ORIGINAL RESEARCH

A concept mapping approach to teaching and learning nursing pathophysiology

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ABSTRACT

Background: A strong grasp of pathophysiological concepts is essential for nursing students as they prepare for clinical work that demands sound reasoning and integration of complex information. This educational innovation introduced concept mapping as a structured learning strategy in a sophomore-level undergraduate pathophysiology course.
Methods: Eighteen students completed two concept maps during the semester and responded to a faculty-developed questionnaire about their experiences. Faculty review of the first and second maps revealed noticeable gains in organization, conceptual clarity, and the accuracy of linkages.
Results: Students reported greater confidence, improved comprehension, and a clearer understanding of relationships among disease processes.
Conclusions: These findings suggest that incorporating concept mapping early in the curriculum supports meaningful learning, strengthens clinical reasoning foundations, and prepares students for the analytical demands of upper-level nursing coursework and clinical practice.

Key Words: Active learning, Concept mapping, Critical thinking

1. BACKGROUND

Concept mapping is a visual and organizational teaching and learning strategy that guides students to connect ideas, analyze information, and relate concepts in a meaningful way. It is particularly beneficial in nursing courses that require the integration of complex information, such as pathophysiology. Pathophysiology is a foundational course in nursing education, yet many students find it challenging to synthesize large amounts of information and recognize how concepts relate across systems. Traditional lecture-heavy approaches may not fully support the analytical skills required for clinical decision-making. Growing evidence emphasizes the need for teaching and learning strategies that foster metacognition, concept integration, and deeper understanding.

A variety of different teaching and learning strategies are used by nursing faculty in pathophysiology instruction. Colsch., Lehman, and Tolcser[1] emphasized the need to investigate alternative pedagogical strategies for teaching pathophysiology, noting that many courses continue to rely on traditional methods despite evidence suggesting their limited effectiveness in promoting student learning. According to Anastasiou et al.,[2] concept mapping is effective in teaching science courses. Concept mapping may support this goal by encouraging cognitive reflection and promoting awareness of one's own thinking and understanding. There is a consensus in the literature that use of concept mapping methodology in nursing education may have positive outcomes in student learning.[3] Further research is needed to

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identify learning strategies that enhance students' metacognitive skills.[4] Concept mapping may teach the learner how to organize information.[5] Nurse educators agree that critical thinking, clinical reasoning, and clinical judgment are expected outcomes of all nursing undergraduates.

Concept mapping, according to Novak and Gowin's work, offers a visual method for helping students organize information and grasp relationships among ideas.[6] Previous studies have shown its value in promoting comprehension, retention, and higher-order thinking. While concept mapping is commonly introduced later in nursing programs, bringing this strategy into earlier coursework may help students build the foundational reasoning skills they need before entering more complex clinical environments. This innovation applied concept mapping in a sophomore pathophysiology course to support that early skill development.

2. METHOD

2.1 Study design

A descriptive study was conducted using a survey that included both closed-ended and open-ended questions. Human subject protection approval was obtained from the University Institutional Review Board.

2.2 Setting

This educational innovation took place in a sophomore-level pathophysiology course at a private Midwestern university that provides a baccalaureate degree in nursing. All 18 enrolled students participated. The classroom setting allowed for didactic instruction.

2.3 Sample

The convenience sample was comprised of second-semester sophomore baccalaureate nursing students (N = 18) who were enrolled in the didactic nursing pathophysiology course. All students received instructions at the beginning of the semester on how to develop a concept map. The reason for selecting second-semester sophomore nursing students was based on literature findings and recommendations. The literature review suggested that the most appropriate time for introducing concept mapping is early in the students' nursing program, before preferred study methods have been established.[7]

2.4 Introducing concept maps

At the start of the semester all students in the classroom setting received instructions on how to develop a concept map. As a learning practice, students developed a concept map in class with faculty guidance prior to the submission of their first graded concept map. Students were required to include essential components within their concept maps including disease-specific pathophysiology, priority patient education related to health promotion and disease prevention, relevant risk factors, clinical manifestations, and appropriate laboratory and diagnostic findings. The grading rubric outlining these criteria was reviewed with students in advance to clarify expectations and support consistent application. Over the course of the semester, every student developed two different concept maps on a topic assigned by the course faculty. Concept mapping was introduced as a required component of the theory course to support students' learning of pathophysiological content. Faculty explained that the use of concept maps could aid in clarifying key concepts, correcting misunderstandings, and reinforcing foundational knowledge to support future coursework and clinical application.

2.5 Scoring concept maps

To support consistent evaluation and reinforce course learning objectives, the faculty revised the existing concept map rubric to better reflect the expectations of the pathophysiology course. Students' two concept maps were reviewed using this updated rubric to observe growth in organization, complexity, and clarity over time. There were two course faculty members who also facilitated the innovation and assigned the final grades for both submissions.

3. INNOVATION OUTCOMES

A total of 18 students completed the survey. After completing both concept map assignments, students completed a 12-item survey that included four closed-ended dichotomous questions, three closed-ended polytomous questions, three Likert-type items, and two open-ended questions. The open-ended items asked students to describe the impact of faculty feedback on their learning and how concept mapping influenced their ability to connect and understand complex pathophysiological concepts. Analysis of the responses revealed that more than half of the students (56%) had no prior experience using concept maps. Among those who had used concept mapping previously, 66% reported that it was equally effective or more effective for learning pathophysiology compared with its use in other subject areas. Additionally, 89% reported feeling somewhat or very confident using concept maps. Sixty-seven percent indicated that concept mapping significantly improved their retention and recall, 89% believed it enhanced their comprehension, 100% stated that faculty feedback after the first concept map strengthened their second submission, and 89% said they would recommend concept mapping to their peers.

The principal investigator, who had extensive experience in developing and scoring concept maps, trained a faculty col-

league and the course instructor in concept map construction and scoring using criteria adapted from Novak and Gowin.[6] The concept mapping rubric was further modified for this study to align with pathophysiology course content. Both researchers independently evaluated students' two concept maps to assess changes in structural complexity and organization over time. Interrater agreement for overall concept map scores was 95%. Final grades for the concept map assignments were determined by the course faculty. The class average score on the first concept map was 88.33%. After individual meetings with faculty that focused on targeted coaching and correction strategies, the class average increased to 95.39%, representing a 7.06% improvement following meaningful faculty intervention in concept mapping. Scoring of the concept maps revealed that the initial submissions contained fewer concepts and demonstrated limited connections between ideas. In contrast, the second set of maps showed an increased number of concepts, more extensive linkages, and greater overall complexity. Comparative analysis between the two sets of concept maps indicated growth over time in the number of valid propositions, hierarchical structures, relational linkages, and incorporation of pathophysiological content.

3.1 Qualitative themes

Responses to the open-ended qualitative questions indicated that students found concept mapping helpful for clarifying and organizing complex pathophysiological concepts. Students also reported that individualized faculty guidance supported their understanding of how to improve their concept mapping skills. The faculty reviewed students' feedback and noted five recurring themes.

3.1.1 *Improved comprehension and organization*

Students shared that concept mapping helped them sort, organize, and connect essential components of a disease process, including signs and symptoms as well as priority education for health promotion and disease prevention. As one student explained, "*Being able to write it all out and connect one idea to another shows the pathophysiology from a bird's-eye view, which helped me learn a great deal.*"

3.1.2 *Enhanced conceptual relationships*

Learners described that creating concept maps encouraged them to think more deeply about how different physiological systems interact. One student noted, "*It challenged me to try to think how a certain disease can impact the whole body or multiple areas of the body.*"

3.1.3 *Improved retention and exam performance*

Several students reported that material reviewed through concept mapping was easier to recall on exams. One commented, "*Topics I did a concept map for were easy for me to remember by test day.*"

3.1.4 *Support for visual learning*

Students frequently mentioned that the visual nature of concept mapping strengthened their understanding. One wrote, "*Writing and drawings helped with connections,*" while another added, "*It made me better remember and apply [content] to my exams.*"

3.1.5 *Faculty feedback as a catalyst for improvement*

Many students emphasized the value of meeting with faculty after completing their first concept map. They noted that individualized guidance helped them refine their second submission and better understand the underlying mechanisms of disease. As one student reflected, "*I met with the teacher and saw ways I could improve... I also got a better understanding of the cause and effect of the disease.*"

4. Discussion

Introducing concept mapping in a sophomore pathophysiology course contributed to stronger comprehension and more deliberate organization of complex content. The iterative process- supported by targeted faculty feedback- encouraged reflection and refinement, both of which are central to meaningful learning. The students reported that the concept mapping improved their ability to articulate disease mechanisms which may contribute to an earlier development of clinical reasoning skills. These results align with current research suggesting that concept mapping enhances comprehension, promotes critical thinking, and supports academic performance.[5, 6, 8, 9]

It is important to note that with the use of Artificial Intelligence (AI) in nursing education, the use of concept mapping may help nursing students to utilize their own creativity in critical thinking and develop analytical skills. Additionally, concept mapping may reduce reliance on AI- generated responses, as creating a visual framework requires deeper cognitive engagement and integration of course concepts than simply producing written answers through automated tools.

4.1 Recommendations

Integrating concept mapping earlier in the curriculum may give students a stronger conceptual foundation to carry into advanced coursework and clinical experiences. Implementing this teaching innovation at the sophomore level appeared to help students organize complex material and recognize relationships among pathophysiological concepts- skills essential for developing clinical reasoning. Students showed growth in their ability to identify relevant information and build connections, suggesting that concept mapping may

support metacognitive development and critical thinking. Because the process requires students to actively synthesize and visually represent relationships among concepts, concept mapping may also promote authentic engagement with course material by emphasizing cognitive integration over passive or externally generated responses. Incorporating concept mapping into other nursing didactic courses may yield similar outcomes. Nurse educators may consider using concept maps both as a teaching strategy and as a means of formative assessment. When faculty provide structured guidance and feedback, students may benefit through improved retention and deeper understanding of course content. To support consistent implementation, faculty development efforts should include training in both facilitating and evaluating concept maps. Future studies should explore broader applications of this approach, including its impact on academic and clinical performance in varied settings and populations.

4.2 Limitations

This innovation was implemented in a single course with a small cohort, which limits generalizability. Survey results were based on student self-report and did not include objective performance metrics such as exam scores. Including additional performance indicators in future research would support a more comprehensive evaluation.

5. Conclusion

Students consistently described concept mapping as a helpful tool for making sense of pathophysiology content, noting that the process allowed them to organize material in ways that supported clearer understanding. The opportunity to meet with faculty after the first map also played an important role, as individualized feedback helped students refine their thinking and strengthen their second submissions. Based on the positive response to this instructional approach, integrating concept mapping earlier in the nursing curriculum appears to be a practical way to encourage deeper thinking and to lay the groundwork for the clinical reasoning skills students will draw upon in more advanced courses.

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Authors contributions

Dr. Samawi and Professor Dusak were responsible for study design and revising. Prof. Dusak was responsible for the data collection. Dr. Samawi and Prof. Dusak were responsible for writing and revising the manuscript. All authors read and approved the final manuscript.

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Data sharing statement

No additional data are available.

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