Facilitating nursing students' critical thinking and problem-solving competence in a computer supported collaborative learning environment

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Abstract: In the era of globalization, teachers primarily assist students in applying realistic learning environments, helping them integrate the knowledge acquired from textbooks with clinical practical issues and develop problem-solving skills. The advancement of mobile technology allows students to access learning resources and receive accurate guidance in a virtual environment, promoting safe and effective learning. This research proposes a computer-supported collaborative learning environment to support the learning of obstetrics and gynecology four-stage palpation professional courses. A quasi-experimental design is conducted to validate the impact of this method on students' learning achievements, engagement, and satisfaction. The experimental results demonstrate that the proposed approach enhances students' learning achievement, critical thinking, and problem-solving competence. Moreover, students engaged in scenario-based learning show more proactive learning behavior compared to the control group. Based on these findings, specific recommendations for developing effective learning strategies and incorporating computer-supported collaborative learning environments in medical and healthcare educational materials are suggested.

Keywords: Computer-supported collaborative learning environment, computer-supported, collaborative, learning environment.

1. Introduction

In the era of globalization, the purpose and educational mission of nursing curriculum training is to cultivate nursing students with core competencies in professionalism, knowledge, skills, and information abilities. Adapting to the challenges of teaching during the pandemic and accurately addressing students' learning needs in real time has become a pressing issue for all educators worldwide. To mitigate the impact of the pandemic on education, many fields in education have turned to managing digital interactive learning platforms as an alternative solution to meet learners' needs. Teachers have been forced to transform their teaching approaches in response to the pandemic, and scholars Nuangchalerm, Prachagool, and Dostál (2020) suggested incorporating more interactive educational courses through digital platforms.

Creating a digital learning environment offers several advantages, including meeting the learning needs of students regardless of time and geographical limitations, addressing interdisciplinary learning needs, and fostering opportunities for interactive learning and a sense of achievement. Modern digitized educational materials should be diverse, incorporating technology options, interactivity, and high-quality content to demonstrate the specific value of specialized fields in digital textbooks. Cultivating nursing students through digital learning materials allows for learning in a safe environment, enhancing students'

professionalism, knowledge, skills, and information literacy, ultimately improving healthcare quality, which is the current educational goal. Moreover, guiding students to prioritize patient and learner safety and facilitating repetitive learning in a secure environment can enhance learning outcomes and make digital platform materials more appealing and appreciated.

Given the demand for digital education and the pandemic's impact, it has been observed that the main issue in nursing teaching lies in the lack of effective interactive teaching materials that allow students to learn anywhere and anytime (Geng, Huang, & Huang, 2021). Analyzing relevant empirical research literature both domestically and internationally, it is worth noting that apart from imparting professional knowledge, meeting learners' needs and using digital learning platforms to teach students to practice and master nursing basic skills through interactive learning strategies can foster students' engagement and improve learning outcomes, making it a crucial topic for teachers to continue researching and addressing (Supriatin, Rithpho, Asiah, & Hikhmat, 2022).

Nevertheless, the amalgamation of interactive learning strategies into education for obstetric assisting nursing skills, commonly referred to as the four-stage palpation education, remains an area that has garnered only minimal research attention. Thus, this study proposes a learning activity that applies the digital learning platform in combination with the computer-supported collaborative learning environment learning model to create an interactive learning environment, incorporating the situational learning theory. Additionally, Salminen et al. (2021) mentioned that the educational goals of the nursing curriculum include cultivating students' professional knowledge, skills, and attitudes. To evaluate the effectiveness of the proposed method, the computer-supported collaborative learning environment learning system is applied to the obstetrics four-stage palpation education course, and its impact on students' learning achievements, critical thinking, and problem-solving competence is examined. Therefore, the following research questions are proposed to verify and assess the effectiveness of the method:

(1) Does the computer-supported collaborative learning environment learning method significantly improve students' learning achievement compared to traditional educational methods?
(2) Does the computer-supported collaborative learning environment learning method enhance students' critical thinking more effectively than traditional teaching methods?
(3) Does the computer-supported collaborative learning environment learning method improve students' problem-solving competence more effectively than traditional teaching methods?

2. Method

2.1 Experimental design

The purpose of this course is to train students in the basic skills of learning obstetric professional knowledge through computer-supported collaborative learning environment and scenario-based learning for the four-stage palpation. To validate the effectiveness of this method, a quasi-experimental design is employed to assess students' learning outcomes, critical thinking, and problem-solving abilities through questionnaires.

2.2 Participants

The participants of this experiment were second-year students from a specialized nursing school. Two classes, each consisting of 20 students, were used as the experimental group and the control group, respectively. The same teacher, who had 20 years of experience in obstetric clinical practice and teaching, conducted the instruction. To prevent potential mutual influence between students from different classes, the two classes received the instruction at different time points. During the learning process, the teacher provided obstetric learning tasks for the four-stage palpation, supplemented with teaching materials and assessment items. Additionally, the teacher addressed any relevant questions about the learning tasks raised by the students during the instructional sessions.

2.3 Experimental procedure

The experimental design of this study lasted for five weeks. In the first week, the students received instructions on basic knowledge related to maternal and infant care. Subsequently, they underwent pre-tests and questionnaire surveys. In the second week, the experimental group received guidance on the four-stage palpation, utilizing computer-supported collaborative learning environment to facilitate scenario-based learning and understanding the objectives of the learning activities. On the other hand, the control group used traditional video learning for the relevant knowledge on the four-stage palpation. All participating students completed post-tests and questionnaires on their learning outcomes, critical thinking, and problem-solving abilities in the fifth week to validate their learning effectiveness, as shown in Figure 1.

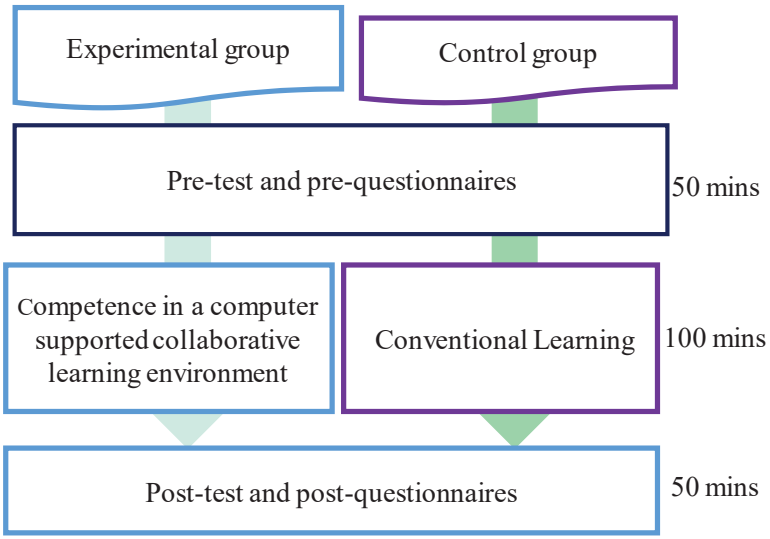

Figure 1. Experimental procedure.

2.4 Measuring tools

The measurement tools used in this study included learning achievement tests and questionnaires to assess the learning status. The test questionnaires were designed by the obstetric course teacher and their validity was evaluated by two obstetric education experts. These tests aimed to understand the learning outcomes of the two groups of students. The pre-test was conducted to assess students' prior knowledge of the four-stage palpation in obstetrics before the learning activities. It consisted of 20 multiple-choice questions, with a maximum score of 100. The post-test included obstetric assessment skill tests derived from obstetric assessment performance proposed by two experienced teachers. It comprised 10 dimensions.

The Critical Thinking Scale was developed by Lai and Hwang (2014) and consisted of 6 items, using a Likert 5-point rating scale, with a Cronbach's alpha value of 0.80. One of the items was "I like to ask some questions that others do not think of."

The Problem-Solving Competence Scale, also proposed by Lai and Hwang (2014), consisted of 6 items, using a Likert 5-point rating scale, with a Cronbach's alpha value of 0.81. One of the items was "I believe that I have the ability to solve the problems I encounter," and "I believe that I can solve problems on my own."

3. Results

3.1. *Learning achievement*

The ACONVA analysis was used to compare the learning achievements of the experimental group and the control group, and to test the homogeneity assumption of ACONVA. The results showed that the pre-test $F = 5.02$ ($p > 0.05$) and the post-test $F = 0.21$ ($p > 0.05$), indicating

that ACONVA could be used to compare the learning achievements of the two groups before and after the intervention. The ACONVA analysis results also indicated that there was no significant difference in prior knowledge between the two groups, with $F = 0.48$ ($p = 0.52$).

Furthermore, there was a significant difference in the post-test scores between the two groups ($F = 3.57$, $p < 0.05$). The experimental group had an average score of 86.08 (standard error = 0.95), which was higher than the control group's average score of 80.80 (standard error = 0.95). This indicates that the learning method based on computer supported collaborative learning environment in the experimental group significantly improved students' learning achievement compared to the traditional learning method in the control group.

3.2. Critical thinking tendency

To validate the rationality of ANCOVA analysis between the experimental and control groups' critical thinking tendency, the homogeneity of regression coefficients within each group was examined. The result showed that $F = 0.58$ did not violate the homogeneity assumption ($p > 0.05$). Subsequently, ANCOVA was used to analyze the variables, with the post-test questionnaire scores as the dependent variable and the pre-test questionnaire scores as the covariate. Table 2 presents the ANCOVA results for the critical thinking tendency after the questionnaire survey in both groups.

After controlling for the influence of pre-test scores, there was a significant difference in the post-test scores between the two groups ($F = 3.35$, $p < 0.05$). The adjusted mean for the experimental group was 4.69 (standard error = 0.69), which was higher than the control group's mean of 4.66 (standard error = 0.69). These results indicate that students in the experimental group, who adopted the learning method based on computer supported collaborative learning environment, demonstrated a significant improvement in critical thinking tendency.

3.3. Problem-solving tendency

This study utilized a pre-questionnaire to measure whether the experimental and control groups had similar experiences in the classroom. The mean and standard deviation of the pre-test scores for the experimental group were 4.64 and 0.32, respectively, while the mean and standard deviation of the pre-test scores for the control group were 4.63 and 0.37, respectively. The results of the t-test indicated that there was no significant difference between the two groups in the pre-test scores ($t = 1.03$, $p > 0.05$). Therefore, it can be inferred that both groups had similar learning experiences.

After the learning activities concluded, a problem-solving competence questionnaire survey was conducted to measure the learning satisfaction of both groups. As shown in Table 3, the t-test results revealed that the problem-solving competence scores in the experimental group were higher than those in the control group ($t = 2.78$, $p < 0.05$). Based on these results, it can be concluded that students using the learning method based on computer supported collaborative learning environment demonstrated an effective improvement in their problem-solving tendency.

4. Discussion and conclusion

Within the context of this investigation, with the aim of elevating the proficiency of nursing students in the domain of obstetric nursing skills, we introduced an innovative computer-supported collaborative learning system. This pioneering approach was subsequently subjected to a quasi-experimental study conducted within a specialized obstetric course, serving as the foundation for an in-depth assessment of the efficacy of this novel pedagogical technique. The empirical outcomes of this study unequivocally demonstrated that the utilization of the computer-supported collaborative context learning method resulted in a noteworthy enhancement of students' learning accomplishments, heightened critical thinking

capacities, and an augmented inclination toward effective problem-solving, all of which stood in marked contrast to the outcomes associated with traditional learning methodologies.

We integrated the clinical learning environment of prenatal care into the computer-supported collaborative learning environment system and designed obstetric context learning, highlighting the key learning activities in the clinical setting. Students in the experimental group were able to practice the learning tasks repeatedly and build essential knowledge and operational skills through the computer-supported collaborative learning environment-based context learning system. As a result, the students in the experimental group demonstrated more concrete nursing concepts and better interaction with the teacher during the learning process. In contrast, students in the control group, who had not experienced obstetric context learning, found the context and operational skills more abstract in the classroom. Therefore, the results indicated that the students who used the computer-supported collaborative learning environment-based context learning method achieved better learning outcomes, learning participation, and overall satisfaction with the teaching.

Based on the findings, we suggest that future research on computer-supported collaborative learning environment-based context learning should incorporate not only context-specific questions, tests, or concepts but also interactive and engaging guidance. These questions should include essential concepts and learning units related to the course. Additionally, educators can present core questions related to the learning units for further exploration and discussion in the classroom.

Nevertheless, this study has some limitations. Firstly, it employed the computer-supported collaborative learning environment-based context learning technology, and its generalizability may be affected by the actual cases in the specialized field. Secondly, the experiment was conducted in a specific school and for a particular course, which may limit the generalizability of the research results to students with different professional backgrounds or in other medical fields. Thirdly, the sample size of this study was limited, and the statistical differences in the results may not be sufficient for inference. Future research could consider implementing additional learning behavior assessments or learning strategies in the computer-supported collaborative learning environment context learning and conducting interviews to understand the impact on student's performance and learning experiences.

In conclusion, the primary contribution of this study is the proposal of the computer-supported collaborative learning environment-based context learning method and its integration with the context-promoting mechanism in the computer-supported collaborative learning environment learning system, which innovatively transforms traditional obstetric teaching design. The experimental results further demonstrate that the learning strategy of guiding students to face contextual problems and seek answers according to the context is applicable to other medical and health education fields, educators, or researchers to promote teaching objectives in various clinical contexts and develop innovative digital teaching materials tailored to different professional medical and health education contexts.

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