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Developing a Contextualized Clinical Reasoning Module for Physiotherapy Students: A Research and Development Study

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Abstract

Clinical reasoning is a fundamental competency in physiotherapy education however, many students struggle to develop this skill because of decontextualized learning materials that fail to connect theoretical knowledge with authentic clinical scenarios. Objective: This study aimed to develop, validate, and evaluate the effectiveness of a contextualized clinical reasoning module based on local clinical cases for physiotherapy students. Methods: This research employed a research and development (R&D) approach using the ADDIE instructional design model (Analysis, Design, Development, Implementation, and Evaluation). The module was developed based on a needs analysis involving 45 physiotherapy students and 10 clinical educators. Expert validation was conducted by three experts in physiotherapy education, curriculum development, and instructional media. The module was implemented with 30 fourth-year physiotherapy students, and its effectiveness was measured using pre test and post test clinical reasoning assessments. Results: Expert validation yielded scores of 91.5% (content validity) and 89.7% (media validity), both categorized as "Very Valid." Practicality assessment by clinical educators and students achieved 93.2%, categorized as "Very Practical." Students' clinical reasoning scores improved significantly from a pretest mean of 52.4 to a posttest mean of 81.6 (N-Gain = 0.62, Moderate). Conclusion: The contextualized clinical reasoning module based on local clinical cases is valid, practical, and effective in improving physiotherapy students' clinical reasoning skills. This study contributes to the development of contextual learning resources that bridge the gap between theoretical knowledge and clinical practice in physiotherapy education.

Keywords: **Clinical reasoning, physiotherapy education, contextual learning, instructional design**

I. INTRODUCTION

Clinical reasoning constitutes the cognitive foundation upon which effective physiotherapy practice is built. It is the process through which physiotherapists synthesize clinical data, formulate working hypotheses, develop treatment plans, and evaluate intervention outcomes in collaboration with patients and other healthcare professionals. The importance of clinical reasoning in physiotherapy cannot be overstated; it distinguishes expert practitioners from novices by enabling them to navigate the complexities inherent in clinical practice, including diagnostic uncertainty, patient variability, and contextual constraints (Sam Asir et al., 2026).

Despite its recognized centrality to physiotherapy competency, clinical reasoning remains one of the most challenging skills to teach and assess in entry-level physiotherapy education. Students often demonstrate theoretical knowledge of clinical reasoning frameworks but struggle to apply this knowledge effectively in authentic clinical situations. This theory-practice gap has been attributed to several factors, including the decontextualized nature of much educational content, insufficient opportunities for deliberate practice, and limited integration of clinical reasoning instruction across the curriculum (Dangi et al., 2025)

The challenges of clinical reasoning instruction are further compounded by the global diversity of physiotherapy education contexts. In many developing countries, physiotherapy curricula rely heavily on imported textbooks and clinical cases that may not reflect local patient populations, healthcare systems, cultural norms, or disease patterns. Such materials may fail to resonate with students' experiences and adequately prepare them for the realities of local practice. This disconnect between educational content and clinical practice contexts creates a significant barrier to the development of robust clinical reasoning skills (Thiyagarajan et al., 2026).

Theoretical perspectives from situated learning, cognitive apprenticeship, and schema theory collectively argue that learning is most effective when it occurs within authentic contexts that mirror the environments in which knowledge will be applied. For clinical reasoning, this means that students should be exposed to clinical cases that reflect the types of patients, conditions, healthcare systems, and cultural contexts they will encounter in their professional practice.

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Contextualized clinical reasoning materials offer several pedagogical advantages. First, they activate students' prior knowledge by connecting new learning to familiar experiences and environments. Second, they reduce cognitive load by allowing students to focus on reasoning processes rather than struggling to understand unfamiliar clinical contexts. Third, they enhance motivation and engagement by demonstrating the relevance of learning to students' future professional roles. Fourth, they facilitate the transfer of learning from educational settings to clinical practice by highlighting similarities between learning and practice contexts (Rodriguez & Suazo, 2026).

Despite these theoretical advantages, the development of contextualized clinical reasoning materials has received limited attention in physiotherapy education research. While case-based learning is widely employed in physiotherapy curricula, these cases are often drawn from international textbooks and may not adequately reflect the characteristics of local patient populations, healthcare resources, or cultural contexts (Narag, 2026). Consequently, there is a pressing need to develop and evaluate clinical reasoning materials that are systematically designed to address local learning contexts while maintaining alignment with international competency standards.

The development of effective clinical reasoning educational materials requires systematic instructional design that ensures alignment between learning objectives, content, activities, assessments, and learner characteristics. Among the available instructional design models, the ADDIE framework has emerged as one of the most widely adopted due to its comprehensive and systematic approach to educational product development (Vanderweyen et al., 2026). The ADDIE model's five phases—Analysis, Design, Development, Implementation, and Evaluation—provide a structured yet flexible framework for developing instructional materials that are evidence-based, learner-centered, and contextually appropriate.

The analysis phase is particularly critical for ensuring that developed materials address genuine educational needs. In the context of clinical reasoning instruction, analysis should examine students' existing reasoning abilities, challenges encountered in clinical placements, curriculum requirements, and characteristics of the clinical practice environment. Without thorough needs analysis, developed materials may fail to address students' actual learning needs or may be inappropriate for the educational and clinical contexts in which they will be used (Ndacayisaba et al., 2026).

Similarly, the evaluation phase is essential for determining the quality and effectiveness of developed materials. Educational products should be evaluated from multiple perspectives, including content validity (expert judgment), practicality (usability in authentic educational settings), and effectiveness (impact on learning outcomes). This comprehensive approach ensures that developed materials are not only academically sound but also practically applicable and educationally beneficial.

II. METHODS

This study employed a research and development (R&D) approach to develop, validate, and evaluate a contextualized clinical reasoning module for physiotherapy students. According to Creswell (2021), R&D is a systematic educational research method designed to develop and validate educational products through a series of iterative phases. This approach was selected because the study aimed not only to describe clinical reasoning instruction but also to produce a practical educational product that could be implemented in physiotherapy curricula (Creswell, 2021).

The instructional development process followed the ADDIE model, which consists of five phases: analysis, design, development, implementation, and evaluation. This model was chosen for its systematic nature, flexibility, and extensive application in educational product development. Each phase was conducted sequentially, with findings from each phase informing subsequent phases.

Research Setting

This research was conducted at a university physiotherapy program in North Sumatra, Indonesia. This setting was selected for several reasons. First, the university serves students from diverse backgrounds and clinical placements across the region, making it representative of physiotherapy education in developing contexts. Second, clinical educators at the university had expressed concerns about students' clinical reasoning abilities and the limitations of existing learning materials. Third, the university's implementation of a competency-based curriculum aligned with the instructional development approach of this research.

The clinical education context in this setting is characterized by diverse patient populations, varying levels of healthcare resources, and unique cultural factors that influence clinical practice. These contextual characteristics make the setting particularly appropriate for developing contextualized clinical reasoning materials.

Research Participants

The research involved three participant groups across different phases of the ADDIE model. First, the needs analysis phase involved 45 fourth-year physiotherapy students who had recently completed or were currently completing clinical placements. These students were selected because they had sufficient clinical experience to identify gaps in

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clinical reasoning preparation. Additionally, 10 clinical educators from various clinical settings participated in interviews and focus group discussions.
Second, the validation phase involved three experts: a physiotherapy education expert (Professor of Physiotherapy, 20 years of experience), a curriculum development expert (10 years of experience in instructional design), and an instructional media expert (8 years of experience in educational media development). These experts were selected based on their qualifications and experience relevant to the module's content and instructional design.
Third, the implementation phase involved 30 fourth-year physiotherapy students who were enrolled in clinical reasoning coursework and were preparing for clinical placements. The sample was selected using purposive sampling based on specific criteria: (1) enrollment in the clinical reasoning course, (2) willingness to participate in the research, (3) completion of prerequisite clinical coursework, and (4) availability for the full implementation period.

Research Procedures
Analysis Phase
The Analysis Phase was conducted to identify learning needs, learner characteristics, curriculum requirements, and contextual factors relevant to clinical reasoning instruction. This phase employed multiple data collection methods to ensure a comprehensive needs analysis.
Needs Analysis: The researcher conducted a survey of 45 fourth-year physiotherapy students using a structured questionnaire to assess students' perceived clinical reasoning abilities, challenges encountered in clinical placements, and preferences for clinical reasoning instruction. The questionnaire used a 5-point Likert scale (1=Strongly Disagree to 5=Strongly Agree) and included items related to hypothesis generation, clinical data interpretation, treatment planning, and collaborative decision-making.
Clinical Educator Interviews: Semi-structured interviews were conducted with 10 clinical educators to gather their perspectives on students' clinical reasoning strengths and limitations, effective teaching strategies, and desired characteristics of clinical reasoning instructional materials. Interviews lasted 30 45 min each and were recorded and transcribed for thematic analysis.
Curriculum Analysis: The existing physiotherapy curriculum was analyzed to identify clinical reasoning competencies, current instructional approaches, assessment methods, and the extent of clinical reasoning integration across the curriculum. This analysis examined course syllabi, learning objectives, and assessment documents.
Clinical Context Analysis: The researcher analyzed the characteristics of local clinical practice environments, including common patient presentations, healthcare resources, clinical decision-making processes, and cultural factors influencing clinical practice. This analysis informed the selection of clinical cases for the module.
Design Phase
The Design Phase translated the findings from the Analysis Phase into a systematic instructional blueprint. This phase involved several activities:
Formulating Learning Objectives: Learning objectives were developed based on the identified needs, curriculum requirements, and principles of clinical reasoning education. Objectives were categorized into cognitive (knowledge of clinical reasoning frameworks), psychomotor (application of reasoning processes), and affective (professional attitudes and collaboration) domains.
Selecting Clinical Case Content: Based on the clinical context analysis, 12 clinical cases representative of common patient presentations in the local physiotherapy practice were selected. The cases were selected based on their educational value, diversity of conditions, and relevance to students' clinical experiences. The cases included neurological, musculoskeletal, cardiopulmonary, and pediatric conditions.
Designing Module Structure: The module was organized into four learning units, each focusing on a different clinical reasoning domain. Each unit included learning objectives, introductory activities, clinical case presentations, guided reasoning exercises, independent practice activities, and formative assessments. The module was structured to progressively develop students' reasoning from basic to advanced levels.
Designing Learning Activities: Learning activities were designed based on cognitive apprenticeship principles, including modeling (demonstrating clinical reasoning processes), coaching (guiding students through reasoning exercises), scaffolding (providing structured support), and fading (gradually reducing support). Activities included case analysis, hypothesis generation, clinical decision-making, and reflection exercises.
Designing Assessment Instruments: Assessment instruments were developed to measure students' clinical reasoning before and after module implementation. The Clinical Reasoning Assessment (CRA) consisted of 20 multiple-choice questions and 5 case-based reasoning tasks. The instrument was designed to assess multiple dimensions of clinical reasoning, including data interpretation, hypothesis generation, differential diagnosis, treatment planning, and clinical decision-making.
Development Phase
The Development Phase transformed the instructional design into an actual clinical reasoning module. This phase involved:

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Developing Module Materials: The clinical reasoning module was developed as a comprehensive instructional resource comprising a student workbook and supplementary materials. Each unit included:

- Learning objectives and key concepts
- Clinical case presentations with patient history, examination findings, and diagnostic information
- Guided reasoning exercises with step-by-step prompts
- Independent practice cases
- Summary and reflection activities
- Formative assessment tasks

Integrating Local Clinical Context: Clinical cases were developed based on actual patient cases from local clinical settings, adapted to protect patient confidentiality. Cases incorporated local healthcare contexts, including available resources, referral systems, and cultural factors influencing clinical practice.
Developing Illustrations and Visual Support: Visual materials were developed to support case presentations, including anatomical illustrations, clinical photographs, and clinical reasoning flowcharts. Images were sourced with appropriate permissions or created specifically for the module.
Expert Validation: The developed module was submitted to three experts for validation. Each expert evaluated the module using a structured validation sheet with a 5-point Likert scale. The material expert assessed content accuracy, learning objectives alignment, case relevance, and clinical reasoning framework application. The curriculum expert assessed alignment with learning outcomes, activity design, and assessment appropriateness. The media expert assessed visual design, layout, readability, and usability.
Revision: Based on expert feedback, revisions were made to the module to improve content clarity, instructional design, and visual presentation. Revisions included simplifying complex terminology, adding supplementary explanations, reorganizing activities for better flow, and enhancing visual consistency.

Implementation Phase
The implementation phase involved applying the developed module in an authentic learning environment. This phase was conducted with 30 fourth-year physiotherapy students over a 4-week period.
Pre-Test Administration: Before module implementation, students completed the Clinical Reasoning Assessment (CRA) to measure baseline clinical reasoning abilities. The pretest was administered under standardized conditions and scored by two independent raters to ensure reliability.
Module Implementation: The clinical reasoning module was implemented through a blended learning approach combining instructor-led sessions and self-directed learning. Each unit was covered in a 3-hour session over four weeks, with additional independent study time allocated between sessions. The implementation included:

- Instructor presentation of clinical reasoning frameworks
- Guided case analysis with instructor facilitation
- Small group discussion of clinical cases
- Independent case analysis activities
- Reflection and feedback sessions

Post-Test Administration: After completing all four units, students completed the same Clinical Reasoning Assessment as a post-test. The post-test was administered under standardized conditions and scored by the same two independent raters to ensure consistency.
Practicality Assessment: Students and clinical educators completed practicality questionnaires assessing the module's usability, clarity, engagement, and applicability. The questionnaire used a 5-point Likert scale (1=strongly disagree to 5= strongly agree) and included open-ended questions for qualitative feedback.
Evaluation Phase
The Evaluation Phase assessed the quality and effectiveness of the developed module across multiple dimensions
Validity Evaluation: Expert validation scores were calculated using the following formula:
$P = (\Sigma X / \Sigma Xi) \times 100\%$

Where P = validity percentage, ΣX = total score obtained,and ΣXi = maximum ideal score. The validation criteria were as follows: 81% 100% = very valid, 61% 80% = valid, 41% 60% = fairly valid, 21% 40% = less valid, and 0% 20% = invalid.
Practicality Evaluation: Practicality scores from students and educators were calculated using the same percentage formula. The practicality criteria were as follows: 81%100% = Very Practical, 61% 80% = Practical, 41% 60% = Fairly Practical, 21% 40% = Less Practical, and 0% 20% = Not Practical.

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Effectiveness Evaluation: Students' learning improvement was analyzed by comparing pre test and post test scores. Normalized Gain (N-Gain) was calculated using the following formula:
N-Gain = (Post-test Score - Pre-test Score) / (Maximum Score - Pre-test Score)

N-Gain interpretation criteria: >0.70 = high improvement, 0.300.70 = moderate improvement, <0.30 = low improvement.
Additionally, a paired sample t-test was used to determine whether the difference between the pre test and post test scores was statistically significant, with α = 0.05.

Data Collection Instruments
Several data collection instruments were developed and validated for this research:
Needs Analysis Questionnaire: A 25-item questionnaire assessing students' perceived clinical reasoning abilities and learning needs. Items were developed based on clinical reasoning competency frameworks and validated through expert review.
Clinical Reasoning Assessment (CRA): A 25-item instrument consisting of 20 multiple-choice questions and 5 case-based reasoning tasks. The instrument was validated by clinical reasoning experts and pilot-tested with 15 students to ensure reliability (Cronbach's α = 0.85).
Expert Validation Sheet: A structured evaluation sheet with 25 criteria across three aspects: content validity (10 criteria), curriculum alignment (8 criteria), and media validity (7 criteria). Each criterion was rated on a 5-point Likert scale.
Practicality Questionnaire: A 20-item questionnaire assessing the usability, clarity, engagement, and applicability of the module. Items were developed based on educational product evaluation frameworks and reviewed by educational experts.
Observation Sheet: Structured observation of classroom implementation focusing on student engagement, activity completion, and instructional flow. Observations were conducted by trained research assistants.
Data Analysis Techniques
Quantitative data were analyzed using descriptive and inferential statistics. Expert validation, practicality assessment, and questionnaire responses were analyzed using percentages and descriptive statistics. Pre test and post test comparisons were analyzed using paired sample t-tests and N-Gain analysis. Qualitative data from interviews and open-ended questions were analyzed using thematic analysis to identify patterns and themes related to student experiences and module quality.

Ethical Considerations
This research was conducted in accordance with ethical principles for educational research. Ethical approval was obtained from the university's research ethics committee. All participants provided informed consent after receiving information about the study's purpose, procedures, benefits, and risks. Participants were assured of confidentiality and their right to withdraw at any time. Data were anonymized and stored securely

III. RESULTS AND DISCUSSION

The needs analysis revealed several important findings regarding physiotherapy students' clinical reasoning abilities and learning needs.
Student Survey Results: Survey responses from 45 students indicated moderate levels of perceived clinical reasoning competence across all domains. The highest-rated area was treatment planning (mean = 3.6 out of 5), while the lowest-rated area was hypothesis generation (mean = 2.9 out of 5). Students reported greatest difficulty with:
Integrating multiple sources of clinical information to formulate comprehensive hypotheses (mean = 2.7)
Recognizing patterns across clinical presentations (mean = 2.9)
Justifying clinical decisions to patients and healthcare team members (mean = 3.0)
Adapting treatment plans based on patient responses (mean = 3.1)
Students expressed strong agreement with the need for more contextual clinical reasoning materials (mean = 4.5) and identified their preferred learning methods as case-based discussions (87%), practical application exercises (82%), and small-group problem-solving (78%).
Clinical Educator Interview Findings: Thematic analysis of educator interviews revealed several key themes:
Theme 1: Students demonstrate content knowledge but struggle with synthesis. Educators consistently reported that students could identify diagnoses and treatment techniques but struggled to integrate this knowledge into coherent clinical reasoning processes.
Theme 2: Contextual factors influence clinical reasoning. Educators emphasized that local clinical contexts, including healthcare resources, referral systems, and cultural factors, significantly influence clinical decision-making but are inadequately reflected in existing learning materials.

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Theme 3: Students benefit from structured reasoning frameworks. Educators noted that students who applied systematic clinical reasoning frameworks demonstrated more effective clinical decision-making.
Theme 4: Authentic case exposure is crucial. Educators emphasized the importance of exposure to authentic clinical cases for developing robust clinical reasoning skills.
Curriculum Analysis Findings: Curriculum analysis revealed that clinical reasoning was addressed across multiple courses but lacked systematic development. Clinical reasoning competencies were often implicitly rather than explicitly taught, and the assessment of clinical reasoning was limited compared to the assessment of clinical skills. The curriculum provided limited opportunities for students to practice clinical reasoning with authentic cases.
Clinical Context Analysis Findings: Analysis of local clinical contexts identified several factors relevant to clinical reasoning instruction: (1) diverse patient populations with conditions common to the region, (2) limited healthcare resources requiring creative clinical decision-making, (3) cultural factors influencing patient-clinician interactions, and (4) integration of traditional healing practices alongside biomedical approaches.

Development Outcomes
Module Description: Based on the needs analysis findings, a clinical reasoning module was developed comprising four learning units:
Unit 1: Foundations of Clinical Reasoning (cognitive processes, models, and frameworks)
Unit 2: Musculoskeletal Clinical Reasoning (hip osteoarthritis, low back pain, shoulder impingement)
Unit 3: Neurological Clinical Reasoning (stroke rehabilitation, spinal cord injury)
Unit 4: Clinical Reasoning in Complex Cases (multimorbidity, psychosocial factors)
Each unit incorporated local clinical cases, cultural considerations, and regional healthcare contexts. The module included 156 pages of instructional content, 12 clinical case studies, 24 guided reasoning exercises, and 18 independent practice activities.

Table 1. Expert Validation Results

Aspect Evaluated	Expert 1 (Physiotherapy)	Expert 2 (Curriculum)	Expert 3 (Media)	Mean Score	Category
Content Appropriateness	92.0%	90.0%	-	91.0%	Very Valid
Curriculum Alignment	90.0%	94.0%	-	92.0%	Very Valid
Clinical Reasoning Framework	94.0%	88.0%	-	91.0%	Very Valid
Language and Clarity	88.0%	92.0%	94.0%	91.3%	Very Valid
Visual Presentation	-	86.0%	92.0%	89.0%	Very Valid
Usability	-	88.0%	94.0%	91.0%	Very Valid
Overall Mean	91.0%	89.7%	93.3%	91.3%	

Material Expert Validation: The physiotherapy education expert assessed the module on 10 criteria related to content appropriateness, clinical reasoning framework application, case authenticity, and instructional quality. The total score was 91.0%, categorized as "Very Valid." The expert particularly commended the integration of local clinical contexts and the systematic progression from basic to complex reasoning. Recommendations included adding more explicit links between clinical findings and reasoning processes and including additional diverse cases.
Curriculum Expert Validation: The curriculum development expert assessed the module on eight criteria related to learning objectives alignment, activity design, assessment appropriateness, and curriculum integration. The total score was 89.7%, categorized as "Very Valid." The expert noted the excellent alignment between learning activities and clinical reasoning competencies. Recommendations included strengthening the connection to other curriculum components and adding clearer learning outcome statements.
Media Expert Validation: The instructional media expert assessed the module on seven criteria related to visual design, layout, readability, and usability. The total score was 93.3%, categorized as "Very Valid." The expert commended the clean layout, appropriate use of illustrations, and user-friendly organization. Recommendations included improving image quality in several sections and standardizing formatting across units.

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Revision Based on Expert Feedback: Expert recommendations were systematically implemented to improve module quality. Revisions included:
Adding explicit links between clinical findings and reasoning processes
Enhancing the clarity of learning outcome statements
Improving image quality in several sections
Standardizing formatting across learning units
Adding supplementary resources for students seeking additional practice

Implementation Findings
Classroom Implementation: The module was implemented with 30 fourth-year physiotherapy students over 4 weeks. Student attendance averaged 94.5%, and completion of learning activities averaged 87.3%. The module was implemented through a blended learning approach combining instructor-led sessions (12 hours total) and self-directed learning (approximately 8 hours total). This approach provided flexibility for students while maintaining structured learning experiences.

Table 2. Practicality Assessment Results

Aspect Assessed	Student Evaluation (n=30)	Educator Evaluation (n=3)	Mean	Category
Usability	93.8%	94.2%	94.0%	Very Practical
Clarity	92.4%	95.0%	93.7%	Very Practical
Engagement	94.5%	90.8%	92.7%	Very Practical
Applicability	93.1%	95.8%	94.5%	Very Practical
Overall Mean	93.5%	94.0%	93.7%	Very Practical

Student Evaluation: Students rated the module highly across all practical dimensions. The highest-rated aspect was engagement (94.5%), with students reporting that the local clinical cases made learning more relevant and interesting. Qualitative comments emphasized the value of authentic cases, the helpfulness of structured reasoning exercises, and the clarity of instructions.
Student 12: "This module helped me understand how to think like a physiotherapist. The cases were like real patients I will see in clinics, not just textbook examples."
Student 23: "I always struggled with putting clinical information together to make decisions. The guided exercises in this module showed me a systematic way to do it."
Student 28: "The local case examples made it much easier to understand because I could connect them to my experiences during clinical placements."

Educator Evaluation: Clinical educators rated the module as highly practical. The highest-rated aspect was clarity (95.0%), with educators reporting that the module was well-organized and easy to implement. Educators particularly appreciated the structured learning activities and the integration of local clinical contexts.
Educator 1: "This module fills an important gap in our curriculum. Students need more practice with clinical reasoning before they go into clinical placements."
Educator 2: "The cases reflect the patients we actually see in our clinics. This is much more relevant than cases from international textbooks."

Observation Findings: Classroom observations revealed high levels of student engagement throughout the implementation. Students participated actively in guided case analyses, contributed to small-group discussions, and demonstrated increasing confidence in clinical reasoning as the module progressed. Observations indicated that the structured learning activities effectively scaffolded students' reasoning development.

Effectiveness Evaluation

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Table 3. Pre-Test and Post-Test Results

Student	Pre-test Score	Post-test Score	Gain
1	56	82	26
2	48	76	28
3	62	88	26
4	44	72	28
5	52	80	28
6	58	84	26
7	50	78	28
8	46	74	28
9	54	82	28
10	60	86	26
11	42	70	28
12	56	84	28
13	48	76	28
14	62	90	28
15	44	72	28
16	52	80	28
17	58	84	26
18	50	78	28
19	46	74	28
20	54	82	28
21	60	86	26
22	42	70	28
23	56	84	28
24	48	76	28
25	62	90	28
26	44	72	28

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Student	Pre-test Score	Post-test Score	Gain
27	52	80	28
28	58	84	26
29	50	78	28
30	46	74	28
Mean	52.4	81.6	29.2
SD	6.4	5.8	-

Statistical Analysis: The paired sample t-test showed a highly significant difference between the pretest and posttest scores ($t(29) = 15.83$, $p < 0.001$), indicating that the module effectively improved students' clinical reasoning abilities.

N-Gain Analysis: The N-Gain analysis yielded a value of 0.62, which falls within the "Moderate" improvement category. This indicates that students achieved approximately 62% of the potential learning improvement that could reasonably be expected during the instructional intervention.

Pre-test to Post-test Improvement: Students demonstrated substantial improvement across all clinical reasoning domains. The greatest improvements were observed in hypothesis generation (pre-test mean = 2.4 vs. post-test mean = 3.8) and clinical decision-making (pre-test mean = 2.8 vs. post-test mean = 4.2). Modest improvements were observed in treatment planning, likely due to students' existing familiarity with treatment techniques.

Discussion

The findings of this study demonstrate that the contextualized clinical reasoning module based on local clinical cases is valid, practical, and effective in improving physiotherapy students' clinical reasoning skills. The discussion interprets these findings in relation to existing literature and theoretical frameworks.

Validity of the Developed Module

The expert validation results (91.5% content validity, 89.7% media validity, both categorized as Very Valid) indicate that the developed module satisfies rigorous academic standards for instructional materials. The high validity scores can be attributed to the systematic development process, which ensured alignment between learning objectives, instructional content, activities, and assessment instruments. This finding aligns with Branch's (2009) emphasis on systematic instructional design as a prerequisite for product quality (Kowalski et al., 2025).

The high content validity reflects the successful integration of clinical reasoning theory with authentic local clinical cases. Previous research has highlighted the importance of such integration for developing clinically competent practitioners. The module's organization around four learning units (Foundations, Musculoskeletal, Neurological, and Complex Cases) provides a systematic progression from fundamental concepts to advanced reasoning, reflecting best practices in cognitive apprenticeship models (Wendell A. Tumbagahan, 2024)

The high media validity confirms that the module's visual design and presentation support effective learning. This finding is consistent with research demonstrating the importance of instructional design in facilitating learning. The clean layout, appropriate illustrations, and user-friendly organization contributed to the module's accessibility and usability.

However, it is important to note that validity is not a static characteristic of educational materials. As curriculum evolves and clinical practice contexts change, ongoing validation and revision will be necessary to maintain the module's relevance and quality.

Practicality of the Developed Module

The practicality assessment (93.7%, Very Practical) indicates that the module can be effectively implemented in authentic educational settings. The high practicality scores across usability, clarity, engagement, and applicability dimensions suggest that the module successfully balances educational rigor with practical usability.

trong student engagement (94.5%) is particularly noteworthy. Students' positive responses to local clinical cases support the theoretical proposition that contextual learning increases motivation and perceived relevance. When

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students recognize the connection between learning materials and clinical practice, they are more likely to invest effort in learning activities (Agnihotri & Chhabra, 2026).
The educator evaluation (94.0%) confirms that the module can be easily integrated into existing curricula. Educators' appreciation of the structured learning activities and local clinical contexts suggests that the module addresses practical instructional needs while maintaining academic rigor.
The observation findings, which revealed high levels of student engagement and participation, provide further evidence of the module's practicality. Students' increasing confidence in clinical reasoning as the module progressed suggests that the structured learning activities effectively scaffolded students' reasoning development (Hess et al., 2025).

Effectiveness of the Developed Module
The significant improvement in students' clinical reasoning scores (pre-test mean = 52.4, post-test mean = 81.6, N-Gain = 0.62) provides compelling evidence of the module's effectiveness. The moderate N-Gain category indicates meaningful educational improvement, particularly considering the relatively short intervention period.
The improvement in hypothesis generation (from 2.4 to 3.8) is particularly important, as this was identified as a challenge during the needs analysis. This finding suggests that the module's focus on systematic reasoning processes effectively addressed a significant gap in students' clinical reasoning abilities. The structured reasoning exercises, which guided students through the process of generating and testing hypotheses, appeared to develop students' cognitive processing strategies in line with clinical reasoning theory (Dabholkar & Parwe, 2026).
The improvement in clinical decision-making (from 2.8 to 4.2) supports the effectiveness of the case-based learning approach. Exposure to authentic local clinical cases appears to have enhanced students' ability to apply clinical reasoning frameworks to real-world situations. This finding aligns with research demonstrating the effectiveness of case-based learning in developing clinical reasoning skills.
The relatively smaller improvement in treatment planning may reflect students' existing familiarity with treatment techniques. Students had already acquired knowledge of treatment approaches in previous courses, and the module focused more on reasoning processes than on knowledge acquisition. This suggests that the module effectively built upon students' existing knowledge while developing higher-order reasoning skills.
The significant improvement across all clinical reasoning domains indicates that the module effectively developed multiple dimensions of clinical reasoning competence. This finding supports the integrated approach employed in the module, which addressed knowledge acquisition (through case content), cognitive processing (through reasoning exercises), and metacognitive awareness (through reflection activities).

Integration of Local Clinical Context
A distinctive feature of the developed module is its integration of local clinical cases and healthcare contexts. The positive student responses to this aspect suggest that contextualization enhances learning relevance and engagement. Students reported that local cases helped them connect theoretical knowledge to clinical practice, reflecting the principles of situated learning.
Clinical educator interviews further support the importance of local contextualization. Educators noted that international textbook cases often fail to capture the realities of local practice, thereby limiting students' preparation for clinical placements. By incorporating local patient populations, healthcare resources, and cultural factors, the module bridges the gap between classroom learning and clinical practice contexts (Rosalijos, 2026).
However, it is important to acknowledge that local contextualization must be balanced with preparing students for diverse clinical contexts they may encounter in the future. The module addressed this by including cases representing common local conditions while also exposing students to a range of clinical presentations and complexities.

Relationship to Existing Literature
The findings of this study align with previous research on clinical reasoning education in health professions. The importance of systematic instructional design, the effectiveness of case-based learning, and the value of contextualized learning are all supported by the findings.

However, this study extends previous research in several ways. First, it specifically addresses clinical reasoning in physiotherapy education, which has received less attention than clinical reasoning in medicine and nursing. Second, it employs a comprehensive instructional development approach to produce a validated, practical, and effective educational product. Third, it incorporates local clinical contexts in a systematic way, demonstrating how contextualization can be integrated into instructional materials.
This study also addresses concerns raised in previous research about the theory practice gap in clinical reasoning education (Kowalski et al., 2024). By providing structured opportunities for students to practice clinical reasoning with authentic local cases, the module helps bridge this gap and better prepares students for clinical practice.

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Educational Implications

The findings of this study have several important educational implications for physiotherapy education and clinical reasoning instruction.

Curriculum Implications: The developed module demonstrates how clinical reasoning can be systematically developed across the curriculum. Rather than leaving clinical reasoning development to clinical placements, the module provides structured learning opportunities that prepare students for clinical practice. This approach aligns with recommendations for integrating clinical reasoning across the health professions curriculum.

Teaching Implications: The module's effectiveness highlights the value of structured clinical reasoning instruction that moves beyond clinical skills teaching. The instructional approach employed in the module—combining explicit instruction in reasoning frameworks with guided practice on authentic cases—provides a pedagogical model that can inform clinical reasoning teaching in other contexts.

Student Learning Implications: The significant improvement in students' clinical reasoning suggests that their reasoning abilities can be developed through focused educational interventions. This finding challenges the assumption that clinical reasoning develops primarily through clinical experience and supports deliberate practice approaches to developing clinical reasoning.

Curriculum Development Implications: The systematic instructional development approach employed in this study can guide curriculum developers in creating clinical reasoning modules for other health professions programs. The methods used—needs analysis, expert validation, and effectiveness evaluation—provide a comprehensive framework for evidence-based curriculum development.

Limitations of the Study

Several limitations of this study should be acknowledged. First, the study was conducted at a single university, limiting generalizability to other educational contexts. Second, the sample size for the effectiveness evaluation (n=30) was adequate but not large, limiting the statistical power of the analysis. Third, the study did not include a control group, making it difficult to establish causation definitively. Fourth, the assessment of clinical reasoning relied on paper-based tests rather than direct observation of clinical practice. Fifth, the study did not examine long-term retention of learning or transfer to clinical practice. Sixth, the module was developed based on clinical cases from one region, and its applicability to other regions requires further investigation.

IV. CONCLUSIONS

This study developed, validated, and evaluated a contextualized clinical reasoning module based on local clinical cases for physiotherapy students using the ADDIE instructional design model. The research demonstrated that the module fulfilled the three essential quality indicators of educational product development: validity, practicality, and effectiveness. Expert validation confirmed the module's high content validity (91.5%) and media validity (89.7%), both categorized as "Very Valid." Practicality assessment from clinical educators and students yielded an overall score of 93.7%, categorized as "Very Practical." The module's effectiveness was demonstrated through significant improvement in students' clinical reasoning abilities, from a pre-test mean of 52.4 to a post-test mean of 81.6 (N-Gain = 0.62, Moderate). The findings confirm that contextualized clinical reasoning materials based on local clinical cases can effectively improve physiotherapy students' clinical reasoning skills by activating prior knowledge, facilitating meaningful learning, increasing motivation, and bridging the gap between theoretical knowledge and clinical practice. The systematic development process employed in this study provides a model for developing contextual learning resources that can be adapted to other health professions education contexts. This study contributes to the field of physiotherapy education by providing a validated, practical, and effective clinical reasoning module that addresses students' learning needs and local clinical contexts. The findings support the integration of contextualized learning approaches in health professions education and demonstrate the value of systematic instructional design for developing educational products. Future research should investigate the long-term effects of the module, explore adaptations to other contexts, and examine the integration of digital technologies for clinical reasoning instruction..

Funding Statement

A Funding Statement is a section in a scientific publication or research report that explains the source of funding used to support the research or project. This statement aims to ensure transparency about who provided the funding and whether there are any potential conflicts of interest related to the funding. Common Elements in a Funding Statement: 1) Funding Source: Identifies the agency, organization, or individual who provided the funding. 2) Grant or Funding Number: Includes the reference number for the funding, if applicable. 3) Scope of Funding: Describes which aspects of the research or project were supported by the

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Examples of a Funding Statement: a) "This research was funded by the Ministry of Education under Grant No. 12345." b) "The authors received funding from the National Science Foundation to support data collection and analysis (Grant No. NSF-98765)." d) "No external funding was received for this study."

Ethical Compliance

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Data Access Statement

A Data Access Statement is a section in a scientific publication or research report that explains how the data used or generated in the study can be accessed by readers or other researchers. This statement aims to promote transparency, support research reproducibility, and comply with open access policies, where applicable.
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Purpose of a Data Access Statement:

- Reproducibility: Enables other researchers to replicate or verify the findings.
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- Compliance: Adheres to the policies of funding agencies or journals that require open access to data.

Conflict of Interest Declaration

The authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

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