links between the data in written comments on the items. Scripts are also refined throughout professional life and linked to the variability of clinical experiences encountered by health professionals, including nurses (Custers, 2015). Indeed, although they may have some similarities, scripts differ from one nurse to another (Custers, 2015), including the scripts of those who designed the items of the pedagogical modality. Therefore, we were not surprised to detect in the results of the study the propensity of participants, regardless of their level of expertise, to state other clinical hypotheses, even if the instructions of the pedagogical modality did not invite them. In other words, participants may have glimpses of other clinical hypotheses in situations not proposed by the LbC modality. Script theory also explains the nuances and subtleties of the comments written by nurses in our study. Their responses presented details explaining data contextualized to clinical practice to judge a clinical hypothesis, illustrating a pragmatic implementation of situated (or contextualized) knowledge. This also illustrates that work environment and context intervene substantially in the clinical reasoning process (Griffits et al., 2023).

The results also highlighted the need to incorporate variations in the use of LbC and complement it with other pedagogical modalities. Indeed, given that only five cognitive strategies were mobilized by participants in our study; the written commentary on the item alone does not appear to sufficiently stimulate the full range of clinical reasoning strategies. While certain nursing cognitive strategies are inherently less solicited by the digital nature and content of the LbC modality (e.g., pausing for reflection, asking questions, drawing conclusions and providing explanations, generalizing/inferring), others—such as pattern recognition—could be more actively engaged. The brief presentation of a clinical vignette in a LbC activity is designed to prompt the recognition of a clinical representation (a pattern), which then guides the evaluation of proposed hypotheses in the items. The study showed that participants were able to identify meaningful and relevant data within the items. However, findings related to the interpretation of clinical data were less conclusive. In short, it was more difficult to observe whether LbC encouraged the use of professional vocabulary and semantic qualifiers indicative of pattern recognition. Yet, translating what students hear, see, or perceive into professional language is essential for forming relationships between clinical data and professional knowledge, as well as for formulating clinical hypotheses (Deschênes et al., 2025). This is also critical for ensuring the coherence and effectiveness of information exchange among professionals, thereby contributing to the safety and continuity of care.

Three variations in the use of the LbC modality are therefore proposed: (1) structuring activities around illness or nursing scripts, (2) incorporating think-aloud strategies into the modality and (3) enhancing interactivity through individual and group-based collaborative work among students.

Regarding a script-based pedagogical modality, Wu et al. (2025) evaluated the influence of this modality on the clinical reasoning of graduate nursing students. Building on the illness script, they used five scenarios in different clinical settings (emergency, oncology, surgery, intensive care and medicine). For each scenario, educators played the roles of experienced nurses and transmitted inter-service shift reports (handovers) to students preparing to take over the next shift. Information regarding illness scripts, such as characteristics, patient medical history, signs, symptoms and consequences of pathology, was provided. Students were then required to analyze the data, identify possible causes of the problems, develop a nursing intervention plan, determine actions to be performed and justify them. Although the teaching method was not

Mr. Foss, 78 years old, underwent right knee replacement surgery. During his hygiene care, you notice a stage 2 pressure ulcer on his coccyx. Mr. Foss has difficulty moving.		
If you were thinking of …	And then you discover …	Your hypothesis becomes ...
... suggesting installing an air mattress (or a therapeutic mattress).	… a Braden score at 15.	☐ Strongly weakened ☐ Weakened ☐ Unchanged ☐ Strengthened ☐ Strongly strengthened
Comment on your response choice		

Fig. 3. Item 1 of vignette 2.

Table 3
Extracts of written comments according to the groups questioned.

Novice students	The therapeutic mattress can't hurt him. *Novice student 4* Even though his risk of developing other pressure ulcers is low, the patient has a stage II coccyx injury and has difficulty moving. It is therefore justified to install an air mattress. *Novice student 6*
Intermediate students	15 = low risk, changing position every two hours would be sufficient." *Intermediate student 12* He has a pressure injury but presents a low risk. The best intervention would be to instruct the attendants to move the patient every two hours and request an occupational therapy consultation for the installation of a gel cushion. Air mattresses are not available in unlimited quantities, so I would start with these two interventions first." *Intermediate student 3*
Nurses	From 15–18 [on the Braden scale], it is a low risk. However, his difficulty mobilizing reduces the risk of developing and/or worsening the existing injury. To this end, a motorized therapeutic air mattress will be considered. Also, regarding nursing therapy, add the directive to mobilize him every two hours in a right or left lateral position. The supine position should be prioritized for meals. Include the nursing directives in the proposed work plan and inform attendants. Although the Braden scale is at 15 (it's an assessment tool), also check whether his clinical status has not changed and perform another assessment. If 15, use your judgment and place him at high risk → 10–12. *Nurse 1* He can indeed have a therapeutic surface, because his Braden scale is at 15. Also, provide teaching to aim for mobilization every 30 min in a chair/bed, verify the effectiveness of the prescribed analgesics (post-surgery). If dolor ↓, the patient will have greater ease with mobility. *Nurse 3*
Nurse educators	Despite a Braden score of 15, the patient already has a pressure injury. Therefore, targeted interventions should be implemented to reduce any pressure at the wound site, particularly with a therapeutic mattress. *Nurse educator 7* Given Mr. Foss's risk of developing a pressure injury, preventive interventions should be implemented to prevent further pressure injuries. These interventions should consider risk factors, and the score obtained. Thus, the use of measures such as a bedside positioning clock and communication with attendants will both prevent further injuries and contribute to the improvement of stage 2 coccyx injury. *Nurse educator 3*

based on LbC vignettes, the results of the study by Wu et al. (2025) showed that the pedagogical modality (based on illness scripts) contributed to improving clinical reasoning in students, including the recognition of patterns to construct or densify scripts, formulation of hypotheses to explain the identified illness and generation of hypotheses. This modality also allowed students to seek specific information to enrich their clinical reasoning processes and confirm or refute clinical hypotheses.

The use of thinking aloud while using the LbC is another avenue to consider, as it allows putting clinical reasoning into words and thereby mobilizes cognitive strategies for transforming and articulating clinical data using professional vocabulary and semantic qualifiers (e.g., acute vs. chronic) (Deschênes et al., 2025). Tedesco-Schneck (2019) practice narrative is an example of the use of vignettes based on script concordance in pediatric nursing care. In class, students responded individually to the test items and provided written comments to explain their answer choices. Then, an educator led a discussion to help students share their written comments and think aloud in groups about the rationale guiding their answer choices, to better understand the nursing interventions to be made in certain situations and to begin to reflect on the difficulties or errors in reasoning (Tedesco-Schneck, 2019).

Another interesting variant is the semi-structured tool proposed by Zagury-Orly et al. (2022) for medical education, based on the format of the LbC vignettes, but with free space in the items. The aim was to encourage students to generate clinical hypotheses and search for additional information, in addition to evaluating clinical hypotheses. In the group experimenting with the modality suggested by Zagury-Orly et al. (2022), students used the tool individually (~5 min) and then in teams (~20 min). Individually, students read the clinical cases and wrote anonymous choices for the items of the LbC vignettes. Each student had to propose a hypothesis, generate clinical data and evaluate how the data influenced the hypothesis. The students repeated this exercise on their teams. Formative feedback was also offered to students during the teaching activities. The control group was comprised of students who did not use the teaching modality but received the standard instruction traditionally provided in the gastroenterology course (e.g., reading materials, clinical cases). The researchers documented, among other outcomes, individual clinical reasoning performance using a multiple-choice questionnaire and the accuracy of individual versus collective responses to pedagogical modality items. The results showed that students were five times more likely to answer the questions correctly if they belonged to the experimental group compared with the control group. The hypothesis accuracy was significantly lower for individuals than for teams. In short, the experiment demonstrated that students benefited from generating their own data, justifying their reasoning and working individually and in teams.

4.1. Strengths and limitations of the study

This study enabled the description of the cognitive strategies involved in clinical reasoning among nursing students using LbC modality, a topic that had not previously been explored. In addition, it provided valuable insights into the adaptation and complementarity of other modalities that can be combined with LbC to promote competency development. The inclusion of participants with varying levels of expertise also enriched the data obtained in this study. However, this study has some limitations. It was conducted at two institutions (a clinical physical rehabilitation setting and an academic setting) with a

Table 4
Frequency of use (in %) of cognitive strategies according to items and groups.

	Identifying data	Forming relationships	Using medical terminology and SQ	Searching for information	Generating other hypotheses
Vignette 1_ Clinical evaluation_patient group					
Item 1					
Novice students	80				
Intermediate students	75	6			
Nurses	75	17		8	
Nurse educators	100	29		14	
Item 2					
Novice students	70	10	14		
Intermediate students	75	13	17	19	
Nurses	92	17	19	42	17
Nurse educators	100	29	20	29	
Vignette 2_ Pressure injury					
Item 1					
Novice students	40	10			10
Intermediate students	44	13			31
Nurses	54	46		23	38
Nurse educators	49	44			29
Item 2					
Novice students					
Intermediate students		6		6	
Nurses	31	38		15	23
Nurse educators	57	14		14	
Vignette 3_ Fall					
Item 1					
Novice students	30	10		10	
Intermediate students	38	-		6	
Nurses	77	15		46	15
Nurse educators	71			57	
Item 2					
Novice students	60			10	
Intermediate students	56			6	13
Nurses	54	8		15	23
Nurse educators	86			43	43

NOTE: Data are presented in %, representing the frequency of use of the strategy according to the number of people in each group

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limited number of participants in each group. Nevertheless, collecting six responses (two items/vignette) per participant increased the total volume of data to be analyzed, providing an in-depth understanding of the phenomenon, of which the data could be observed on more than one occasion (Vasileiou et al., 2018). The use of participants' written responses may only capture a portion of the mobilized cognitive strategies, leaving others unseen. These responses could also mobilize less perceptible cognitive strategies of clinical reasoning. The pedagogical modality LbC also invites relatively short written responses. They often require little wording and completeness, thereby limiting the conclusions drawn from the obtained results. One possible avenue would be to integrate thinking aloud in person or in a digital learning environment to better capture mobilized cognitive strategies.

5. Conclusion

This study aimed to identify and describe the cognitive strategies for clinical reasoning used in the LbC modality in nursing. The cognitive strategies used included identifying meaningful data, searching for additional information and forming links between the data. Variabilities in terms of precision, length (of written comments) and contextualization of clinical reasoning were observed among the four groups studied. Highlighting the consistency of the teaching method with the theory underlying its design (i.e., script theory), the results suggest the need to incorporate variations in the use of pedagogical modality to optimize the use of cognitive strategies necessary for applying nursing clinical reasoning.

CRediT authorship contribution statement

Caty Marie-Ève: Writing – review & editing, Validation, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Lechasseur Kathleen:** Writing – review & editing, Validation, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Fernandez Nicolas:** Writing – review & editing, Validation, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Lavoie Patrick:** Writing – review & editing, Validation, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Deschênes Marie-**

France: Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT to improve language and readability. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the publication's content.

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Appendix A. Supporting information

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