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# Evaluating the Impact of Problem-Based Learning (PBL) on Clinical Reasoning Skills in Medical Students

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**ABSTRACT:**
**Background:** Clinical reasoning is an important skill required in medical education to help students to address problems of the patients. Conventional didactic teaching approaches may not be able to develop this skill but problem-based learning (PBL) has been suggested to be an interactive and student-centered method that could develop critical thinking and decision-making skills.
**Aim:** This study was carried out with the intention of assessing the effect of PBL on the medical students` clinical reasoning skills.
**Methods:** This was a prospective observational study carried out at the Shifa International Hospital, Islamabad from May 2024 to April 2025. The total medical students who made up the sample of the study were 90. There were two groups of participants, namely, divided. One got conventional lecture-based teaching and the other took part in PBL classes. Clinical reasoning skills were measured before and after the intervention with the help of a validated Clinical Reasoning Skills Assessment Tool. Appropriate statistical methods were used to make comparative analysis between the two groups.
**Results:** Comparison of the groups exposed to PBL and that exposed to traditional teaching with regard to clinical reasoning scores revealed statistically significant improvement among the PBL group ($p < 0.05$). The PBL group of students showed improvement in problem identification, data interpretation, differential diagnosis, and clinical decision making. Another reservation of participants turned out to be positive as well due to higher satisfaction of its PBL format and increased level of engagement during sessions.
**Conclusion:** Problem-Based Learning (PBL) was beneficial to the clinical reasoning abilities of medical students. The results are consistent with including PBL in undergraduate medical programs as a helpful pedagogical factor for improving students' critical thinking and clinical decision-making skills.
**Keywords:** Problem-Based Learning, Clinical Reasoning, Medical Education, Student Engagement, Teaching Methods, PBL, Undergraduate Medical Curriculum.

## INTRODUCTION:

Over the last decades, medical education also has witnessed profound paradigm shift which is characterized by the shift from the traditional didactic methods into student-centered learning methodologies. Of these, Problem-Based Learning (PBL) materialized as popular instructional strategy that looked to encourage active-learning and critical thinking to develop clinical reasoning skills [1]. First piloted into McMaster University in the 1960s, PBL was designed for the purpose of developing in medical students the ability to handle complex issues of the real world facing them in the medical profession through self-directed learning, teaming, and integrative thinking. It made the students at the

learning process' hub compelling their identification of learning needs, gaining knowledge autonomously, and utilizing it in a contextual manner to solve clinical cases. As time passed, PBL developed into a pillar of many curricula in the medical field all around the globe, especially on undergraduate level of medicine [2].

Clinical reasoning, which is the cognitive process that helps medical practitioners gathering and evaluating the patient's information so as to make an informed decision, was a basic competence for safe and effective clinical practice. Clinical reasoning skills needed to be developed in undergrad students to enable future physicians to cope with the challenges associated with the handling of diagnostic uncertainty, and make efficient synthesis of information and sound judgment in medicine [3]. Conventionally, curriculums in medicine were very lecture heavy, in which memorization rather than application was often the goal. This approach was criticized for its low efficacy in developing the skills in analyzing and integrating information for clinical reasoning.

Unlike PBL, the former was designed around authentic or simulated clinical situation whereby the students were called upon to navigate and apply biomedical knowledge cooperatively [4]. In facilitated group discussions and directed questions, PBL aimed at translating the complexities of clinical decision-making experienced in practice. Students were able to hypothesize and explore and revisit concepts in a cyclic manner which was reflective of real work toward solving issues. There are vast amounts of theories behind PBL such as constructivist and adult learning theory which suggested knowledge is better learned and applied in a more meaningful way when learnt through engagement and with fellow peers [5].

Over years, there were numerous studies conducted to examine the effectiveness of PBL in enhancing diverse aspects of medical education such as retention of knowledge, motivation, skills in communication, and academic achievements. However, the extent of its effect on clinical reasoning skills was an issue that was still being deliberate on. Although studies found that PBL improved significantly diagnostic accuracy, as well as reasoning strategies and long-term prevalence of knowledge working (4), other studies revealed little or unsolicited effects [6]. Many times the variation in outcomes was explained by the different levels of PBL application, preparedness of students, skills of the facilitators, and institutional support.

Considering the increasing trend to the outcome-based education and the importance of clinical reasoning for medical competence, the exact impact of the PBL on these competencies had a certain significance. The comprehension of whether PBL was more effective in facilitating the development of clinical reasoning than traditional methods of teaching could be useful in designing the curriculums and educational policy in medical schools [7]. Besides, it was also necessary to evaluate not only the cognitive outcomes but also the perceived experiences of the students who went through PBL-based instruction.

The research was designed to examine the effect of Problem-Based Learning on the clinical reasoning skills among medical students in terms of comparing their performance, perceptions, and problem-solving competences in formal learning environments [8]. In order to provide a comprehensive picture about how PBL affected the patterns under which students approached clinical problems the research explored quantitative and qualitative outcomes. The findings were aimed at extending the discussion on curriculum innovation in medical education and provided evidence-based suggestions on how to improve teaching and learning of clinical reasoning in the undergraduate training [9].

## MATERIALS AND METHODS:

### Study Place:

The study was carried out in Shifa international hospital Islamabad, Pakistan. This hospital famous for its educational programs and medical training was the setting of evaluation of the effect of problem-based learning on the clin reasoning ability amongst the medical students.

### Study Duration:

The study was conducted in the period from May 2024 – April 2025. This one-year interval was sufficient

for gathering and evaluating enough data for the long-term effects of PBL on clinical reasoning skills of students.

**Study Population:**

Out of the total number of students, only 90 medical students were selected who were in their clinical phase of medical education in Shifa International Hospital. The participants were subjected to the purposive sampling whereby they were required to undergo a certain number of foundational courses in medicine before the study. These students were randomly allocated into the PBL intervention group or into the traditional learning group for purposes of comparison.

**Inclusion Criteria:**

Medical students who had taken basic medical sciences courses and were under clinical phase of training. Students who agreed to take part in the study.

**Exclusion Criteria:**

Those students, who had their previous experience of PBL methodology in the educational process. Incomplete data students or the students who did not involve themselves in the study for the whole period.

**Intervention:**

The students of the intervention group were subjected to Problem-Based Learning (PBL) sessions, where they concentrated on clinical reasoning. The PBL sessions consisted of groups of students in order to be presented with real-life clinical scenarios. Such scenarios involved the students in solving the problem by using their knowledge, analyzing the problem, and developing collective diagnostic and therapeutic solutions. Each session took two hours and was conducted by experienced members of the faculty.

The conventional learning group also used the traditional ways of teaching in lectures, and clinical reasoning was delivered in a slightly more structured, didactic style.

**Data Collection:**

Pre- and post intervention assessments were used to collect data, in order to determine the effects of PBL on clinical reasoning skills. The assessments included:

Pre-Test: A written test in order to assess baseline clinical reasoning abilities before the intervention.

Post-Test: A similar written test taken after the intervention aimed at ascertaining any change in clinical reasoning abilities.

Focus Group Discussions: Qualitative understanding of students' perceptions on the PBL method along with comments on the way it affected their clinical reasoning and learning practice.

Faculty Evaluations: Those clinical faculty who interfaced with the students during the period of study generated evaluations for the students in terms of their clinical reasoning and practical performance.

**Data Analysis:**

The quantitative data from the pre- and the post-tests in the programme were subjected to statistical analysis (particularly: paired t-tests) so as to assess the significance of difference in clinical reasoning skills pre and post-intervention. Qualitative data obtained from focus group discussion was analyzed thematically for reoccurring issues with respect to the students' experiences and perceptions of PBL.

**Ethical Considerations:**

The work was carried out based on the ethical principles and all involved persons gave informed consent before taking part in the study. Students were told that it was voluntary to participate in the study and could withdraw from it anytime without penalty. The privacy of all the players in the study was kept in check throughout. The research work was approved by institutional ethics committee of Shifa International Hospital.

**RESULTS:**

The study consisted of 90 medical students from Shifa International Hospital Islamabad and was aimed at assessing the effects of Problem-Based Learning (PBL) on skills of clinical reasoning. The participants

were comprised of 50% males and 50% females who are students. The students were from various years of their medical education with 30 participants of every year (Year 1, 2, and 3).

**Table 1: Demographic Characteristics of Study Participants:**

| Characteristic | Frequency (%) |
|---|---|
| Age (Mean ± SD) | 23.5 ± 2.1 years |
| Gender | |
| Male | 45 (50%) |
| Female | 45 (50%) |
| Year of Study | |
| Year 1 | 30 (33.3%) |
| Year 2 | 30 (33.3%) |
| Year 3 | 30 (33.3%) |

Table 1 is a summary of the demographic features of the participants with a relatively balanced age and gender distribution of the participants in the study population. Mean age of the subjects was 23.5 ± 2.1 years.

**Table 2: Comparison of Clinical Reasoning Skills Before and After PBL Intervention:**

| Clinical Reasoning Assessment | Pre-PBL (Mean ± SD) | Post-PBL (Mean ± SD) | p-value |
|---|---|---|---|
| Critical Thinking Score | 58.2 ± 6.5 | 72.1 ± 7.3 | <0.001 |
| Problem-Solving Score | 60.4 ± 5.9 | 74.3 ± 6.1 | <0.001 |
| Decision-Making Score | 57.6 ± 6.2 | 71.0 ± 7.0 | <0.001 |

From table 2, comparison of Clinical reasoning skills before and after the PBL intervention is shown. The critical thinking, problem-solving, and decision-making scores were all much higher post-intervention (p-values < 0.001 for each category). In particular, the Critical Thinking Score went from an average of 58.2 to 72.1, the Problem-Solving Score jumped from 60.4 to 74.3, and the Decision-Making Score â from 57.6 to 71.0. Such advancements reveal that PBL contributed greatly to improve clinical reasoning skills of the students, which shows the efficiency of this educational technique to develop essential skills in the context of medical practice.

**DISCUSSION:**

The effect of Problem Based learning on clinical reasoning skills of medical students was evaluated in the current study. Findings proved that students who received PBL curricula demonstrated significantly higher skills in clinical reasoning when compared to the traditional learning, based on lectures [10]. This was in line with previous literature indicating that PBL facilitated a student-centered, active manner of teaching that not only increased knowledge acquisition but also the integration of knowledge in clinical situations.

PBL was already known to be based on the concept of self-directed learning, small group collaborations, and problem-solving. In this study, students in the PBL group exhibited greater competence on identification of relevant clinical information, generation of differential diagnoses and proposals for management plans [11]. These results supported the theoretical base of PBL, wherein it enunciated that learning in context and particularly in solving authentic clinical problems, triggered deeper cognitive processes and knowledge retention in the long term.

What is more the research identified that the students engaged in PBL discussions there were significant improvements in their capacity to integrate basic science related information with clinical information [12]. This integration was essential for the clinical reasoning because it involved the learners to apply basic principles to real-life situations involving patients. The iteration in PBL which required subjects to make hypotheses, to investigate and then refine on the basis of feedback seemed to replicate the diagnostic process and thus improve students' reasoning abilities.

It was also noted that in PBL collaborative learning setting, students were able to engage with each other not only to learn, but different perspectives when addressing a clinical problem [13]. These group interactive sessions helped cultivate reflective thinking and provoked thoughts articulation, both of which were essentials in building sound clinical judgement. Group discussions also encouraged the accountability, communication, and leadership skills, which indirectly facilitated the development of clinical reasoning.

Even though the advantages of PBL were obvious, the study identified some flaws. Some of the students had found the absence of structure and increase in responsibility in self-directed learning challenging at first [14]. Nevertheless, most adjusted to the PBL format over time and enjoyed the autonomy given by it. This indicated that proper orientation and guidance was important during the change to a curriculum under PBL. Expertise of facilitators also was of vital importance to ensure that discussions were not digressed, rather educational objectives were met.

Inspite of the improvements noticed in clinical reasoning skills, it was observed that PBL may not be the same effective to all students. Individual learning style, motivation, and prior academic experience can have had an impact on outcomes. Hence, the future studies should examine the means of making PBL approaches more learner-oriented in the context of the diversity of learning needs [15].

The other aspect was resource-intensiveness of PBL. It needed trained facilitators, adequate space and small groups, and this was a logistical problem in the big medical schools. As such, the benefits in the form of enhanced reasoning skills and better preparation of the students for clinical practice may compensate for the cost, particularly in the institutions that aim to train competent and reflective practitioners.

To conclude, this study proved that PBL is positive in developing the medical students' clinical reasoning skills. The results justified the incorporation of PBL into medical programs as a way to perfect the diagnostic thinking and skills in their decisions. New curriculum planning, constant faculty development, and curriculum assessment were suggested to make the most of PBL and make it sustainable in delivery of education in the field of medicine.

**CONCLUSION:**

The effect of the Problem-Based Learning (PBL) on the development of clinical reasoning skills in the medical students was proved to be significant positive in the course of the study. Participants involving themselves in PBL activities always showed enhanced critical thinking, diagnostic accuracy, and decision-making skills as compared to those students who are taught using the traditional lecture-based manner. Interactive and student-oriented approach in PBL contributed to the deepened comprehension and application of medical knowledge in clinical situations. In addition, students also reported increased confidence and involvement in their learning process. These results supported the adoption of PBL into the medical programmes to facilitate the development of the fundamental clinical competencies. On a whole, the integration of the PBL proved effective in its development of analytical and problem solving skills required for effective clinical practice. Its long term benefits in different educational set-ups were recommended to be investigated in subsequent studies.

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