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APPLICATION OF THE CASE-BASED CONCEPT MAP METHOD TO ENHANCE CRITICAL THINKING AND CLINICAL REASONING SKILLS IN NURSE PROFESSIONAL STUDENTS

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ABSTRACT

Introduction: Critical thinking and clinical reasoning are essential competencies in delivering safe and effective nursing care. However, identifying effective learning strategies to foster these skills remains a challenge. This study aimed to examine the effectiveness of a case-based concept map method in improving critical thinking and clinical reasoning abilities among newly enrolled nurse professional students.
Methods: This quasi-experimental study employed a one-group pre-test–post-test design without a control group. A total of 18 newly admitted nurse professional students were recruited using total sampling. The intervention involved developing concept maps based on clinical cases over one week. Clinical reasoning was assessed using quizzes with clinical vignettes, while critical thinking was measured using the Critical Thinking Disposition Inventory. Paired t-tests were used to evaluate the differences in scores before and after the intervention.
Results: There was a significant improvement in total critical thinking scores following the intervention ($t = 2.25$, $p = 0.038$), particularly in the analytical and systematic thinking domains ($t = 2.30$, $p = 0.023$). Clinical reasoning scores also showed a marked increase post-intervention ($t = 11.93$, $p < 0.001$), with a mean difference of 9.56.
Conclusion: The case-based concept map method is effective in enhancing both clinical reasoning and critical thinking skills among nurse professional students. Integrating this approach into nursing education may better prepare students for clinical practice by promoting deeper understanding and structured decision-making.

Keyword: Clinical Reasoning, Concept Mapping, Critical Thinking, Nursing Education, Nurse Professional Students, Teaching Methods

INTRODUCTION

Regarding with nursing curriculum in Indonesia, students are required to have a strong foundation on the basics of disease pathophysiology to support the preparation of nursing care plans before facing clinical learning (Asosiasi Institusi Pendidikan Ners Indonesia, 2021). The pathophysiology of disease is the foundation for nursing students to devise an appropriate patient nursing care plan. Students are acquired to have a great understanding of disease pathophysiology in order to obtain better comprehension of patients as the parties most affected by the illness process who are deserve receiving appropriate care to enhance the quality of life for those who suffer from the condition (Cheng et al., 2016; de la Croix et al., 2011).

In the nursing care plans formulation based on the disease pathophysiology, clinical reasoning represents the essence of nursing practice.

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Clinical reasoning guides students and nurses in assessing, assimilating, retrieving, and/or eliminating information components that affect patient care so as to create safe and effective care (Carvalho, Oliveira-Kumakura, Morais, 2017). In addition, clinical reasoning is able to trigger the application of other competencies such as clinical judgment, the application of clinical interventions and evaluation of care, as well as the development of professional roles, so as to be able to provide quality, safe and effective patient care (American Association of Colleges of Nursing, 2021).

Beside clinical reasoning, professional nurse students in clinical practice are required to have good critical thinking skills. Critical thinking is crucial for understanding illness pathophysiology since it is fundamental for formulating nursing care plans for patients. When becoming nurses, they will face complex problems and decisions that require critical thinking to identify patient needs and implement the best nursing practices (Kaddoura et al., 2016). Also, American Association of Colleges of Nursing (2021)agreed on the importance of recent nursing graduates thinking critically to solve problems in various clinical settings.

However, several literature report that most of the problems that new nurses experience in providing nursing care was in lack of clinical reasoning competence and critical thinking (Killam, Luhanga, & Bakker., 2011; Andersson et al., 2012). To facilitate this problem, nursing students in clinical education need to be equipped with increased competence through effective learning methods throughout clinical learning in hospitals. This is a challenge for nurse educator in university to create effective learning methods. The learning model recommended and needed by students for these competences is the integration and connection between pathophysiology and nursing care practice. As many as 90% of students agree that learning the pathophysiology of diseases that focuses on student needs will be able to help increase knowledge about the patient's condition (Christensen et al., 2015).

Concept map might be a right solution for this demand. Concepts are encased in circles or boxes in creative graphical learning, and relationships between concepts are shown by a connecting line (Novak & Cañas, 2006). This method has been proven to improve the knowledge and critical thinking skills of nursing students (Daley et al., 2016; Kaddoura et al., 2016). Concept maps have also been shown to improve clinical reasoning in students (Wu et al., 2016). Cased-based concept map is a modification of the concept map, which is a creative learning method that is able to connect clinical theory and practice. Case-based concept map uses cases as triggers for students to compile a concept map consisting of signs and symptoms of diseases experienced by patients as well as physical examinations and supporting examinations carried out and the results.

Some research on concept maps has been conducted on nursing students and remained limited during clinical practice learning. The research was conducted on medical-surgical nursing (Shia-Lian et al., 2011), cardiovascular nursing(Sarhangi et al., 2011),and maternity nursing (Nirmala &; Shakuntala, 2011). Kaddoura et al., (2016) reported the application of concept maps in pathophysiology and pharmacology course provides a significant improvement in the critical thinking of nursing students. However, previous studies did not evaluate the development of concept maps and students' clinical reasoning in clinical learning in hospitals which are also fundamental in nursing care. Therefore, the ability to think critically and clinical reasoning after applying the concept map to students needs to be explored further, especially during clinical practice learning.

METHODS

Study Design

This study was a quasi-experimental study with a pre-posttest without control group. Eighteen new students of the nursing profession, Faculty of Health Sciences were involved as respondents in this study using total sampling techniques. The study was conducted during August to September 2023.

Instruments and Procedure

This intervention was carried out for one week and was in conjunction with preclinical preparation for new professional nurse students. The pretest was conducted on the first day of the intervention after the researcher obtained approval to be a respondent. All respondents filled out informed consent, respondent characteristics questionnaire, critical thinking questionnaire, clinical reasoning quiz through google form. The intervention group was previously given training in making concept maps using CmapTools software (IHMC Cmap Tools, Florida). The concept map prepared by students includes disease

pathophysiology, nursing diagnosis, outcome criteria, and nursing intervention plans according to available cases. The cases used in this study were adjusted to the most frequent cases of disease in four stages, including medical surgical nursing stage, pediatric nursing stage, maternity nursing stage, and emergency and critical nursing stage. Each day, students in groups compile a concept map at one station according to the case. Student groups presented and obtained feedbacks on concept maps prepared from other groups and facilitators. Then, the student group was provided the task of making a concept map for the next case at the same stage. On the next day, students discuss the concept map assignments that have been created, and the facilitator provides feedbacks on those concept map. The intervention process was carried out for five days. The posttest is carried out on the sixth day. All respondents filled out questionnaires and quizzes through google form.

The critical thinking skills questionnaire used in this study was the Chinese Version of Critical Thinking Disposition Inventory(Huang & Yeh, 2017). This instrument consists of 20 questions with a likert scale of 1-6 (1 = never to 6 = always). This instrument acquires four domains, including analytical and systematic ability (9 questions), open-mindedness (4 questions), curiosity (3 questions), and reflective thinking (4 questions). The score range of this instrument is 20 -120, where the higher the score obtained, the better the critical thinking ability possessed. This instrument has been culturally adapted and translated into Indonesian by researchers. This instrument has also been tested for the validity of Pearson correlation content with a score range of 0.426 – 0.762 and the reliability test value using Cronbach's Alpha is 0.904, so this instrument is valid and reliable.

To evaluate clinical reasoning, this researcher compiled a quiz of 30 questions in the form of a vignette. The quiz questions are finished within 30 minutes with the topic of questions according to the disease which will be compiled with a concept map. The vignette questions were compiled in the form of multiple-choice questions by the research team focusing on clinical manifestations, nursing diagnoses, outcome criteria, and nursing interventions. The score range of this quiz is 0 – 60. The higher the score obtained, the higher the clinical reasoning ability possessed by respondents.

This research has received ethical clearance number 1165/EC/KEPK/VI/2023 issued by the health research ethics commission of the Faculty of Health Sciences, Jenderal Soedirman University. The researcher explained the research procedure, and then the researcher shared a google form link for informed consent, filling out questionnaires on respondent characteristics, and filling out questionnaires on critical thinking skills, both during the pretest and post-test. After data collection, all respondents were given stationary sets.

Data Analysis

The analysis in this study used SPSS version 23.0, IBM corp., New York. Frequency, percentage, mean and standard deviation are used to analyze the characteristic data of respondents. Paired t-tests were used to analyse differences in data before and after treatment in the intervention group. The significance level considered in this study was $p < 0.05$.

Ethical Clearance

This research has received ethical clearance number 1165/EC/KEPK/VI/2023 issued by the health research ethics commission of the Faculty of Health Sciences, Jenderal Soedirman University. Before collecting data, we requested that respondents complete an informed consent form at the start of the survey. This form included details about our research, such as the study's purpose, objectives, participant information, anonymity, and their right to participate voluntarily. We emphasized that participation was entirely voluntary and that they could withdraw at any time.

RESULTS

This study involved 18 new students of the profession nurse program. Based on the characteristics of respondents, the average age of respondents is 22 years 4 months 24 days. The majority of respondents are Women (94.4%), have a Bachelor of Nursing GPA >of 3.51 (66.67%), come from outside Banyumas (66.67%), have organizational experience (83.33%), and have no experience participating in student competitions (72.22%) (Table 1.)

This study measured differences in clinical reasoning scores and critical thinking skills in all respondents. This study reported significant

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Tabel 1 Demographic characteristics of respondents (n= 18)

Characteristics	Mean	SD	n (%)
Age	22.39	0.78	
Gender			
Male			1 (5.56)
Female			17 (94.44)
Grade Point Average (GPA)			
3.51- 4.00			12 (66.67)
≤ 3.50			6 (33.33)
Origin			
Banyumas			4 (22.22)
Outside Banyumas			12 (66.67)
Outside Java Island			2 (11.11)
Organizational experience			
Yes			15 (83.33)
No			3 (16.67)
Competition Experience			
Yes			5 (27.78)
No			13 (72.22)

differences in clinical reasoning scores, where clinical reasoning scores after the intervention were higher than pre-intervention scores ($t = 11.93$, $p = 0.000$) with the difference in average scores was 9.56. The study also reported a significant increase in scores on total critical thinking skills scores after the intervention ($t = 2.25$, $p = 0.038$). However, when looking at each domain on critical thinking skills, significant score improvements after intervention occurred only in the domains of analytical and systematic skills ($t = 2.30$, $p = 0.023$). The study was unsuccessful in finding significant differences between pre- and post-intervention scores in the domains of open-mindedness, reflective thinking, and curiosity ($p > 0.05$) (Table 2).

DISCUSSION

This research involved new students of the professional nurse program who would like to conduct clinical practice learning in hospitals and no one withdrew from the research. This research was conducted to evaluate differences in clinical reasoning skills and critical thinking skills after the application of the Case-based Concept map on disease pathophysiology and nursing care planning process, and then to provide preclinical provisions for new professional nurse students in nursing care plan formulation.

This research shows a significant increase in clinical reasoning scores after implementing the concept map. This research was in line with previous studies (Alfayoumi, 2019; Daley et al., 2016; Montpetit-Tourangeau et al., 2017; Wu et al., 2016)displayed students gained control over the components of their clinical reasoning and improvement in their independence in clinical reasoning and clinical judgment. In addition, Paucard-Dupont (2014) reported the benefits of concept map in clinical reasoning, especially in diagnostic assessment. Concept-based learning exercises also assist students to improve their intuitive reasoning skills and metacognitive skills development. Before drawing a conclusion, concept map might compel students to investigate client data using multidimensional and integrative procedures as well as to clarify the interconnected chains of cause-and-effect linkages (Chen et al., 2011). Concept map is able to increase conceptual understanding that affect clinical reasoning by improving capacity to apply theoretical understanding to the clinical setting, then the students obtained meaningful learning (McMillan, 2010).

In this study, students were also offered other cases to be solved by students to create the concept map. After that, students were provided feedback and input related to the concept map that has been prepared. The independence of students in compiling this concept map may also contribute to improving clinical reasoning. The independence of students in identifying clinical manifestations and significant signs in cases is very similar to the process of "noticing" in clinical reasoning (Watson & Rebair, 2014;Alfayoumi, 2019). The "Noticing" process is a precursor of clinical reasoning

Table 2. Differences in Clinical Reasoning and Critical Thinking Scores among the Intervention Groups (n = 18)

Variable	Before Intervention		After Intervention		Mean difference	t value	p*
	mean	SD	Mean	SD			
Clinical Reasoning Score	28.00	6.14	37.56	8.07	9.56	11.93	0.000
CT Skills Systematic and Analytical Thinking	42.44	4.84	44.50	3.26	2.06	2.50	0.023
Open-mindedness	19.89	2.30	20.83	1.85	0.94	1.73	0.101
Curiosity	12.83	2.38	13.33	2.25	0.50	1.64	0.120
Reflective Thinking	20.11	2.05	20.28	1.96	0.17	0.34	0.74
CT Total Score	95.28	10.14	99.06	8.11	3.78	2.25	0.038

CT = Critical Thinking; SD= standard deviation, p* = Paired t-test

because in this process students are able to process personal knowledge, knowledge in the past, formal learning processes, and the latest knowledge related to patient responses (Watson & Rebair, 2014; Alfayoumi, 2019).

Concept map demands a topic, context, or subject that the students should interact with collaboratively in order to facilitate clinical reasoning (Chen et al., 2011). This study equipped with cases to support students in the concept map creation of disease pathophysiology and nursing processes (assessment, nursing diagnosis, and nursing intervention). In addition, this study not only used a concept map, but also it used multiple-choice questions accompanied by a vignette to measure clinical reasoning. The use of vignette in improving clinical reasoning has been shown to be an effective learning and assessment method in clinical reasoning in health care professionals, although this method is less disseminated. Vignette is a short and concise description of a real case that is attractive and sensational, and can detect a person's behaviour, attitude, and knowledge(Carvalho et al., 2017). Vignette is able to evaluate perceptions, opinions and knowledge of students related to the phenomenon or case studied (Gould, 1996). Vignette in this study was applied based on the patient real cases (general conditions, complaints, physical examination results, and supporting examination results) to trigger students to determine the correct disease process, nursing assessment, diagnosis, nursing intervention should be carried out.

This study also shows the effectiveness of concept maps in improving critical thinking in professional nurse students. This research is in line with Eisenmann (2021) and Yue et al., (2017). Concept map assist students to learn meaningfully by encouraging them to process information deeply for true understanding rather than by rote memorization (August-Brady, 2005). By compiling a concept map, students are better able to focus to patients' condition, make connections, organize, increase creativity, evaluate and consider all relevant information in the case. All of these processes are able to strengthen critical thinking skills in students (Mueller et al., 2002). Experiences and feedbacks from students were positive related to concept maps, especially in the concentration increasing to prioritize nursing care, to simplify and to assimilate complex information into a care plan so as improving critical thinking skills and clinical judgment (Eisenmann, 2021). In addition, concept maps are able to foster critical thinking when pieces of information are evaluated and weighed to determine their relevance to a particular situation. This ability is crucial for students in clinical practice. The concept map supports students to interpret the available information by making the information interconnected, so as to form a holistic and complete picture of relationships in applying the process and diagnosis of nursing relationships through visual illustrations (Yue et al., 2017).

Based on critical thinking's domain, this study found a significant improvement in the ability to think analytically and systematically. This research is in line with Kostovich et al. (2007) and Yue et al. (2017). During the preparation of the concept map, students are asked to construct concepts that have been available both inductively and deductively including organizing and correlating data and information, so that analytical skills can increase (Kostovich et al., 2007). The research in metanalysis reported significant increasing at systematicity and analysis ability of

students (Yue et al., 2017). Areesophonpichet (2013) also reported increased ability analytical thinking after use concept map using Cmap Tools. A concept map provides opportunities for students to take meaningful learning that can increase learning potential and develop analytical thinking skills. The ability to think analytically is crucial for students in this millennial era. This ability helps students to be in High Order Thinking Skills (HOTS) in order to develop themselves, build innovation and become effective leaders in society (Areesophonpichet, 2013).

In addition, in the preparation of this concept map, students integrate all processes in thinking, analyse documents systematically, sequence knowledge, and build knowledge structures from the most general concepts to more specific concepts, and reflect on the understanding obtained clearly and concretely which ultimately leads to a comprehensive and systematic understanding. Comprehensive thinking leads students to a higher critical thinking process (Areesophonpichet, 2013; Yue et al., 2017). To map the connectedness of all stages in the nursing process, students must firstly identify these relationships in their thinking, then determine how various aspects of the disease process, associated signs and symptoms, related diagnoses and treatments affect each other resulting in an overarching of concepts (Yue et al., 2017)

This critical thinking ability is supported by the concept map establishment procedure in this study which includes a complete and systematic creation. Students analyse the pathophysiology of the disease based on the clinical manifestations contained in the case. After that, students compile nursing diagnoses, outcome criteria, and nursing interventions. With this process, students are able to analyse and compile pathophysiology and nursing care planning (assessment, nursing diagnoses, outcome criteria, and nursing interventions) that are systematic and comprehensive. In addition, facilitator lecturers provide feedbacks as soon as possible after students have finished compiling the concept map, so that students might better understand the pathophysiological process and the appropriate nursing care planning process according to the case. Therefore, a series of processes are very supportive in improving critical thinking skills.

Concept maps can improve critical reasoning and critical thinking simultaneously. This occurs because critical thinking and critical reasoning are interrelated and constitute a series of thought processes. In the thinking process, critical thinking skills are able to build clinical reasoning skills. Both abilities ultimately subsidize the ability in clinical decisions (Aparecida et al., 2010.; Cerullo & Cruz, 2010).

The preparation of the concept map in this study used Cmap Tools software (Cañas et al., 2004). This software combines a concept map with technology and the internet so that it will make it easier for users especially for generation Z students. This computer-based software also has additional features such as adding, deleting, rewriting text, files, images, and source links to make further explanations in the concept map (Cañas & Novak, 2014). This software supports students to create propositions with specific connecting words so that they more effectively describe the relationship between concepts. In addition, concept maps use visual codes in structuring knowledge gained from cases, attractive graphical appearance on a computer screen improves students' understanding and retention of text outlines (Dias, 2011). Therefore, the use of cmaps tool software is very helpful in improving students' understanding and critical thinking skills.

The use of Cmap Tools software is involved in improving critical thinking skills and clinical reasoning. Some students in this study revealed more practical and more understanding related to disease pathophysiology, establishing nursing diagnoses, and nursing care plans. Several studies have reported that the Cmap Tools is able to facilitate students to more easily improve meaningful learning in the fields of nursing education (Ghojazadeh et al., 2014), medicine (Daley et al., 2016; Sannathimmappa, 2022) and other scientific fields (Suero López et al., 2020). Meaningful learning is adapted from Ausubel's theory (1963) and is defined as the assimilation of relationships between old and new information created in cognitive structures in a rational and authentic way, as well as the process of assigning meaning to new information by considering the personal element in cognitive structures (Correia &; Cicuto, 2014; De Sousa, Formiga, Oliveira, Costa, & Soares, 2015).

The study had several limitations. This study involved only a limited number of samples. This limited number of samples is due to the fact that most of the undergraduate nursing students who continue to the nursing profession have registered in the previous period. This number is four times more than new professional nurse students. In

addition to the limited number of samples, this study also used quizzes to measure clinical reasoning ability. This measurement is still general, so it is only able to describe in general clinical reasoning ability. Therefore, further research is recommended to use research instruments that specifically measure clinical reasoning.

CONCLUSIONS

Case-based concept map is an effective learning method in improving clinical reasoning and critical thinking skills in new students. Case-based concept maps can improve students' analytical and systematic skills. Case-based concept map are able to be used as a learning method to prepare professional students during the transition from undergraduate academic learning to clinical learning. To further support more evidence related to the application of concept maps in nursing education, there needs to be further research of higher quality with universal instruments.

DECLARATION OF CONFLICTING INTEREST

none

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AUTHORS' CONTRIBUTIONS

All authors contributed equally to the conception, design, data collection, analysis, and writing of this manuscript.

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