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Innovative approaches in nursing education: Enhancing learning efficiency and critical thinking based on cooperative and project-based learning

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ABSTRACT

The study investigates the impact of a blended teaching approach combining Cooperative and Project-Based Learning (CPBL) on the critical thinking abilities and learning efficiency of vocational nursing students, aiming to determine its effectiveness compared to traditional teaching methods. The study employed an experimental design, involving vocational nursing students divided into experimental and control groups. The experimental group participated in 20 instructional sessions using the CPBL approach, while the control group received traditional teaching. Learning outcomes were assessed through pre-test and post-test evaluations using the Learning Efficiency Assessment Scale (LEAS) and the Critical Thinking Ability Assessment Scale (CTAAS). The experimental group demonstrated significant improvements in learning efficiency ($M=76.04$, $t=-10$, $p<0.05$) and critical thinking skills ($M=137.6$, $t=-4.33$, $p<0.05$), while the control group showed only slight increases in learning efficiency ($M=75.52$, $t=-2.316$, $p<0.05$) and critical thinking ($M=136.48$, $t=-2.113$, $p<0.05$). These results affirm the superior effectiveness of the CPBL approach in fostering critical cognitive and psychomotor skills. This pedagogical strategy offers a robust framework for curriculum designers aiming to improve student performance and engagement in professional education settings.

Contribution/ Originality: This study pioneers the integration of Project-Based Learning and Cooperative Learning (CPBL) in vocational nursing education, focusing on its simultaneous impact on critical thinking and learning efficiency. Unlike previous research, it offers a structured evaluation of CPBL's role in enhancing essential nursing competencies through a tailored experimental design.

1. INTRODUCTION

Professional nursing education is the cornerstone of nursing students' career development that incorporates essential physical, psychological, and intellectual attributes that are key to improving nursing students' clinical practice and overall quality of life (Aryuwat, Holmgren, Asp, Radabutr, & Lövenmark, 2024). It encompasses the comprehensive array of professional knowledge, skills, abilities, and attitudes required for nursing graduates. In addition to preparing students for their professional careers, nursing education meets the pedagogical requirements of the nursing field. In China, nursing faculty are primarily recruited from medical colleges and vocational institutes, with many nursing programs also recruiting faculty from pedagogical colleges, a practice uncommon in other academic fields (Hou et al., 2014). Many Chinese hospitals play significant roles in the training process, overseeing nursing students' internships and mentoring nurses pursuing advanced education (Zhang et al., 2022). Larger hospitals frequently participate in teaching clinical nursing theory and training graduate students,

identifying teaching as one of their three core responsibilities, alongside medical care and research (Clarke, van der Riet, & Bowen, 2020).

However, many educators in Chinese nursing schools and hospitals have limited formal and systematic training in teaching methodologies. While most institutions offer short-term training for new staff, this training is often procedural, focusing on certification rather than genuinely improving teaching abilities, resulting in criticisms of uniformity and a lack of innovation in Chinese nursing education (Zhou, 2020). To improve the quality of education, there is an urgent need to enhance teacher training in instructional methods and promote diverse pedagogical approaches. Fang, Zhang, Mei, Chai, and Fan (2018) argue that vocational nursing students often struggle due to weaker cultural and academic foundations, which negatively impact their learning, cognitive processes, and psychological resilience. Many students harbor misconceptions about nursing, perceiving it as a low-status, burdensome profession, thereby reducing their enthusiasm and sense of responsibility (Kalimaposo, 2014). Addressing these issues requires a focus on two critical areas: selecting relevant teaching content and implementing effective teaching methods. Educators can learn by experience from the nursing education in developed nations for emulating and upgrading the methodology of teaching continuously and raising the overall quality of nursing education.

Collaborative learning (CL) plays a central role in teaching methodologies due to its diverse benefits. CL fosters a sense of collegiality among nursing students, in addition to facilitating knowledge acquisition (D'Souza, Venkatesaperumal, Radhakrishnan, & Balachandran, 2013). Razmerita, Kirchner, and Nabeth (2014) found in their experiment with groups that the exchange of ideas and opinions within groups enhanced individual knowledge and fostered a sense of collective identity. The same is true in nursing education as it mirrors the teamwork that is essential in medical practice. Teamwork can also extend beyond the classroom to create a professional community rooted in mutual support and shared experience, one of the foundations needed for professional development (Smith, Sheppard, Johnson, & Johnson, 2005). It also models teamwork, a critical skill for nursing students who must work with other healthcare professionals in patient care. CL recognises the challenges involved in teamwork and develops the essential communication, co-ordination and problem-solving skills needed to manage complex interdisciplinary collaborations.

The incorporation of project-based learning (PBL) in the educational curriculum for nursing is an essential step towards adopting a more practical approach to learning. Meng, Dong, Roehrs, and Luan (2023) noted that this approach compensates for the drawbacks of the conventional theory-dominated classroom by allowing students to experience learning in a different setting. As observed by Wu, Huang, Su, Chang, and Lu (2018) the application of PBL in education resolve the suspensions created by knowing the principles of nursing theoretically but being unable to implement due to lack of practice. According to DeFillippi and Milter (2009) project-based work enhances professional skills because students do not only learn theory but practice it in simulated environments. As it pertains to Helle, Tynjälä, and Olkinuora (2006) PBL not only gives emphasis on theory but practical aspects of the education as well. The role of this approach is to develop the ability for problem solving, decision making, and clinical judgment according to the specifics of the actual healthcare situation. In this way, PBL is revolutionary in its approach to health education where nursing students are molded with theoretical knowledge and skills that are practically relevant in clinical settings.

With the growing importance of the effectiveness of learning, the challenge of improving the system of training vocational nurse educators is more pressing. This approach recognizes that every student comes from a different background and has a different way of learning. The improvement of teaching techniques is imperative. Learning effectiveness can be increased by innovating and adjusting teaching techniques to suit the tastes of vocational students, thus increasing participation and understanding of the subjects taught. This is especially important in primary health care programs where there are scarce teaching resources, and so learning wise it is a must (Leslie, 2020). Critical thinking is one of the core competencies introduced in the nursing education model to prepare

reflective nursing practitioners. Nutritional and dietary sciences students' analytical and reasoning abilities are emphasized early in their education (Paul & Heaslip, 1995). This is in line with the basic nursing curriculum in which critical thinking teaching is integrated to allow the students' practice-oriented and clinically-oriented thinking development. Consequently, all students who complete their training should possess enough cognitive capabilities to carry out clinical reasoning without compromising on quality during their practice.

To improve the quality of nursing education, educators must prioritize innovation and refinement of teaching methods (Rao, 2019). Introducing diverse instructional techniques, such as CL or PBL, along with a focus on learning efficiency and critical thinking, provides students with a comprehensive learning experience. This approach not only supports academic achievement but also establishes a solid foundation for students' future professional development. In this context, teacher training in modern instructional methods is essential, as only well-trained educators can guide students effectively and foster continuous improvement in nursing education. Thus, enhancing teacher training and promoting diverse teaching approaches have become urgent priorities in the field.

2. LITERATURE REVIEW

2.1. Importance of Learning Efficiency and Critical Thinking Ability

From an economic perspective, efficiency is defined as the ratio of inputs to outputs (Johnes, 2004). In education, this concept includes both quantifiable outputs and intangible benefits, such as cognitive development and interpersonal skills. When applied to learning efficiency, both inputs and outputs must be carefully considered. From the input perspective, time is a crucial factor, but it is essential to account for teacher engagement, the choice of teaching methods, classroom management, and student participation (Hoy & Weinstein, 2006). Effective learning only occurs when both teachers and students are actively engaged in the process (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013). From the output perspective, a holistic approach is necessary, emphasizing not only students' knowledge and skills acquisition but also their emotional, cognitive, and interpersonal development (Lozano, Merrill, Sammalisto, Ceulemans, & Lozano, 2017). It is crucial to assess whether students can apply their acquired knowledge in real-world situations, rather than simply measuring how much knowledge they gain. In this context, attention to individual learning needs is paramount, as effective teaching must cater to every student to ensure equitable development across the classroom. Critical thinking, on the other hand, is a key competence that plays an integral role in both personal and academic growth. Defined by Ennis (1987) as "rational reflective thinking aimed at deciding what to believe or do," critical thinking enables students to evaluate information impartially and make informed decisions. In a world inundated with information, the ability to discern truth from falsehood is invaluable. Critical thinking encourages students to question existing knowledge, challenge assumptions, and undertake thorough analysis, fostering intellectual independence (Pithers & Soden, 2000). In this process, the teacher's role is that of a facilitator who supports students in thinking critically by asking probing questions and guiding discussions through active engagement. As Goe, Bell, and Little (2008) highlight, the effectiveness of classroom instruction and the cultivation of critical thinking are interdependent; effective instruction fosters the development of higher-order thinking skills. Moreover, countries like the United States, the United Kingdom, and China have acknowledged the significance of critical thinking in education, incorporating it into their curricula to cultivate innovative talents (Ryan, 2010). While learning efficiency optimizes instructional time usage, critical thinking enhances the quality of learning by developing students' ability to think independently, solve problems, and make reasoned decisions—skills essential for navigating an increasingly complex world.

2.2. What is Cooperative Learning?

Aristotle proposed that establishing a collaborative and relaxed educational environment can inspire a desire for knowledge and promote the full realization of individual potential. As early as the 1st century, the Roman

Quintilian school acknowledged the advantages of mutual teaching and learning among students, believing that collective learning could stimulate mutual encouragement and enhance learning effectiveness. During the Renaissance, Czech educator Comenius emphasized that students' sources of knowledge are not limited to teachers but can also be derived from their peers. In the Enlightenment era, figures such as Rousseau in France, Locke in England, and Jefferson and Benjamin Franklin in the United States highlighted the significance of collaboration in education. In the 18th century, Joseph Lancaster and Andrew Bell promoted CL groups in the United Kingdom, which spread to the United States in the 19th century, where educators like Parker and Dewey made significant contributions. Parker advocated for schools as spaces to actualize democratic ideals through collective learning, while Dewey viewed CL as integral to his "learning by doing" philosophy (Casey & Quennerstedt, 2020).

In the 1960s and 1970s, CL experienced a revival in the United States, spurred by the demand to enhance educational quality following the Soviet Union's launch of an artificial satellite. This resurgence challenged traditional teaching methods and grading systems, leading to the global spread of CL in countries such as Israel, New Zealand, Sweden, Japan, and Canada. Butera and Buchs (2019) highlighted the main theories supporting CL, including Social Interdependence Theory, Needs Satisfaction Theory, and Constructivist Learning Theory. These theories emphasize group cooperation, cognitive development, and motivation, providing a solid theoretical foundation for CL. Over time, multiple approaches developed, and Johnson and Johnson (2008) categorized them into formal CL, informal CL, and collaborative base groups. Although research in China started relatively late, distinctive models such as the Stratified CL Model and the Autonomous Collaborative Inquiry Learning Model have been developed, contributing to educational reform and progress.

2.3. What is Project-Based Learning?

PBL has been extensively applied in medical education, differing significantly from traditional models in terms of its design principles, implementation strategies, assessment systems, and practical outcomes (Gwee, 2009). Since the 1920s, the U.S. medical community has identified crises in medical education, noting that the growing body of medical knowledge overwhelmed students, risking rote memorization at the expense of practical skills and ethics. As a result, enhancing students' proactive learning abilities has become essential in modern medical education. In the 1950s, the University of Western Ontario introduced integrated courses in basic medical education, breaking disciplinary boundaries and fostering interdisciplinary connections. This set the foundation for Professor Barrows, who, in 1969, developed the PBL model at McMaster University, Canada (Barrows, 1998). His approach combined self-directed learning with tutor-guided group discussions, focusing on real-world medical cases. By the 1990s, PBL was implemented in 70% of U.S. medical schools, gaining traction in Europe and Asia. The University of Hong Kong adopted PBL in 1997, and today, over 1700 medical schools worldwide, including those in China, utilize PBL, reflecting its global significance (Cheng, Guo, & Zhao, 2017). Educators such as Bate, Hommes, Duvivier, and Taylor (2014) describe PBL as a learner-centered approach that encourages self-directed learning, practical skill development, and teamwork. This contrasts with traditional teaching, which typically lacks real-world problem-solving elements and does not equally foster higher-order thinking, discussion, and reflection. PBL affirms the importance of collaboration and situates learning in meaningful scenarios to develop a broad and flexible knowledge base, critical thinking skills, and habits of lifelong learning.

Students adopt accountability for their education, actively participating as problem solvers in authentic, frequently ambiguous situations that test their analytical and cognitive skills. Teachers, who serve as facilitators, assist students by offering educational resources, promoting critical thinking, and nurturing collaborative endeavors (Kitchen & Petrarca, 2016). This approach fundamentally contrasts with traditional models in which teachers serve as the primary providers of knowledge. It necessitates that students confront complex and authentic problems, fostering deep learning and independent inquiry, which enhances their problem-solving abilities, autonomy, and creativity. Teachers facilitate rather than dictate, assisting students in reflecting on their learning

strategies and promoting collaboration among peers. Effective PBL facilitators employ questions to enhance critical thinking and facilitate group interactions, fostering positive relationships and ensuring active participation (Hmelo-Silver, Bridges, & McKeown, 2019). As students progress in their education, instructors progressively decrease their engagement, enabling students to take on increased responsibility for their learning. PBL alters the educational dynamic by enabling students to independently construct knowledge and collaborate effectively in groups, thereby increasing their motivation and engagement in the learning process.

3. RESEARCH METHODOLOGY

3.1. Participants

The participants were drawn from one cohort of 345 freshmen at Yunnan Medical Health College. A total of 50 students were randomly assigned to two groups: the experimental group (n=25) and the control group (n=25). The average age of the control group was 19.7 years (SD=0.83), while the average age of the experimental group was 20.2 years (SD=0.97). All participants had similar academic backgrounds and were enrolled in the nursing program.

3.2. Research Design

The study was conducted in three phases: 1) The first phase focused on the design of a blended learning approach. A comprehensive literature review was conducted on CL, PBL, learning effectiveness, and critical thinking skills. Basic nursing course materials were analyzed with frontline nursing faculty. Subsequently, based on the content of the textbook and the core elements of CL and PBL, an instructional approach (CPBL) for the full course was designed, and two scales were developed to measure learning efficiency and critical thinking skills. 2) The second phase involved validation and revision. Five experts were invited to assess the research instrument and score it using Item Objective Congruence (IOC). The reliability and validity of the research instrument were tested on a small scale to further refine the instrument. 3) The final phase involved implementation using an equivalent control group design with a significance level (α) of 0.05. Pre-tests were administered to both the experimental and control groups to establish baseline data on learning effectiveness and critical thinking skills. After one month of intervention, a post-test was administered to measure the effectiveness of the teaching methodology, allowing for comparative analysis between the two groups.

3.3. Research Design

The independent variable is the teaching method, which consists of two groups: the experimental group employs a hybrid method (CPBL), while the control group follows traditional teaching methods. The dependent variables are student academic performance and self-motivation.

3.4. Intervention

The intervention was conducted in a natural classroom setting at Yunnan College of Medicine and Health Professions. Students' learning effectiveness and critical thinking skills were initially assessed through a pre-test. CPBL was then introduced. The entire teaching process consisted of 20 lessons, each lasting 45 minutes. In the experimental group, 25 students were divided into five groups, and each group elected a leader responsible for organizing and coordinating group learning tasks. The groups completed the tasks through cooperative learning, sharing knowledge, solving problems among group members, and applying theoretical knowledge to real-world situations through PBL. Each session was centered on a specific nursing case to develop critical thinking and teamwork skills. The teacher played a guiding and supportive role throughout the process to ensure that each group could fully engage and advance. A post-test was administered after the instructional period to assess student progress in terms of learning outcomes and critical thinking skills.

3.5. Research Hypotheses

H_1: The instructional approach CPBL will improve the learning efficiency and critical thinking ability of vocational nursing students compared to their pre-intervention levels.

H_2: The instructional approach CPBL will lead to higher learning efficiency and critical thinking ability in vocational nursing students compared to the control group using traditional teaching methods.

3.6. Research Instruments

3.6.1. Learning Efficiency Assessment Scale (LEAS)

The Learning Efficiency Assessment Scale (LEAS) consists of 20 items assessing 1) Goal Setting, 2) Methods and Strategies, 3) Motivation and Willingness, and 4) Environment and Support. Each domain consists of five items. Each item is based on a Likert scale ranging from 1 to 5, with 5 indicating the highest level of agreement. The translation was conducted by a bilingual education expert fluent in English and Chinese and was subsequently reviewed by five experts (mean IOC=0.78). The reliability of the questionnaire was determined by Cronbach's α=0.82, a coefficient that indicates strong internal consistency.

3.6.2. Critical Thinking Ability Assessment Scale (CTAAS)

The Critical Thinking Ability Assessment Scale (CTAAS) is adapted from Facione's California Critical Thinking Dispositions Inventory (CCTDI). The CTAAS consists of 35 items assessing several critical thinking domains, including 1) Truth Seeking, 2) Open Thinking, 3) Analytical Skills, 4) Systematic, 5) Confidence, 6) Inquiry, and 7) Cognitive Maturity. Each domain consists of five items. Each item is based on a Likert scale ranging from 1 to 5, with 5 indicating the highest level of agreement. Similarly, the CTAAS was translated into Chinese by a bilingual education specialist fluent in English and Chinese. It was then reviewed by five experts (mean IOC=0.81). The reliability of the questionnaire was determined by Cronbach's α=0.85, a coefficient that indicates strong internal consistency.

3.7. Data Collect and Analysis

The data on the scores of LEAS and CTAAS were collected and analyzed using statistical analysis software SPSS 28.0. The data collected in this study were analyzed using analysis of variance (ANOVA) and t-tests, focusing on two main comparisons: 1) between the pre-experimental and post-experimental groups, and 2) between the experimental and control groups. The level of significance was set at $p<0.05$, and effect sizes were calculated using Cohen's d, where Cohen's d=0.2, 0.5, and 0.8 represent small, medium, and large effect sizes, respectively.

3.8. Ethical Approval

This study was approved by the Ethics Committee of Yunnan Medical and Health Vocational College. All participants were informed and signed written consent forms prior to the experiment, ensuring compliance with ethical standards and protecting the privacy and rights of the participants.

4. RESULT

Twenty-five participants in the experimental group demonstrated significant improvements in both learning efficiency and critical thinking ability following the instructional intervention (Table 1). Pre-intervention, participants had an average learning efficiency score of 75.04 (SD=4.83), which increased to 76.04 (SD=4.89) post-intervention. This improvement was statistically significant, $t(24)=-10$, $p<0.05$, with a large effect size (Cohen's d=2). Similarly, critical thinking ability saw a significant increase from a pre-test mean of 135.68 (SD=9.32) to a post-test mean of 137.6 (SD=9.51), $t(24)=-4.33$, $p<0.05$, Cohen's d=0.87. The results confirm that the CPBL

effectively enhanced both learning efficiency and critical thinking in the experimental group, as evidenced by the strong effect sizes in both measures. Therefore, hypothesis 1 can be accepted.

Table 1. Comparison of pre-test and post-test in the experiment group.

Variable	df	Mean	SD	t	P	Cohen's d
Learning efficiency						
Pre-test	24	75.04	4.826	-10	0.000*	2
Post-test	24	76.04	4.886			
Critical thinking ability						
Pre-test	24	135.68	9.322	-4.332	0.000*	0.866
Post-test	24	137.6	9.513			

Note: *P<0.05.

We next conducted a series of independent samples t-tests (Table 2) to compare pre-test scores between the experimental and control groups across two key variables: learning efficiency and critical thinking ability. For learning efficiency, the control group (M=75.40, SD=4.59) demonstrated slightly higher pre-test scores than the experimental group (M=75.04, SD=4.83).

However, this difference did not reach statistical significance, t(24)=1.98, p>0.05, Cohen's d=0.40. Similarly, the control group exhibited a marginally higher mean score in critical thinking ability (M=136.36, SD=8.39) compared to the experimental group (M=135.68, SD=9.32), though this difference also approached but did not meet conventional thresholds for significance, t(24)=1.85, p>0.05, Cohen's d=0.37. These findings indicate that the two groups were fairly well-matched on both measures prior to the intervention, as reflected in the non-significant p-values and modest effect sizes.

With these baseline similarities established, we can now proceed to compare the post-test results between the experimental group and the control group to evaluate the impact of the instructional intervention.

Table 2. Comparison of experiment group pre-test with control group pre-test.

Variable	df	Mean	SD	t	P	Cohen's d
Learning efficiency						
Control group	24	75.40	4.592	1.984	0.059	0.397
Experiment group	24	75.04	4.826			
Critical thinking ability						
Control group	24	136.36	8.386	1.846	0.077	0.369
Experiment group	24	135.68	9.322			

As expected, the post-test analysis indicated notable differences between the experimental and control groups in both learning efficiency and critical thinking ability (Table 3). In terms of learning efficiency, the experimental group (M=76.04, SD=4.89) outperformed the control group (M=75.52, SD=4.59).

This difference was statistically significant, t (24) =-2.32, p<0.05, with a moderate effect size (Cohen's d=0.46). Similarly, critical thinking ability scores were higher in the experimental group (M=137.6, SD=9.51) compared to the control group (M=136.48, SD=8.43), with this difference also reaching significance, t(24)=-2.11, p<0.05, Cohen's d=0.42.

These results demonstrate that the instructional intervention contributed to meaningful gains in both areas, further supporting its effectiveness in enhancing students' performance. Therefore, hypothesis 2 can be accepted.

Table 3. Comparison of experiment group post-test with control group post-test.

Variable	N	Mean	SD	t	P	Cohen's d
Learning efficiency						
Control group	24	75.52	4.593	-2.316	0.029*	0.463
Experiment group	24	76.04	4.886			
Critical thinking ability						
Control group	24	136.48	8.432	-2.113	0.045*	0.423
Experiment group	24	137.6	9.513			

Note: *P<0.05.

5. DISCUSSION

The CPBL has proven highly beneficial for vocational nursing students by improving their learning efficiency and critical thinking abilities. These results align with existing literature on active learning in healthcare education, which emphasizes the value of student engagement, collaboration, and the application of theoretical knowledge to real-world situations (Johnson & Johnson, 2008; Prince, 2004). The significant improvement in both cognitive and practical skills observed in the experimental group strengthens the growing consensus that traditional lecture-based teaching methods are inadequate for developing the complex competencies required for modern nursing practice (Azer, Guerrero, & Walsh, 2013).

Stanovich and West (2000) dual-process model of cognitive control offers a valuable framework for understanding the cognitive gains in this study. System thinking, defined by deliberate and reflective processes, appears to have been strengthened through the structured, goal-oriented activities of CL. Group discussions and project-based tasks required students to articulate their ideas, consider diverse perspectives, and continuously refine their understanding of complex nursing concepts (Lee, Yoon, & Hwang, 2024). These processes promote deeper cognitive engagement, leading to significantly stronger critical thinking skills in the experimental group.

In addition to its cognitive benefits, CL provides significant affective advantages. According to educational psychologists like Korpershoek, Canrinus, Fokkens-Bruinsma, and De Boer (2020) social interaction in the classroom positively affects motivation, reduces anxiety, and fosters a sense of belonging. The evidence suggests that the academic performance of students in the experiment group improved more, having received more attention and interaction in the learning process. This is consistent with the assertion of Garrison and Kanuka (2004) that learning in groups enhances interaction encouraging participants to feel a sense of belonging and ownership.

The pragmatically sequenced heuristic search, in addition to supporting project-oriented tasks, probably accounts for the improvement in critical thinking skills in the experimental group. It is a process where learners examine complexities and provide reasoning with appropriate information from varying angles and contexts, according to Payne and Braunstein (1978). PBL includes many skillsets, including decision-making in medical practice, where the heuristic search process is situated. For example, clinical decision-making in real life encompasses risk levels and benefits, patient prognosis, and moral issues (Thompson & Stapley, 2011). That's why Rubino (2024) claims that this method simulates the real-life processes that students will face such as, not just memorizing theories, but practicing them in a real-world clinical setting encouraging flexibility of the mind.

The findings revealed that students who undertook more elaborative heuristic searches were better able to connect the dots between the theory of the content and real-life application of that content. In this respect, Mohammed, Ferzandi, and Hamilton (2010) offered a similar position in that cognitive elaboration is one of the processes that enable experts to construct a wider and better knitted comprehension of their domain. Consequently, it is possible that the students in this study practiced-more than the rest of the students-competencies of their classroom training within the clinical setting, which could have had a positive impact on their overall performance in the test that assessed critical thinking.

The research carries substantial implications for nursing education, calling for the employment of non-conventional methodologies of instruction in the present system which mainly relies on lectures. The CPBL very

engaging pedagogy applied in this study is cognitive as well as affective. Health education, in which students learn technical skills and at the same time, develop relationships and teamwork for patient care, is a unique area, especially in the context of PBL.

These results highlight the need for 'real-life' problem-solving experiences in as many subjects as possible and within early stages of the nursing education. Taking part in project activities which were aimed at clinical simulations helped students practice the very thinking that they would give a decision under duress in healthcare. These results correspond with Peters et al. (2006) which stated, that students who were introduced to problem solving tasks early in their education were already capable of tackling the demands of the clinical practice.

These studies provide further support for the implementation of the collaborative learning (CL) model in the field of nursing education. Hall and Weaver (2001) argue that nursing practice is inherently collaborative. It necessitates that students work effectively in teams, communicate clearly, and coordinate care across multiple disciplines. As Prince (2004) observes, CL enhances individual learning outcomes while fostering essential teamwork skills, which are crucial for success in increasingly complex healthcare environments.

While the immediate benefits of the CPBL are evident, future research should explore the long-term effects of these methods on professional performance. Previous studies suggest that PBL enhances knowledge retention and facilitates greater skill transfer to professional contexts (Hmelo-Silver, 2004). Following the participants in this study as they transition into clinical practice would help determine whether the improvements in learning efficiency and critical thinking translate into better patient outcomes and more effective clinical decision-making in the long term.

Although this study focused on vocational nursing students, the findings may be applicable across different levels of nursing education. Given the diverse backgrounds of nursing students, instructional methods should be tailored to meet the needs of learners at various stages of their education. Future research should investigate how CPBL can be adapted for graduate nursing programs, where students face more complex clinical challenges and are expected to engage with research-based practices.

6. LIMITATIONS AND FUTURE RESEARCH

Despite the positive findings, this study is not without limitations. The relatively small sample size limits the generalizability of the results, and future research should replicate this study with larger and more diverse student populations. Additionally, while the study measured short-term improvements in learning efficiency and critical thinking, it did not evaluate the long-term retention of these skills. Longitudinal studies are needed to evaluate whether the observed gains are sustained over time and how they influence clinical performance. As this study focused on the cognitive and emotional aspects of CPBL, it will additionally be useful to consider how these approaches impact other major metrics like the students' resilience, adaptability and ability to manage stress. Such aspects are important in the nursing profession considering how high-pressure situations involve making instant decisions especially for nurses (Liaw, Scherpbier, Rethans, & Klainin-Yobas, 2012). More research is needed to understand how active learning strategies help to create a complete healthcare practitioner.

7. CONCLUSION

The integration of CPBL enhances the learning efficiency and critical thinking skills of students taking vocational nursing courses. These results underscore the importance of active and student-centered teaching methods in nursing education and as a means of improving the students' readiness for the multifaceted nature of clinical practice. There is need for more studies to evaluate the wider use of these pedagogies especially with regard to the sustainers of the changes in professional behavior over time and to the applicability of the pedagogies in different contexts within the learning spectrum.

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