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The Impact of Problem-Based Learning on Improving the Critical Thinking Skills of Undergraduate Nursing Students

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ABSTRACT *Critical thinking is an essential skill in nursing practice to enhance patient safety and outcomes. Traditional lecture-based teaching methods are usually insufficient to acquire these skills, whereas Problem-Based Learning (PBL) is mean to develop these skills as it consists of student-centered learning and problem solving. The purpose of this study was to examine the effectiveness of teaching strategy, PBL on critical thinking of undergraduate nursing students in The Maldives National University (MNU). This study used an experimental design with a pretest-posttest control group structure and 54 second year undergraduate nursing students were compared (control/traditional lecture-based group, n=28 and experimental group/PBL, n=26). PBL scenarios were made on different childhood disease conditions. Pre and post-test critical thinking scores were measured by using The Short Form Critical Thinking Disposition Inventory. The paired t-test showed that there was no improvement of critical thinking skills in the control group, with identical pretest and posttest mean scores (69.07) and a decrease in the standard deviation (SD) from 6.58 to 6.63. In contrast, the experimental group demonstrated a significant increase of mean score of critical thinking (from 62.46 (SD = 6.13) to 74.42 (SD = 5.84, p <0.001). The independent t-test also showed that posttest scores were significantly higher in the experimental group than in the control group (t = -4.373, p < 0.001). These results emphasize the marked benefit of PBL in nursing students' critical thinking skills in comparison with the traditional teaching methods. The results of this study showed that PBL significantly enhances the critical thinking of nursing students, and support the integration of PBL into nursing curriculums to help bridge the gap between theory and practice.*

Keywords: Critical Thinking, Problem-Based Learning, Nursing Education

Introduction

Critical thinking has been cited as an essential part of the skillset in the contemporary healthcare environment of the 21st century; it is viewed as an important skill set in the nurse profession (Rasheed, 2022).The need to develop critical thinking skills in nursing education will enable nurses to think critically in complex situations and make quality clinical decisions and provide standardized high-quality care. When nursing students' transit into clinical practice, it is highly recommended to enhance their critical thinking skills and improve the nursing competencies to provide effective and safe nursing care (Rasheed, 2022).

Even though it is essential, research shows that students tend to find it difficult to use their critical thinking skills and instead they have to engage in rote learning. A large percentage of them are unable to apply theoretical knowledge into practice

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(Liu & Pasztor, 2022; Musa et al., 2021). Such gap highlights the necessity of radical teaching strategies unrestricted to traditional teaching approaches. Problem-Based Learning (PBL) has become one of the novel disciplines based student-centered methods that notably match with constructivist ideas. PBL helps to stimulate active learning, collaboration, and problem-solving with knowledge application by presenting students with complicated and real world-related situations (Lu et al, 2022; Rasheed, 2022) . These are essential factors in learning how to critically think about information, judgements and make sound clinical decisions (Hmelo-Silver & Barrows, 2020). PBL has become a popular method introduced in nursing education as it successfully helps to reduce the gap between theory and practice and, finally, develop effective clinical decision-making skills in students and the provision of safe nursing care (Lu et al., 2022).

The focus of this study was the evaluation of the effectiveness of PBL in enhancing the critical thinking abilities of undergraduate nursing students at MNU. It will use an experimental design to compare the results of students who have undergone traditional lectures to those who have been exposed to PBL in terms of critical thinking. Examining how PBL affects critical thinking, this research aimed to provide evidence to support the implementation of innovative educational strategies in nursing education.

Significance and Background

The greatest attributes that are crucially important in nursing education to guarantee safe and quality nursing care are critical thinking, good clinical judgment, and effective problem-solving skills (Rasheed, 2022). The advancements in the nursing profession requires well-trained professionals with high competency who can make effective and timely decisions that immensely matter to the exigent populations, especially in the field of pediatric nursing (Liu & Pasztor, 2022). Yet, most nursing courses at MNU still rely on traditional lecture-based practices. These forms of teaching are good, but they do not give much opportunities to develop critical thinking and other higher-order cognitive skills (Moradi et al., 2019).

MNU undergraduate nursing students in their 2nd year (3rd semester) are now in a theory-based semester in which they have no chances of experiencing clinical exposure. The traditional approach of lecture is still the main teaching method for these students. Innovative pedagogical methods like PBL are yet to be incorporated into their curriculum. These constraints in pedagogical transformation could negatively impact the capability of students to transfer theoretical concepts into clinical practice and confidence of those students (Lu et al., 2022). In addition, clinical reasoning is one of the most important aspects that students have difficulty with, and it is relatively easy to get confused in stressful situations without the active learning approach, such as PBL (Amin et al., 2024). The dependence on traditional lectures limits the acquisition of critical thinking skills, the skill that is needed prior to students moving to clinical settings, especially in high-demand units like pediatric wards (Rasheed, 2022). Lack of development and a considerable enhancement of these skills might cause obstacles to the students when they are posted to complex care units.

PBL has been classified as a novel, student-centered pedagogical approach, which is effective to close the gap between theoretical knowledge and the clinical

practice (Amin et al., 2024). PBL encourages critical thinking, active learning and cooperation among the students through introducing clinical situations faced in real life. Research studies are consistent that PBL is effective in improving critical thinking, decision-making as well as problem-solving abilities in undergraduate nursing learners (Lu et al., 2022; Kim & Park, 2020; Bonafide et al., 2021; Amin et al., 2024). PBL can be particularly applicable in pediatric nursing where accurate, yet patient-centered decisions must be made promptly (Amin et al., 2024). Also, PBL promotes self-directed learning, producing a sense of ownership over education, developing the capacity to discover, analyze and transfer knowledge themselves, promoting lifelong learning in nursing practice (Jamshidi et al., 2021).

Although there has been an increase in using PBL in nursing education globally, there is a lack of use of this method in the Maldives higher education system. At present, the undergraduate 2nd year nursing students at MNU are not exposed to PBL as an instruction method. This disparity emphasizes the necessity to implement innovative teaching tools to make students well-prepared to clinical practice. The lack of PBL integration may also result in lack of confidence in students and make it difficult for them to think critically and manage real world situations in paediatric emergencies (Lu et al., 2022). Due to the current global concern, nursing educators aims at addressing the rising needs of healthcare systems and improving professional skills by capitalizing on student-centered approaches, including PBL, instead of traditional lecture-based approaches (Lu et al., 2022). Moreover, PBL facilitates adaptability and lifelong learning, and they are important aspects of healthcare that is constantly changing (Kim & Park, 2020). The current transformation of medical technologies and quality standards of patient care requires nursing educators to work with students through strategies that promote their flexibility and ability to respond to a variety of challenges, thus promoting their competencies (Amin et al., 2024).

This study aimed to evaluate the impact of PBL as a teaching strategy to enhance the critical thinking abilities in undergraduates enrolled in the nursing programs at MNU. As pediatric nursing is a demanding area by the virtue of its stakes, this study is needed for the development of nursing education in Maldives and the rest of the world.

The hypotheses of this study are:

1. There will be a significant improvement in the critical thinking skills of undergraduate nursing students educated using PBL compared to students educated using traditional lecture-based methods.
2. The difference between pretest and posttest critical thinking scores within the experimental group will be significant

The objectives of this study are:

1. Compare the changes in critical thinking skills between students taught using PBL and those taught through traditional lecture-based methods.
2. Determine the differences within pretest and posttest scores of critical thinking skills in both control and experimental group.

Literature Review

Critical thinking is essential in the dynamic healthcare environment as student nurses need to make fruitful clinical decisions, starting with a problem to a solution (Bonafide et al., 2020). The demand to ensure that students be competent in clinical reasoning and practice has increased with the evolution of the nursing care, leading to a direct effect on patient outcomes and safety (Musa et al., 2021). Educational programs in nursing have acquired more student-centered approaches, such as PBL, where students actively involved in the resolution of real-life issues and are invited to develop critical thinking and fill the gap between theory and practice (Amin et al., 2024; Lu et al., 2022). PBL also equips the students to deal with multidimensional approaches in nursing, by incorporating unique learning situations (Kousar & Afzal, 2021).

The theories, frameworks, and strategies of teaching critical thinking to nursing students are reviewed in this literature review and the role of PBL is explored. Also, it discusses the advantages of enhancing the critical thinking skills of nursing students and highlights the research gaps in this particular area, which still need to be addressed. The effective theoretical basis concerning the improvement of critical thinking among the nursing students is required. Constructivist Learning Theory usually supports critical thinking within the nursing education environment, meaning in terms of the theory students learn and develop knowledge through active engagement, experiential learning, and through solving problems, which is a direct improvement of their critical thinking (Hmelo-Silver & Barrows, 2020; Rasheed, 2022).

Figure 1. The Theoretical Framework of The Study

PBL is supported with the help of constructivist theory by exposing learners to real-life situations which promote problem solving ability, critical thinking, and development of higher-order skills such as evaluation and analysis (Moradi et al., 2019). Also, constructive approaches increase the level of deeper understanding, autonomy, and responsibility, as well as stimulate active learning and the acquisition of academic competence in clinical practice (Liu & Pasztor, 2022). Moreover, the practice that promotes reflection, which is supported by constructivism, assists nursing students in noticing gaps in the knowledge to facilitate autonomous learning and constantly becoming better (Lestander et al., 2021). The shared belief

of cooperative learning, as a fundamental belief of constructivism, can lead to teamwork, the plurality of outlook, and enhanced problem-solving skills (Vleuten et al., 2020). Also, approaches involve providing students with more control over their learning experience, which helps to combine practice and theoretical knowledge and comply with the requirements of nursing education (Lu et al., 2020; Rasheed, 2022). These attributes equip students with the capabilities to handle convoluted clinical scenarios with ease.

Impact of PBL on Improving Critical Thinking Skills

PBL has been recognized to be very effective in influencing critical thinking. PBL as an innovative instruction method encourages active learning as students are placed in real-world issues. Research has established that it plays a major role in developing critical thinking abilities in nursing students (Liu & Pasztor, 2022; Rasheed, 2022). This approach enhances students to be skilled at analysing, developing and applying knowledge in clinical practice, which are usually poorly developed in the students receiving teaching based on traditional lecture methods (Lee et al., 2021). Besides, PBL focus on self-guiding learning and collaboration is seen as hugely helpful in developing critical thinking. PBL plays the role in increasing self-motivation and promoting a more profound collaboration by encouraging learners to be responsible in their learning (Kim & Park, 2020). Additionally, the use of collaborative problem-solving during the PBL approach positively influences the development of communication and team-working skills in learners, both of which are the key factors to arriving at proper and reasonable clinical decisions (Moradi et al., 2019).

Associated with this, PBL has shortcomings. It is also indicated that its success may depend on previous experience, culture and cognitive aptitude of the students (Wei et al., 2023). Moreover, PBL vitally relies on the quality of scenarios, which display poor results in decreasing the critical thinking skills of students (Wu et al., 2022). PBL is also laborious and complicated, and it might need considerable planning and guidance on the side of educators (Almulla, 2021). Besides, there exist research gaps such as conducting research on long-term positive effects on students when it comes to critical thinking skills because of PBL. Although several studies focus on its immediate effect, a longitudinal study is indispensable to investigate the sustainability of the benefits of PBL in clinical practice. Also, both culture and context as pertaining to the effectiveness of PBL are poorly studied and culturally diverse research is necessary (Wu et al., 2021).

Benefits of Enhancing Nursing Students' Critical Thinking Skills

Nursing students need critical thinking, which would help them solve complicated clinical decision-making, interpret situations, make prerequisites, and adopt evidence-based practice which are imperative in providing safe and effective nursing care (Carter et al., 2020). In addition to individual competence, critical thinking improves self-directed learning and provides students with the ability to overcome a continuously changing environment in healthcare settings and incorporate the newest research into practice (Lee et al., 2021; Bressington et al., 2021). The proficiency would also be instrumental in multidisciplinary collaboration as effective teamwork and valid decisions made in difficult scenarios would result in better patient outcomes (Walsh et al., 2022). Such an approach like

PBL can successfully predetermine the active learning process and the acquisition of critical thinking skills by nursing students (Lee et al., 2021). Carter et al. (2020) highlighted that students whose critical thinking skills are adequately developed have the abilities of better clinical judgment that leads to safer and higher-standard of care (Bressington et al., 2021).

Critical thinking also enables the nurses to evaluate clinical scenarios, determine risks, and develop evidence-based judgments which translates into good patient outcomes especially in demanding departments such as pediatric wards (Walsh et al., 2022). As Bressington (2022) emphasized, those nursing students who excelled at critical thinking would be able to provide evidence-based care suitable to the most current research studies. Although critical thinking in nursing comes with its rewarding results, there are gaps. Further longitudinal studies are required to judge the maintenance of critical thinking abilities as well as its execution in practice (Lee et al., 2021). Enhancement of critical thinking in nursing education is essential to the further development of patient safety and the response to the requirements of the modern healthcare system (Bressington et al., 2021).

Effectiveness of PBL in Nursing Education

The PBL is identified as a novel educational approach to nursing education that advances the capacity to solve problems, make clinical decisions, and think critically, among others. There is evidence that PBL can help students connect the theory and practice, critically thinking about intricate real-life cases and training in preparing to address healthcare issues (Srilatha et al., 2022). PBL promotes an active learning process and student-centered learning, collaboration, and teamwork, which is the paramount feature of the nursing practice (Rideout et al., 2022).

Furthermore , Saudi-based studies indicated that students in nursing school subjected to the PBL cultivated a better grasp of the knowledge and more flexibility in clinical settings (Aboonq, 2019). In the same manner, Zinkeng et al. (2020) carried out the study that led to the conclusion that PBL improves the problem-solving skills which enhances patient outcomes. The introduction of PBL in nursing curriculums enhances critical thinking in the academic process, active learning, and increase the confidence levels of students (Lu et al., 2022). It is also noted in PBL that encourages self-directed learning and reflective practice, which is critical to adjust to the changing nature of healthcare environments (Jamshidi et al., 2021). PBL fosters preparedness to make proper clinical decisions by compelling the students to think and assess real-life situations. A study conducted in China showed that students who were taught using PBL gained better communication, leadership, and teamwork abilities (Lu et al., 2022). Moreover, the permanent effect of PBL has been witnessed all over the world, and nurses educated in PBL have resulted in high job satisfaction and versatility (Merlin et al., 2024). Although several issues, such as a requirement to have trained facilitators, still exist, PBL can be used because it aligns with new competencies of nursing students (Rideout et al., 2022). Further research should be focused on culturally appropriate teaching strategies to meet diverse learning needs of students and facilitate equal learning opportunities (Aboonq, 2019).

Methodology

Study design

This research employs experimental research design in the format of pretest-posttest control group. With the pretest-posttest design, it is possible to assess the change in critical thinking results before and after the intervention and demonstrate a powerful piece of evidence concerning PBL (Cohen et al., 2020). Traditional lecture-based approaches and PBL are the independent variables of the study. Traditional lecture is a teacher-centered style of instruction where delivery is made in form of lectures by the teacher (Rasheed, 2022). Conversely, the PBL is a student-centered pedagogy that encourages active learning in enhancing problem-solving and critical thinking skills (Rasheed, 2022). The critical thinking skills constitute the dependent variable of the present research. The aspect of critical thinking is an essential part of nursing care as nurses can determine the needs of patients, support the process of solving problems, and develop decision-making abilities (Liu & Pasztor, 2022).

Participants and sampling

The students of the 2nd year (3rd semester) nursing programs at MNU completed the study as the participants. Initially, 80 students volunteered to take part in the study and were randomly assigned to control and experimental groups. It is imperative, according to Creswell & Creswell (2017), that the process of randomization will be necessary to make sure that by the initial point of measuring, both groups are similar and to reduce the possibility of selection bias. A total of three sessions were conducted, each focusing on a key pediatric nursing topic: pediatric asthma, gastrointestinal disorders, and genitourinary disorders. The experimental group was taught using PBL method while the control group was taught using traditional lecture-based methods. Some students were eliminated from the study as they did not participate in all the three sessions. There were 54 students who attended all three sessions (out of which 28 were in the control group, and 26 in the experimental group). The research was conducted at the School of Nursing, MNU.

Inclusion And Exclusion Criteria

The 2nd year (3rd semester) under graduate nursing students from School of Nursing who have not been previously exposed to the PBL teaching method are included in the study. In addition, students who have participated in all the three sessions are included in the study. Students who have been previously exposed to the PBL strategy and students who have participated in any training on critical thinking skills are excluded from this study. Moreover, students who did not attend all three sessions were also excluded from the study.

Research instrument

This study was conducted using the Short Form English version of the Critical Thinking Disposition Inventory (SF-CTDI-CV). The CTDI is a popular instrument that is used to measure the core critical thinking dispositions in which there are four dimensions of reasoning, confidence, open mindedness, and systematicity. The psychometric properties of the CTDI have demonstrated to be strong, including good internal consistency and reliability (Liu et al., 2021). In

2002 this tool was translated to Chinese by a Chinese scholar Yeh who subsequently measured and validated this form of the tool that various scholars have used (Du et al., 2013; Liu et al., 2016; Tai, 2007). This version of the tool obtained a content validity index (CVI) of 0.50 to 0.80, and the total CVI of 0.85 and Pearson r values of 0.33 to 0.79, and the total correlation of 0.79 (Ludin, 2018). These figures indicate evidence of reliability upon ratings of critical thinking ability. Also, the subscale alphas of this version of the CCTDI have been observed to be 0.34 to 0.73 with a total alpha of 0.71. Later, in 2010, Hwang et al. assessed and developed the Chinese version and shortened it due to convenience and validated it (Liu et al., 2021). They translated the same to English. This version comprises 18 items that would have 3 sub-groups as systematic analysis (five items), thinking within the box (eight items) and thinking outside the box (five items). Responses to each sub-category can be rated with the help of the five-point Likert scale on the 1 to 5 scale ranging from completely disagree to completely agree (Ludin, 2018). The sub-category and the overall Cronbach alpha coefficients and intra-class correlation coefficients were above 0.8 in the study by Hwang et al. (2010), which means that content validity was evident. The goodness-of-fit of the final SF-CTDI -CV was satisfactory in case of overall fit (/2 = 4.04, p = < 0.05). The researchers have also found that short version of the form (SF-CTDI-CV) is more applicable in the assessment of critical thinking among nurses (Ludin, 2018).

To achieve internal validity of the research, students in the research were randomly allocated into both experimental and control group to minimize selection bias. Both groups had the same research instrument in both pretest and posttest hence providing consistency in the measure. Further, due consideration was made to eliminate testing effects. The time interval between the posttest and pretest (7 weeks) was also sufficient to minimize the possibility of the gains made by the participants concerning critical thinking solely because they became familiar with the tool as a result of the PBL intervention. Moreover, the study controlled potential confounding factors, including prior exposure to PBL, academic performance, and clinical experience checked before the randomization procedure .

To mitigate the risk of contamination between the experimental and control groups, which were part of the same academic cohort, several steps were implemented. First, the PBL sessions were held outside the usual classroom activities and in distinct time frames that lowered the risks of observational exposure. Secondly, students were instructed not to disclose the content of their discussions or activities to peers in the other group, and this was reinforced throughout the study. Finally, the specific nature of the PBL intervention (it needed collaborative work in the concrete group context) further reduces the chances of the direct transfer of the learning to the control group.

Intervention

PBL was chosen as the intervention for this research. Prior to the intervention, students received an introduction to the PBL process, including the roles of group members, problem-solving techniques, and strategies for searching academic databases. The PBL intervention spanned a seven-week period and comprised three sessions, each focusing on key pediatric nursing topics: pediatric asthma, gastrointestinal disorders, and genitourinary disorders. In every session, small

groups (5 to 6 members) of students were given complicated realistic scenarios of pediatric disorders. Students engaged in brainstorming, created their hypothesis, conducted independent research, and reconvened to discuss optimal solutions. The researcher facilitated these discussions, ensuring that students effectively employed critical thinking skills. To reinforce their learning, groups submitted reports and participated in reflective debriefings at the conclusion of each session.

In contrast, the control group received traditional lecture-based instruction, providing a baseline for comparing the effectiveness of PBL. This group experienced the same topics as the experimental group, but instruction was delivered through conventional means, including slide presentations, whiteboard explanations, and textbook-based lectures. To minimize disruptions to the control group's learning, the sessions were properly organized that encouraged students to take notes, ask questions, and clarify doubts during and after each presentation.

Alongside lectures, the control group participated in tutorial sessions where the lecturer addressed key points and explained complex issues, followed by structured review questions. However, these tutorials did not include small group work or case-based studies, which distinguished them conceptually from PBL. Additionally, students were assigned individual tasks such as mini quizzes, written summaries, and end-of-session reflections. Learning materials for homework and self-study were also provided.

Data were collected from both groups using the SF-CTDI-CV instrument as a pretest before the intervention. Following the three intervention sessions, posttest data were gathered using the same instrument. This approach allowed for a comparison of pretest and posttest scores both within and across groups, facilitating an assessment of changes in critical thinking skills while maintaining the integrity of each instructional method. Scores were given with the help of five-point Likert scale in which points ranging from 1 for completely disagree and 5 for completely agree.

Data analysis

The analysis of data was performed using the IBM SPSS Statistics 27.0 version, which provided quality and effective data handling and computations. Inferential statistics such as the paired t-tests were used to examine the changes of the difference between the pretest and posttest critical thinking scores within the groups. Additionally, an independent t-test was employed to compare critical thinking skills between the groups.

Ethical consideration

Prior to the study, the researcher obtained blanket approval from MNU for ethical considerations (Research Ethics approval number: RE/2024/A-3). Also, the approval of School of Nursing (SN) was sought as the study participants were SN students. Before initiating data collection, a written consent was obtained from all participants, ensuring they were fully informed about the study's aims, procedures, and potential risks. Participants were assured of confidentiality and anonymity, and they were informed that they could withdraw from the study at any time without facing any repercussions. Furthermore, it was guaranteed that the information collected would be stored in a password-protected folder, accessible only to the researcher. Participants were informed that the data would be used solely for the purposes of this study.

Results

Control group (Within-Group Comparison)

A paired-samples t-test was conducted to examine the impact of the traditional lecture-based methods on critical thinking scores within the control group (n = 28). The results showed no significance difference in scores from pre-test (M = 69.07, SD = (6.59) to post-test (M = 66.96, SD = 6.63), t (27) = 1.27, p = 0.217. The mean difference was 2.11. The effect size was small, Cohen's d = 0.24 (95% CI [-0.14, 0.61]), indicating no significant improvement in critical thinking skills in the control group.

Experimental Group (Within-Group Comparison)

A paired-samples t-test was conducted to examine the impact of the intervention on critical thinking scores within the experimental group (n = 26). The results revealed a statistically significant difference in scores from pre-test (M = 62.46, SD = 6.13) to post-test (M = 74.42, SD = 5.84), t (25) = -12.67, p < .001. The mean difference was -11.96. The effect size was large, Cohen's d = -2.49 (95% CI [-3.27, -1.69]), indicating a significant improvement in critical thinking skills in the experimental group.

Table 1. Critical Thinking Skills Within the Control and Experimental Group

		M (SD)	Mean difference	T (df)	P value	Cohen's d	95% CI for d
Control group	Pre-test Post-test	69.07 (6.59) 66.96 (6.63)	2.11	1.27 (27)	0.217	0.24	[-0.14, 0.61]
Experimental group	Pre-test Post-test	62.46 (6.13) 74.42 (5.84)	-11.96	-12.67 (25)	<0.001	-2.49	[-3.27, -1.69]

Note. M = Mean; SD = Standard Deviation; d = Cohen's d; CI = Confidence Interval

An independent t-test was conducted to compare the means of the two independent groups. This statistical method is suitable for this research, which involves both an experimental group and a control group. According to Field (2018), the independent t-test is appropriate when the data originates from two distinct groups, making it essential for assessing whether the observed results stemmed from an intervention.

The conditions required for conducting an independent t-test include having two independent samples, normal distribution of data, homogeneity of variance, scale of measurement, random sampling and absence of influential outliers. All these conditions are met in this study, confirming that the independent t-test is an appropriate statistical method for analyzing the data. To test the normality of the data, skewness and kurtosis were assessed for all study variables. The results indicated a normal distribution, as the skewness values were less than 0.5 and the kurtosis values were below 1. Following Field (2018), a skewness of less than 0.5 and kurtosis under 1 are indicative of normality.

The results of the independent t-test indicate that the p-value of Levene's test

is 0.052, which is greater than 0.05. This suggests that the assumption of equal variances is satisfied. According to Pallant (2020), when the p-value of Levene's test exceeds 0.05, the assumption of equal variances is met. Hence, the results under the heading 'Equal variances assumed' have been used for data interpretation. There was a significant difference in the mean between the experimental and control group t [52] = -4.37, p=<0.001) indicating the mean critical thinking score of experiment group is higher than the control group.

The mean difference between the control and treatment groups was -7.459. Additionally, the 95% confidence interval (CI) ranging from -10.881 to -4.036 further underscores the statistical significance of these findings. These statistics suggest that Problem-Based Learning (PBL) is highly effective in enhancing the critical thinking skills of nursing students. The posttest critical thinking scores for the PBL group (experimental group) were significantly higher than those of the traditional lecture group (control group). Thus, the result highlights the efficacy of PBL in improving the critical thinking abilities of nursing students.

Table 2. Independent t-Test Results (Between-Group Critical Thinking Components and Total Score)

		Levene's Test for Equality of Variances		**t-test for Equality of Means**					**95% Confidence Interval of the Difference**	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std Error Difference	Lower	Upper
CT post-test score	Equal variances assumed	0.052	0.821	-4.373	52	<0.001	-7.459	1.706	-10.881	-4.036

Discussion

The result of this study result highlights the efficacy of PBL in improving the critical thinking abilities of nursing students. These findings align with those of Yuan et al. (2020), who emphasized that PBL promotes active learning, teamwork, and higher-order cognitive skills conducive to effective learning. Furthermore, the lack of significant change in the control group supports the assertions made by Schmidt et al. (2019) that traditional lecturing methods have not proven effective in fostering higher-order critical thinking skills.

Likewise, the results of this research work concur with several other studies which demonstrate the efficacy of PBL on developing critical thinking skills among nursing students. Sarma et al. (2021) revealed that PBL allows higher-order thinking skills and student-directed education, both of which are vital for improving the ability of nursing students to think critically. Similarly, Wei et al. (2022) reveal that through PBL, problem-solving skills are developed, which is one of the characteristics of critical thinking. Along with these findings, the drastic improvement of critical thinking in the experimental group in this research implies that PBL is also one of the best ways of nursing students developing critical thinking

through active learning and application of real-life knowledge. Additionally, another study by Liu et al. (2021) emphasized that PBL fosters active learning and collaboration that attracts excellent thinking and clinical judgment skills. The implications of this research indicate that students taught through PBL exhibited improved consistency in post-test performance, as evidenced by a decrease in standard deviation. This suggests that PBL promotes a uniformly high level of enhancement in critical thinking skills among students. This finding is consistent with existing literature that advocates for the positive role of PBL in strengthening the critical thinking abilities of nursing students.

However, there are variations when comparing this study results with other research. For example, Yu et al. (2013) found no significant effect on the improvement of critical thinking skills of undergraduate nursing learners exposed to PBL in the study. The inconsistency could be caused by varying the period of intervention or the scenario design incorporated in PBL. Nonetheless, the duration of PBL exposure in this study, which is 7 weeks, and 3 sessions that covered complex scenarios on pediatric disease conditions, might have given the students enough time to participate in real-world scenarios where they can solve problems and thus have improved critical thinking skills. The variations in study results underlies the importance of contextual characteristics involved as significant factors to influence PBL efficacy; the length of PBL sessions, the level of sophistication of the experienced scenario, and the teaching skills .

Comparing the studies, disparities can be observed in the findings when making a comparison between the results of the control group of the research to that made by others. Amin et al. (2023) confirmed that the lecture-based method, too, enhances the critical thinking skills albeit a slow pace in comparison with PBL. But in this study the control group failed to reveal any improvement in the critical thinking skills. This may be attributed to the fact that PBL fosters active, student-centered learning, which is often lacking in traditional lecture formats. In the context of this study, traditional teaching methods may promote passive learning, where students are passive recipients of information without opportunities to critically engage with and apply their knowledge. This could explain the lack of improvement in critical thinking skills among students in the control group.

Recommendation and Implication

It is recommended that PBL could be adopted into the nursing programs of MNU in large scale. The results of the study with respect to the positive influence that the use of PBL had on the experimental group point toward the use of PBL as one of the most critical teaching strategies in the sphere of nursing programs in the context of higher education of Maldives. Nursing educators could evaluate how PBL might be used to teach complex disease conditions through scenarios, to advance thinking capacities and clinical judgment.

In addition, since this research included the involvement of real-life complex situations associated with complex paediatric disease conditions, it is advisable that other nursing education programs at MNU like reproductive health or critical care nursing should also introduce real life situations in their PBL lessons. This approach would provide students with diverse experiences and challenges, better preparing them for the various roles they will encounter during clinical

placements. Equally, to optimize the effectiveness of PBL in the Maldives, it is crucial to provide training for nursing educators in higher education. The training of nursing educators needs to be done not just on the technical level of integrating PBL, but on the level of improving a learning environment that both enforces team work, problem solving and critical thinking skills. Besides, as demonstrated in this study, effective facilitation by instructors is vital for integrating critical thinking skills throughout the PBL process.

While this study underscores the efficacy of PBL in developing critical thinking skills, future research should focus on longitudinal studies to assess the long-term impact of PBL on these skills. Additional studies should compare PBL with other active learning methods, such as case-based learning, peer teaching, and the jigsaw strategy, to identify specific benefits and challenges associated with each approach. To enhance the adoption of the PBL strategy, further research is recommended to examine how group cohesion, active engagement, and student motivation influence PBL effectiveness. Understanding these factors can inform the refinement of the PBL process, leading to improved learning outcomes and greater student involvement. Furthermore, the integration of the technology in the form of digital tools and platforms may help integrate PBL process to provide learners with advanced and engaging learning experiences. Future studies may look at how technology can be integrated in the PBL sessions that enhance better teamwork, and critical thinking skills in nursing education.

Limitations

Though the study outcomes have disclosed the efficacy of PBL as an argument to enhance critical thinking abilities of the undergraduate nursing students, the study has limitations. The sample size of the Study was 54 undergraduate nursing students from the 2nd year (3rd semester), and it is quite a small sample. This has restricted the extension of findings to a greater population of nursing learners. Besides, the research was done in MNU, hence making the research results less applicable in other higher learning settings, i.e., settings not having the same curriculum. Equally, the length (7 weeks) of the PBL intervention can be considered narrow to observe the sustainable implication of the PBL on the abilities of critical thinking. In addition, the study only applies paediatric nursing scenarios. Combination of a wide variety of scenarios and context might provide more detailed data of the results of PBL in various fields of nursing.

Conclusion

This study revealed that PBL is very effective in enhancing critical thinking skill of undergraduate students of nursing compared to traditional lecture-based methods. PBL encourages higher-order thinking skills which facilitate appropriate clinical judgments necessary in pediatric nursing specialty through encouraging engagement of students by offering real-life situations and group work. According to the results, there exists an alarming need of switching the traditional routes to active learning routes in nursing education. The incorporation of the PBL in the nursing curriculum at the institutes of higher education in the Maldives would help bridge the theory and practice gap.

Declaration

This paper was originally submitted to Post Graduate Diploma in Higher Education/ EST457 as a part of a course requirement of Faculty of Education, The Maldives National University in December 2024. As a result, it appears in the Moodle, which has contributed to the current similarity index of 27%. I confirm that I am the original author of this work, and the content is entirely my own. All external sources used have been properly cited according to the journal's required citation style. This work has not been previously published or submitted to any other journal.

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