Efficiency of Problem-Based Learning (PBL) over Lecture method in terms of enhancing critical thinking skills and problem solving ability among Nursing students in selected Nursing Institutions of Tamil Nadu

A Thesis

Submitted to The Tamil Nadu Dr. M.G.R Medical University, Chennai,

for the award of the Degree of

Doctor of Philosophy in Nursing

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DECEMBER 2012

CERTIFICATE BY GUIDE

This is to certify that the thesis entitled "**Efficiency of Problem-Based Learning (PBL) over Lecture method in terms of enhancing critical thinking skills and problem solving ability among Nursing students in selected Nursing Institutions of Tamil Nadu",** submitted by **Shyla Kamalakumari.R**, who registered for Ph.D in 2009 is a bonafide record of the research done by her during the period of study under my supervision and guidance and that it is not formed on any basis for the award of any other Degree, or Diploma, Associateship, Fellowship or any other similar title or any other Universities.

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DECLARATION BY THE CANDIDATE

I hereby declare that this thesis entitled "**Efficiency of Problem-Based Learning (PBL) over Lecture method in terms of enhancing critical thinking skills and problem solving ability among Nursing students in selected Nursing Institutions of Tamil Nadu**, is an original work done by me under the guidance of **Prof.Dr.A.Charles Stephen Rajasingh, M.S., M.Ch.,** and has not been submitted elsewhere, either partially or fully for the award of any other Degree, or Diploma, Associateship, Fellowship or any other similar title.

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A THESIS SUBMITTED TO THE TAMILNADU DR. M.G.R MEDICAL UNIVERSITY, CHENNAI, INDIA, FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN NURSING

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ABSTRACT

A study was done to evaluate the efficiency of problem-based learning **(PBL)** over Lecture method in terms of enhancing critical thinking skills and problem solving ability among nursing students in selected Nursing Institutions of Coimbatore, Tamil Nadu for the award of the degree of Doctor of Philosophy in Nursing to The Tamil Nadu Dr. M.G.R. Medical University, Chennai during the year 2012.

INTRODUCTION: In today's fast paced, technologically advanced world, the challenge for nursing faculty is to teach students critical thinking (CT) skills and the ability to practice competently in a variety of situations. The rapidly changing nature of the health care system presents nurses with varied complex practice issues with no clear solutions. These health care problems require nursing students and nurses to have CT skills. Educators have to equip nursing students with skills that promote their CT to solve complex issues. The development of CT skills requires students to engage in discussions to become active participants in their own learning. Education with an active learning will result in significant increase between the education and medical practice. Unfortunately, traditional undergraduate exercise science courses using lecture based instruction are often content driven, emphasizing abstract concepts over concrete examples and application. Nurse educators in academia have long supported the notion of self-directed problem-based learning (PBL). Problem-based learning originated in the late 1960s at McMaster University in Ontario, Canada. Howard Barrows, the founder of this educational methodology, developed the self-directed model to improve education in the school of medicine. It was developed to improve medical education by moving from a subject and lecture-based curriculum to an interdisciplinary one guided by 'real-life' problems. Its effectiveness has been well documented in medical education research. Along with

self-directed learning, the development of critical thinking and problem solving skills is the main goal of PBL.

THE OBJECTIVES

The Objectives of the study were:

1. To assess the pre test level of critical thinking skills and problem solving ability of nursing students among the control and the interventional groups.
2. To assess the post test level of critical thinking skills and problem solving ability of nursing students among the control and the interventional groups.
3. To determine the effectiveness of PBL on critical thinking skills and problem solving ability of nursing students.
4. To assess the students' perception on the influence of PBL and Lecture method on their critical thinking skills and problem solving ability in both control and the interventional groups.
5. To associate the level of critical thinking skills and problem solving ability of both the groups with selected demographic variables.
6. To associate the students' perception on the influence of PBL and Lecture method on critical thinking skills and problem solving ability in the control and the interventional groups with selected demographic variables.

METHODS: A Quasi Experimental study with control group pre test and post test design was adopted to determine the effectiveness of PBL in enhancing critical thinking skills and problem solving ability among Nursing students. A total sample of 260- II year B.Sc Nursing students from selected colleges of Nursing in Coimbatore were included in this study, out of which 130 were allotted to the interventional group and the remaining 130 to the control group. Purposive Sampling Technique was adopted for this study. A structured questionnaire to assess the higher level of

cognitive skills was used to assess critical thinking skills and problem solving ability of nursing students. A five point Rating scale to assess the perceived benefits of the teaching method on critical thinking skills and problem solving ability was used. The data collected were analyzed using descriptive and inferential statistics based on the objectives and hypotheses.

RESULTS: The result of the present study reveals that there was a significant increase in the overall level of critical thinking skills and problem solving ability in the interventional group than in control group. Further, the students who underwent PBL process had a favorable perception towards PBL method of learning. Comparison of pre test and post test levels of critical thinking skills and problem solving ability of nursing students within both the groups. The overall 't' level in all the areas were 4.97 and 32.87 in the control and the interventional groups respectively, which shows a highly significant difference between the pre test and post test scores of interventional group ($P<0.001$). Further, there was a significant difference between post test -2 of control group and post test -2 of interventional group in the level of critical thinking skills and problem solving ability. The obtained overall't'value 12.17, was higher than the table value, which is highly significant at 0.001 level of significance. Differences between the control and the interventional groups at different points of time show a statistically significant difference was found in both the control group ($P < 0.001$) and the interventional group ($P < 0.001$). "F" value was highly significant in Interventional group compared to control group.

CONCLUSION: In the light of the findings, there is a positive effect on the influence of PBL in enhancing critical thinking skills and problem solving ability among nursing students. It offers several advantages over traditional lecture methods. It is based on principles of adult learning theory, including motivating the students,

encouraging them to set their own learning objectives, and giving them a role in decisions that affect their own learning. So, it was concluded that PBL is a potentially powerful and essential approach to promote quality in nursing practice, which is dependent upon the educational preparation of nurses to think critically and solve problems.

RECOMMENDATIONS:

1. The study can be replicated in a larger sample size.
2. A similar study can be conducted in other parts of Tamil Nadu.
3. Longitudinal studies can be done to provide a profile of students' development of approaches to learning over time in order to assess the enduring effect of PBL.
4. PBL should be introduced into nursing curriculum in order to promote critical thinking skills and problem solving ability among nursing students.

TABLE OF CONTENTS

Contd…

Contd…

Contd…

Contd…

LIST OF TABLES

Contd…

Contd…

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER-1

INTRODUCTION

1.1. BACKGROUND OF THE STUDY

Health care organizations have made dramatic advances and transformations during the last few decades, resulting in rapid growth of technology and theory. Some of the changes facing nursing today are an expansion in technology, consumer demand for quality care, pressure for cost containment, decreased length of stay in hospitals, an aging population, complex disease processes and increased patient acuity. These changes have been associated with incumbent ethical and moral dilemmas which are borne out in the daily practice of nurses. More marked changes are predicted in the coming decades, such as the development of technology prolonging an individual's life-span, which compounds the aging population situation and increases the burden of escalating healthcare expenditure.[1-9]

If nurses are to deal effectively with complex change, increased demands and greater accountability, they must become skilled in higher level thinking and reasoning abilities. Knowles[10] states that "facts learned in youth have become insufficient and in many instances actually untrue; skills learned in youth have become outmoded by new technologies". Nurses are now required to provide skilled, multidimensional care in multiple, often unfamiliar environments or settings.[11]

With its global social, economic, educational, environmental and health challenges, the 21st century does not demand the teaching of soon-to-be obsolete facts, but, rather, the fostering of critical thinking at all levels of education.[12] The need for documentation and evidence of critical thinking development in the accreditation of nursing programmes have been affirmed by the USA's National League for

Nursing.[13] The promotion of critical thinking as a major educational outcome of the nursing curriculum is also stipulated by the Council of Europe.[14] No thoughtful person can be appeared in a society in which educational system accepts the problems uncritically.[15]

The world of nursing has been changing daily specially in the last two decades. In today's fast paced, technologically advanced world, the challenge for nursing faculty is to teach students critical thinking (CT) skills and the ability to practice competently in a variety of situations. The rapidly changing nature of the health care system presents nurses with varied complex practice issues with no clear solutions. These health care problems require nursing students and nurses to have CT skills.[16]

Educators have to equip nursing students with skills that promote their CT to solve complex issues. The development of CT skills requires students to engage in discussions to become active participants in their own learning.[17] An efficient nurse requires some skill in order to overcome some practical difficulties. Most universities in the world are trying to find some educational approaches by which practical decision capacities, continuous and self-confidence educations to be enhanced in students.[18] Nurses have found that there is a gap between theory and practice. They are usually unable to do medical performances.[19] Education with an active learning will result in significant increase between the education and medical practice.[20]

Too often we... enjoy the comfort of opinion without the discomfort of thought."

– John F. Kennedy

Critical thinking is the first needed skill for nurse students.[21] It is the advance process of cognitive domain for decision making upon caring patients. The affective disposition of a critical thinker includes being inquisitive, systematic, judicious, truth seeking, analytical, open-minded, and confident in reasoning.[22]

In the contemporary healthcare environment characterized by rapidly changing developments and relentlessly increasing knowledge, the possession of critical thinking is essential for nurses in order to make sound judgment when solving clinical problems.[23-25]

Fowler [26] claims that practicing nurses and nurse educators concur that the increasing complexity of modern healthcare demands critical thinking. Every day, nurses sift through an abundance of data and information to assimilate and adapt knowledge for problem clarification and solution. Moreover, nurses are constantly involved in making decisions within their practice. These decisions are frequently concerned with situations where there is no single or absolutely correct response.[27]

Colucciello[28] proclaims the use of critical thinking is vital in examining simple and complex situations in nurses' day-to-day responsibilities. It is an essential means of establishing whether the information or assessment obtained has been accurately captured in order to articulate specifically and distinctly what the information conveys. Alfaro-LeFevre[23] asserts that critical thinking belongs in nursing because nursing is concerned with purposeful goal-directed thinking, with the primary aim of making judgments grounded on factual evidence rather than conjecture.

In the current climate of short staffing, cost containment and high expectations for quality nursing care, there is an urgent need for nurses to recognize and act upon

organizational and system problems. Failure to act on these problems may result in inequitable, poor quality or even dangerous nursing care.[29]

Snyder [2] states in the past, nursing has not been concerned with administrative aspects of health care. However, the time is ripe for nursing to address consumer-focused care. The process of critical thinking will enhance the ability of nurses to identify clinical indicators, assess their significance and discuss areas for improvement. Nurses use information from nursing practice, nursing theory and other sciences to apply knowledge to individual situations. As indicated by Halpern,[30] it is vital that teachers encourage students to apply the knowledge and skills learned in one context to other situations. Students should be encouraged to transfer critical thinking knowledge, skills, and dispositions learned in the educational environment to their personal and professional lives. Nurses need to be prepared for lifelong learning.[31,32] and the future nursing profession is going to recognize a graduate who can think critically and identify complex clinical phenomena. In order to solve unique and complex problems nurses need to be organized and utilize information innovatively. This is an empowering activity.[10]

Invest a few moments in thinking. It will pay good interest." - Author Unknown

Ulsenheimer[34] suggests critical thinking is a process for reasoning which anyone has the capacity to master, proposing that "such a reasoning process will provide nurses with a capacity to defend their actions". Alfaro-LeFevre[23] emphasizes, it is imperative that nurses become critical thinkers in order to practice sound clinical judgment. He defines clinical judgment as critical thinking in a clinical area. Nurses must use critical thinking skills to rigorously investigate and reflect on all aspects of a clinical observation or problem in order to decide on an appropriate course of action.

Incorporating critical thinking skills also involves a reflective component. The nurse must make decisions based on sound clinical judgments, as gathered from a wide variety of sources, as well as the nurse's own observations. The reflective component is a review of those judgments and a validation of their appropriateness.

Kurfiss[35] perceives critical thinking as an investigation in order to explore a situation, question, problem or phenomenon. From this inquiry, the person is able to arrive at a reasoned conclusion that can be justified. As Kurfiss states "in critical thinking all assumptions are open to questioning, divergent views are aggressively sought and the inquiry is not biased in favour of a particular outcome."

"Children are not vessels to be filled but lamps to be lit."

-Swami Chinmayananda, Indian Spiritual Leader

"Out of the questions of students come most of the creative ideas and discoveries."

- Ellen Langer

Central to this interpretation of critical thinking is a realization that critical thinking is not a method to be learned, but rather a process, an orientation of the mind and so, includes both the cognitive and affective domains of reasoning.[36] As a concept, critical thinking has been expressed in several ways. A major influence in critical thinking traces back to the work of John Dewey.[37]

From a philosophical perspective Dewey[37] proposes that critical thinking involves suspension of judgment and healthy skepticism. Early writers such as Ennis[38] suggest students should be assisted in the engagement of thinking that is reflective, reasonable and directed on what to believe or do. Ennis[38] views critical thinking as

"the correct assessing of statements" and notes an individual who is able to think critically, according to this definition, has the skills to evaluate statements.

Employers seek graduates who are highly knowledgeable, skilled problem solvers, team players, and lifelong learners.[39] In order to prepare students for entry into professional practice, educators must create learning environments that engage students in ways that help them develop the necessary context expertise as well as problem solving, collaboration, and lifelong learning skills.[40]

Unfortunately, traditional undergraduate exercise science courses using lecture based instruction are often content driven, emphasizing abstract concepts over concrete examples and application. Little attention is given to learning problem solving, collaboration, and lifelong learning skills.[41] Furthermore, faculty often have little pedagogical training and revert to previous learning experiences, simply stated "teaching as we were taught".[42] Traditionally, lecture has been the choice method of instruction because it is seen as the most efficient and convenient method of instruction to offer the most information in the shortest time. Faculty may be unaware that it is reported that only 5-15% of presented content is learned in lecture based courses.[43] Furthermore, there is often little concern for the students' capacity to absorb, understand, retain, and apply the information in subsequent clinical situations.[41] If students cannot retain or apply information given by lecture than the goal of professional preparation is not being met. In retrospect, lecture-only courses may not be the most effective method of professional education.

"The objective of education is to prepare the young to educate themselves throughout their lives." *- Robert Maynard Hutchins*

Information–heavy presentation within a lecture likely results in students cramming to simply memorize information in order to pass examinations. Such instructional methods may not result in long-term knowledge retention.[44] Long-term knowledge is acquired through activation of prior knowledge, discussion, application, and reflection. Cognitive psychology principles suggest that prior knowledge is the key in determining what additional knowledge can be learned.[45] Instructional methods must allow the activation of prior knowledge in order to process and garner new knowledge.

No problem can be solved by the same consciousness that created it. We need to see the world anew." - *Albert Einstein*

Problem solving has been referred to as the ability to apply appropriate metacognitive and reasoning strategies. [46] In the traditional classroom setting students often are exposed to problem solving application lectures in a contextual situation; yet for a student to truly learn to perform problem solving skills, he or she must be given the opportunity to actively do so.

During the problem-solving process, the professional must analyze the problem using prior knowledge activation to determine what is known and unknown and seek a variety of sources to assist in finding the unknown information. The professional synthesizes a solution through critical thinking and reflects upon the experience through self-evaluation once all the pertinent information is collected and critiqued. In critical thinking, a person gives reasoned consideration to evidence, context, theories, methods, and criteria in order to form a purposeful judgment and simultaneously monitors, corrects, and improves the process through meta-cognitive self-regulation. Critical thinking experts define critical thinking as the process of

purposeful, self regulatory judgment; an interactive, reflective, reasoning process.[47] For example, The National League of Nursing has affirmed that professionalism requires thoughtful decision making founded on the ability to make purposeful, reflective judgments which involve analysis, interpretation, inference, evaluation and explanation i.e., critical thinking.[48]

Bloom's taxonomy moves from the simplest level of learning (knowledge) -- to the most complex level (evaluation). The words used to construct a question will determine the level of the answer.

Too often we give children answers to remember rather than problems to solve."

- Dr.Roger Lewin, British anthropologist and science writer

Recent trends in education point to a shift from a traditional teaching paradigm of teacher-directed and traditional lecture format to a learning paradigm of self-directed, interactive learning.[49] Nurse educators in academia have long supported the notion of self-directed problem-based learning (PBL). Problem-based learning originated in the late 1960s at McMaster University in Ontario, Canada. [50] Howard Barrows, the founder of this educational methodology, developed the self-directed model to improve education in the school of medicine.[51] It was developed to improve medical education by moving from a subject and lecture-based curriculum to an interdisciplinary one guided by 'real-life' problems.[50] Its effectiveness has been well documented in medical education research.

An essential characteristic of the PBL approach is the concept of self-directed learning. The literature reveals that self-directed learning is associated with Malcolm Knowles, an influential leader in the field of adult education.[52] The notion of

andragogy, based on the assumption that adults learn differently than children, is the central concept of Knowles' model of teaching adults.

Along with self-directed learning, the development of critical thinking and problem solving skills is the main goal of PBL. According to Ladouceur et al, [53] "critical thinking is one of the core competencies identified by nursing faculty through educational experience and support from the literature as essential for individuals to become self-directed learners". Problem-based learning affords an environment conducive to teaching and learning critical thinking skills.

There is an abundance of literature to support the effectiveness of PBL in medical and nursing education.

Key words:

- Problem – Based Learning
- Critical Thinking
- Problem Solving

Problem – Based Learning (PBL)

Problem Based Learning (PBL) encourages students to identify their own gaps in knowledge. It is a process – driven method for learning, which has as its goal self – directed information retrieval, and utilization of that information to solve clinical problems.

An essential component of PBL is that context is introduced in the context of complex real – world problems. PBL uses an inquiry model.

Critical Thinking

Critical thinking (CT) is a learned behavior which is essential for decision making. Skills in critical thinking provide the necessary broader outlook, creative solution, and multiple pathways needed for successful quality improvement initiatives.

Problem Solving

Problem solving is the practical application of critical thinking skills. Problem solving is a systematic process leading to the achievement of outcomes.

Table No. 1.1. Comparison – CASE Method and PBL

CASE METHOD	PBL
Uses case material or problem sceneries as a vehicle for analysis and / or decision making	Same
Knowledge precedes the problem	The problem comes first
Often a step-by-step analysis by the teacher models the critical thinking process, followed by student discussion.	The problem is posed so that the students discover that they need to acquire some new knowledge before they can understand or solve the problems.

1.2. SIGNIFICANCE AND NEED FOR THE STUDY

Information – dense lectures, presented by a series of experts to large student audiences, seemed disconnected from the application of content to real life, which requires integration of knowledge, decision making and working and communicating

with others. The traditional lecture is one of the oldest and predominantly used teaching methods in American colleges and universities. Traditional educational curricula are didactic, teacher-centered teaching methods organized around subject areas or disciplines.[54] A prominent feature of such an educational philosophy is a hierarchical view of teacher and students, in which the faculty teaches, and students learn by listening to the teacher. Hence, the traditional classroom is teacher-centered, with students passively accepting information given by the lecturer, who is in the position of authority. A traditional teaching-learning environment tends to produce shallow, surface thinkers who primarily rely on rote memory rather than careful understanding of the content.[55] It has been argued that outcomes of didactic learning fail to exhibit a patient-oriented; critically thinking nurse capable of adequate decision making in practice, as lecturing principally provide basic knowledge and theory.[56]

According to Charlton,[57] lectures are for the most part a form of spoken communication that is delivered to an audience by an actually-present and visible person. Once combined with active learning strategies, teaching becomes a process where the learner takes an energetic role in education. Active learning is usually enjoyable, motivational and effective, and retention of knowledge is perceived to be increased.[58]

The teacher delivers structured packages of theoretical or practical knowledge complete with analysis, insight, and conclusions, while students are expected to take notes, memorize and master the imparted information.[59] Traditional educational curricula are didactic, teacher-centered teaching methods organized around subject areas or disciplines.[59] A prominent feature of such an educational philosophy is a hierarchical view of teacher and students, in which the faculty teaches, and students

learn by listening to the teacher. Hence, the traditional classroom is teacher-centered, with students passively accepting information given by the lecturer, who is in the position of authority. The teacher decides about the teaching-learning process. A traditional teaching-learning environment tends to produce shallow, surface thinkers who primarily rely on rote memory rather than careful understanding of the content.[55] Once combined with active learning strategies, teaching becomes a process where the learner takes an energetic role in education. Active learning is usually enjoyable, motivational and effective, and retention of knowledge is perceived to be increased.[58]

According to Richardson,[60] the key student behavior that brings about active learning is engagement. According to Kane,[61] it is satisfying for educators to think that students might enjoy themselves while being engaged in their learning, as they learn something useful. The traditional lecture format in higher education often represents an exercise in one way communication that places students in a passive rather than an active role and which ultimately minimizes the students' ability to develop higher order skills such as analysis, evaluation and synthesis of ideas and concepts. Studies have shown that the "pure" lecture method is not the most effective teaching strategy to stimulate thought and enhance problem-solving skills. At the same time, there is an abundance of literature that challenges educators to consider moving beyond the lecture method to active learning models which requires students to take greater responsibility in their own learning. The rapid changes in healthcare and growing complexity of nursing requires that students be proficient in critical thinking in order to provide safe, quality care for increasingly acute and complicated problems in a variety of settings. Nurses are frequently called upon to make immediate life and death decisions, and their ability to do so is dependent upon their ability to think critically and problem solve. Although these skills are called by

various names in the profession, including “the nursing process” and “clinical reasoning”, they are modeled on the scientific method and entail goal directed thinking using judgments based on evidence. [62] Although the ability to solve problems and make decisions has been identified by employers as the most important competency for beginning nurses, it is also the one that was least likely to be observed.[63]

Fostering critical thinking ability in nursing students has become one of the most imperative tasks for nursing education. Over the past ten years, critical thinking became a required learning outcome for national accreditation of nursing education programs, yet there is still lack of consensus in regard to what critical thinking is in nursing, and very little formal research has been done to determine which teaching methodologies improve critical thinking in nursing students. Teaching methodologies used to promote critical thinking needs to be investigated to enhance the delivery of safe and effective care to improve student success on the NCLEX-RN Exam. To McPeck[64] critical thinking involves both a propensity and skill – “one must develop the disposition to use those skills”.

There is some evidence to suggest that medical students following PBL curricula are better disposed towards research and show significant improvements in preventive care and diagnostic performance in practice after graduation. PBL is an educational tool that has been widely used in medical education to introduce learners to independent problem solving. PBL has strong political support in health care studies. Among others, the World Health Organization, the World Bank Group and the ENB (The English National Board for Nursing, Midwifery and Health Visiting) have begun to publicly support PBL-based training. In the 1990s, for example, the

World Bank Group set as a condition for financing nursing training in developing countries, that the study programme had to be based on the PBL idea.[65,66]

National Strength and Conditioning Association Certification Commission (NSCA-CC) defines three cognitive levels as recall, application, and analysis. Although recall is important, application and analysis are complex cognitive skills applied to critical thinking, not rote memorization. The NSCA-CC definitions of application and analysis include additional higher order cognitive thinking based on Bloom's Taxonomy[67] such as synthesis and evaluation. To best prepare students for the strength and conditioning profession, educators must find the most effective instructional method for teaching students how to design strength training and conditioning programs. In order to properly design a program the student will need to learn critical thinking skills of application and analysis. Because traditional lecture instruction (TI) has been shown to be less effective than other teaching methods in practical application and critical thinking skills,[68-70] a solution might be Problem-Based Learning (PBL). PBL is an active learning instructional method that uses "real world" problems to facilitate instruction so students can develop critical thinking and problem solving skills while gaining new knowledge. PBL allows students to become active learners because learning is placed in the context of real-world problems and requires students to become responsible for their own learning, i.e. self-directed learning .[46] Problem based learning courses have also been reported as having an increase in course enrolment and more positive feedback from faculty and employers.[71] In addition to emphasizing learning by "doing," PBL requires students to be meta-cognitively aware, that is, students must learn to be conscious of what information they already know about the problem, what information they need to know to solve the problem, and the strategies to use to solve the problem. Being able

to articulate such thoughts helps students become more effective problem-solvers and self-directed learners.[72]

PBL in the education of health professionals was first established in North America at McMaster University in 1969 due to the increasing frustration of the inability of medical students to apply knowledge learned in previous years.[72] It has also been used in the fields of health professionals such as nurses, chiropractors, physical therapists, athletic trainers, and pharmacists, as well as basic science courses.[73-81]

In a study comparing PBL with conventional lecture approaches, the PBL students rated themselves higher as a measure of clinical problem solving ability.[82] In nurse education, the relation between theory and services is strengthening. Nurse education may be significantly improved if new teaching practices are introduced. One suggested way to bridge the gap between education and medical practice is to change the traditional education system (lecture based learning) into a problem-based learning (PBL) approach which historically can be traced back to Socrates.[83]

According to Celia and Gordon,[84] problem scenarios are designed to challenge the learners to meet the curriculum's objectives. Learners are presented with a clinical situation or issue about which they must engage in collaborative learning. This integrative group approach to learning develops interpersonal skills, teamwork, and personal growth for the participant. According to Price and Price,[85] "The application of this learning methodology can be viewed as essential for staff nurses in that it allows them to contextualize their knowledge. Furthermore, they suggested that adjustments to the traditional process of PBL in the clinical setting may be necessary. For instance, clinical learning is not continuous, and it may need to be reviewed over

a period of time. It is imperative that the nurses recognize this and be able to transfer and contextualize their knowledge to different patient populations. In addition, clinical supervisors or clinical leaders may fulfill the role of the facilitator but in a modified manner ''. It is essential, however, that the facilitators in the clinical setting promote and create a culture of learning that is aligned with the primary objectives and key concepts associated with a PBL program.

PBL promotes students' confidence in their problem solving skills and strives to make them self-directed learners. These skills can put PBL students at an advantage in future courses and in their careers. While such confidence does not come immediately, it can be fostered by good instruction. Teachers who provide a good learning community in the classroom, with positive teacher-student and student-student relationships, give students a sense of ownership over their learning, develop relevant and meaningful problems and learning methods, and empower students with valuable skills that will enhance students' motivation to learn and ability to achieve.[86]

The literature on self-directed learning is expansive. Faculty at McMaster University's School of Nursing has integrated many of Knowles' concepts in the development of the PBL approach to nursing education. Based on Knowles' basic principles of self-directed learning, the faculty of McMaster proposed six competencies essential for individuals to become self-directed learners: the assessment of learning gaps, evaluation of self and others, reflection, information management, critical thinking, and critical appraisal.[87] "Students develop a deeper awareness and ownership of important concepts in the course by working on activities, a basic tenet of the constructive approach to learning".[88]

Several studies have reported on the effectiveness and applicability of PBL in medical education. According to Beers,[89] "one of the strongest arguments in favor of PBL is that it provides a more enjoyable and stimulating learning environment for both students and faculty". Studies have assessed student's attitudes, clinical reasoning abilities, problem solving skills, critical thinking skills, effect on learning styles, and retention of information as related to the use of PBL. "Albanese and Mitchell[90] conducted a literature review on outcomes and implementation issues of PBL. All of the studies cited found students' attitudes toward PBL to be positive".[44] Powerful learning environments should support the constructive cumulative, goal oriented acquisition processes in all students, they should allow for the flexible adaptation of the instructional support, especially the balance between self-discovery and direct instruction.[91] Although active learning requires additional work on the part of students and faculty, Kingsland[92] observed that students find PBL courses satisfying.

Albanese and Mitchell [90] as cited in Morales-Mann and Kaitell[27] reported that students and faculty felt more rewarded and nurtured and thus enjoyed PBL more than traditional learning approaches. According to Siu, Laschinger, and Vingilis[82] "findings from research have shown PBL is more effective than conventional approaches in facilitating greater student motivation, breadth of interest, learning satisfaction, confidence with clinical functioning, knowledge acquisition, use of a variety of learning resources, and self-directed work". Furthermore, the educational methodology of PBL provides an environment conducive to flexible learning, collaborative learning, opportunities for self and professional development, and finally, a sense of empowerment, which in turn enhances the process of learning.

Meyers[93] suggests that for a learning environment to be conducive for the development of critical thinking, four elements have to be present: (1) stimulating students' interest, (2) creating meaningful discussion, (3) exposure to thoughts and views of others, and (4) fostering a trusting and supportive atmosphere. When the principles and processes of PBL are examined, it seems that this learning strategy encapsulates those four elements proposed by Meyers. PBL embodies the principle that the starting point of learning is a problem. By presenting students with a problem for which no certain answer exists, their interest is captured. As the students reason their way through the learning process, questioning and debating through each stage of the problem-solving, they are engaging in meaningful discussion. PBL encourages students to share their analyses of the problem situation, and to consider theirs as well as alternative analyses. Finally, PBL acknowledges students as key players in their own learning and capable of thinking for themselves. This philosophy of recognizing students' ability in independent thinking and active learning fosters trust and respect in the learning environment. Thus, it can be argued that PBL creates suitable conditions for students to develop their critical thinking. Indeed, it has been suggested that PBL is one of the most effective ways of fostering critical thinking in nursing students.[94]

At the New Mexico VA Health Care System, problem-based learning was implemented in ambulatory care to enhance critical thinking and decision-making skills. Both critical thinking and decision making are fundamental to providing quality, efficient, and cost-effective care

The complexity of today's society is characterized by an infinite, dynamic and changing mass of information, the massive use of the internet, multimedia and educational technology, a rapid changing labor market demanding a more flexible

labor force that is directed towards a growing proportion of knowledge-intensive work in teams and lifelong learning.[95] As a consequence, today's information community expects graduates not only to have a specific knowledge base but also to be able to apply this knowledge to solve complex problems in an efficient way.[96] Educational research has shown that successful problem solvers possess an organized and flexible knowledge base and master the skills to apply this knowledge for problem solving.[97] Assessment needs to fit the philosophy of active learning rather than passive reproductive learning. It may be preferable, and more rigorous, for assessments to follow the PBL philosophy and to require the individual to analyze a problem, search for and then apply relevant information.[98]

The concept of critical thinking is described synonymously in the literature as creative thinking, smart thinking, high-quality thinking, and in-depth thinking.[99] The philosophical origins of critical thinking can be traced to that of Socrates and his use of cross questioning and the process of reasoning.[100] Both inductive thinking and deductive thinking are part of the critical thinking process. Hence, critical thinkers are able to relate concepts and determine causal relationships.[99] Critical thinking must and can be nurtured in both the academic and clinical settings for nurses. Problem-based learning affords an environment conducive to teaching and learning critical thinking skills.

Although new in some aspects, problem-based learning (PBL) is generally based on ideas that originated earlier and have been nurtured by different researchers.[101-105] PBL, as it is known today, aimed to increase students' abilities in independent study, problem-solving skills and analysis.[106] In 1971, PBL moved to Europe; the first faculty to use this strategy was the Mastrich Faculty of Limberg University. In 1982, medical teachers were introduced to an independent study as a basis of education and hence PBL was selected as an appropriate method to achieve

the aim. It grew from dissatisfaction with the common medical education practices in Canada.[107,108] Nowadays PBL is developed and implemented in a wide range of domains.

Barrows and Tamblyn[72] were two of the principal creators of the problem-based learning approach that was introduced at MacMaster University, and they offer the following definition:

Problem-based learning is the learning that results from the process of working toward the understanding or resolution of a problem. The problem is encountered first in the learning process! Barrows and Tamblyn suggest that problem-based learning is not simply the presentation of problems as a focus for learning, but rather it involves a very specific approach to education, which is supported by tools designed to support the teaching–learning process. Indeed, Barrows and Tamblyn claim that: problem-based, student-centered learning is the most efficient method of simultaneously developing knowledge, reasoning skills and study skills. Although the method was designed for use in medical education, Barrows and Tamblyn argue that problem-based learning is relevant and appropriate to other healthcare professionals, because it will enable them to apply their knowledge and enhance their practice.

The author also believes that healthcare organizations should actively support and promote educational methodologies such as PBL that will assist and support nurses in their clinical education and professional development. Moreover, the integration of PBL into clinical practice for nurses as an effective educational methodology allows nurses to achieve best practice outcomes based on real-life clinical problems, thus linking research evidence to nursing practice.

The felt needs by the investigator are the following:

(1) No such detailed study has been done in Indian context.

(2) Problem-based learning (PBL) has been advocated as a promising strategy to promote students' critical thinking. The desire to ascertain the effect of PBL on students' critical thinking led to this study.

(3) There is an abundance of literature to support the effectiveness of PBL in medical and nursing education. However, there is little evidence to support the transfer of this effective educational methodology to the clinical setting as a primary method of educating nurses.

Therefore, the researcher felt the need to enhance the critical thinking skills and problem solving ability of the learners through PBL approach.

1.3. STATEMENT OF THE PROBLEM

A study on the efficiency of Problem Based Learning (PBL) over Lecture method in terms of enhancing critical thinking skills and problem solving ability among Nursing students in selected Nursing Institutions of Tamil Nadu.

1.4. AIM AND OBJECTIVES

Aim of the Study

To investigate the efficacy of PBL approach on nursing students in enhancing their critical thinking skills and problem solving ability with that of lecture method.

Objectives

1. To assess the pre test level of critical thinking skills and problem solving ability of nursing students among the control and the interventional groups.

2. To assess the post test level of critical thinking skills and problem solving ability of nursing students among the control and the interventional groups.
3. To determine the effectiveness of PBL on critical thinking skills and problem solving ability of nursing students.
4. To assess the students' perception on the influence of PBL and Lecture method on their critical thinking skills and problem solving ability in both control and the interventional groups.
5. To associate the level of critical thinking skills and problem solving ability of both the groups with selected demographic variables.
6. To associate the students' perception on the influence of PBL and Lecture method on critical thinking skills and problem solving ability of both the groups with selected demographic variables.

1.5. HYPOTHESES

1. H_1- There is a significant difference in the level of critical thinking skills and problem solving ability of nursing students between the control group and the interventional group.
2. H_2- There is a significant difference in the level of perceived benefits on the influence of teaching method on critical thinking skills and problem solving ability of nursing students between the control group and the interventional group.
3. H_3- There is a significant relationship between the critical thinking skills and problem solving ability of nursing students and their perceived benefits on the influence of teaching method.

4. H_4- There is a significant association between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits with selected demographic variables.

1.6. OPERATIONAL DEFINITIONS

Efficiency

Efficiency refers to the outcome of PBL methodology in terms of enhancing critical thinking skills and problem solving ability of nursing students, as measured by the developed structured questionnaire on diabetes mellitus.

Problem – Based Learning (PBL)

Problem – Based Learning is a student-centered instructional strategy in which students collaboratively solve problems and reflect on their experiences. It is a learning that results from the process of working towards the understanding or resolution of a problem. As a curriculum, it consists of carefully designed and scripted problem scenario that demand a range of skills from the learner. These skills include: self-directed learning, critical thinking, team participation and acquisition of critical knowledge.

In this study PBL is an innovative learning method introduced to 2nd year B.Sc.Nursing students in which a case scenario on diabetes mellitus was assigned, that requires students to apply the seven steps of PBL, including (i) clarifying concepts, (ii) defining the problem, (iii) analyzing the problem, (iv) organizing facts and knowledge, (v) formulating learning objectives, (vi) self directed study and (vii) discussion. Here, the application of this PBL process will help the nursing students to

gain in-depth learning on the given scenario on diabetes mellitus through enhanced critical thinking skills and problem solving ability of nursing students.

Lecture Method

Lecture Method refers to a traditional method of teaching in which the teacher talks more or less continuously to the class on diabetes mellitus. This method of teaching allows students to be passive learners, depending solely on the faculty to teach them information instead of actively involving themselves in the learning process, thereby resulting in stifling of nursing students' critical thinking skills and problem solving ability.

Critical Thinking Skills and Problem – Solving Ability

In this study, the concept of critical thinking encompasses problem-solving as an integral part, which refers to the capability of the students to solve a patient problem on diabetes mellitus through purposeful, self-regulatory judgment, an interactive, reflective, and reasoning process of making a judgment, which is enhanced by PBL approach, as measured by the structured questionnaire on diabetes mellitus, comprising the levels of cognitive domains such as knowledge, comprehension, application, analysis, synthesis and evaluation.

Nursing Students

"Nursing students'' refer to 2nd year male and female B.Sc. Nursing students from selected Nursing Institutions.

Nursing Institutions of Tamil Nadu

Here, Nursing Institutions of Tamil Nadu refer to the Nursing Colleges at Coimbatore City that offer B.Sc.Nursing degree course and are affiliated to the Tamil Nadu Dr. M.G.R. Medical University, Chennai.

1.7. ASSUMPTIONS

1. Quality in nursing practice is dependent upon educational preparation of nurses to solve problem, think critically, and make decisions in today's health care system. PBL will positively influence learning outcomes along with learner's higher order thinking skills, such as critical thinking and problem solving.

2. PBL will promote integration of knowledge and foster a deeper approach to life-long learning.

1.8. DELIMITATIONS

This study was delimited to;

- only II year B.Sc.Nursing students studying at selected Institutions of Coimbatore, Tamil Nadu.
- Institutions affiliated to the Tamil Nadu Dr.MGR Medical University, Chennai.
- the responses of the respondents elicited through the structured questionnaire.
- evaluating the effectiveness of PBL only in terms of critical thinking skills and problem solving ability.
- only one topic (Diabetes Mellitus) in Medical Surgical Nursing-I.

1.9. PROJECTED OUTCOME

The result of the study would help to enhance critical thinking skills and problem solving ability among nursing students. Therefore PBL can be inculcated in the nursing curriculum as an effective teaching-learning method to promote life-long learning. PBL will further improve peer interaction and team work, in which students can discuss their thoughts and thereby will cause effective learning and will be an effective method to bridge the theory-practice gap.

CHAPTER-II

REVIEW OF LITERATURE

A good research does not exist in vacuum. Review of literature refers to an extensive, systematic examination of publication relevant to the research process. It is a written summary of the state of existing knowledge on a research problem. The task of reviewing research literature involves the identification, selection, critical analysis, and written description of existing information on a topic.

A wide range of literature was reviewed using various combinations of the following key words: critical thinking, critical thinking and problem solving abilities, critical thinking and nursing education, problem based learning, problem based learning and critical thinking skills, problem based learning VSs lecture method on critical thinking skills.

Review of literature for this present study is presented under the following sectors;

2.1. Studies related to Critical Thinking Skills and Problem Solving Abilities.

2.2. Studies related to Problem Based Learning

2.3. Studies related to Problem Based Learning on Critical Thinking Skills and Problem Solving Abilities

2.4. Studies related to Problem Based Learning VSs Lecture method on Critical Thinking Skills and Problem Solving Abilities

2.1. STUDIES RELATED TO CT SKILLS AND PROBLEM SOLVING ABILITIES

Critical thinking...the awakening of the intellect to the study of itself.

Critical thinking is a rich concept that has been developing throughout the past 2500 years. The term "critical thinking" has its roots in the mid-late 20th century. The word “critical” comes from the Greek word kritikos, meaning “critic”. To be critical means to question, to make sense of, to analyze. By being critical, one examines his or her own thinking and the thinking of others. The term “critical” is often thought of in a negative, destructive way; however, using it to describe thinking can portray a positive process in which one challenges one’s thinking and the thinking of others.[109]

Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. In its exemplary form, it is based on universal intellectual values that transcend subject matter divisions: clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth, and fairness.

It entails the examination of those structures or elements of thought implicit in all reasoning: purpose, problem, or question-at-issue; assumptions; concepts; empirical grounding; reasoning leading to conclusions; implications and consequences; objections from alternative viewpoints; and frame of reference. Critical thinking - in being responsive to variable subject matter, issues, and purposes - is incorporated in a family of interwoven modes of thinking, among them: scientific

thinking, mathematical thinking, historical thinking, anthropological thinking, economic thinking, moral thinking, and philosophical thinking.

Critical thinking can be seen as having two components: 1) a set of information and belief generating and processing skills, and 2) the habit, based on intellectual commitment, of using those skills to guide behavior. It is thus to be contrasted with: 1) the mere acquisition and retention of information alone, because it involves a particular way in which information is sought and treated; 2) the mere possession of a set of skills, because it involves the continual use of them; and 3) the mere use of those skills ("as an exercise") without acceptance of their results.

Critical thinking varies according to the motivation underlying it. When grounded in selfish motives, it is often manifested in the skillful manipulation of ideas in service of one's own, or one's groups', vested interest. As such it is typically intellectually flawed, however pragmatically successful it might be. When grounded in fairmindedness and intellectual integrity, it is typically of a higher order intellectually, though subject to the charge of "idealism" by those habituated to its selfish use.

Critical thinking of any kind is never universal in any individual; everyone is subject to episodes of undisciplined or irrational thought. Its quality is therefore typically a matter of degree and dependent on, among other things, the quality and depth of experience in a given domain of thinking or with respect to a particular class of questions. No one is a critical thinker through-and-through, but only to such-and-such a degree, with such-and-such insights and blind spots, subject to such-and-such tendencies towards self-delusion. For this reason, the development of critical thinking skills and dispositions is a life-long endeavor.

Critical thinking is self-guided, self-disciplined thinking which attempts to reason at the highest level of quality in a fair-minded way. People who think critically consistently attempt to live rationally, reasonably, empathically. They are keenly aware of the inherently flawed nature of human thinking when left unchecked. They strive to diminish the power of their egocentric and sociocentric tendencies. They use the intellectual tools that critical thinking offers – concepts and principles that enable them to analyze, assess, and improve thinking. They work diligently to develop the intellectual virtues of intellectual integrity, intellectual humility, intellectual civility, intellectual empathy, intellectual sense of justice and confidence in reason. They realize that no matter how skilled they are as thinkers, they can always improve their reasoning abilities and they will at times fall prey to mistakes in reasoning, human irrationality, prejudices, biases, distortions, uncritically accepted social rules and taboos, self-interest, and vested interest. They strive to improve the world in whatever ways they can and contribute to a more rational, civilized society. At the same time, they recognize the complexities often inherent in doing so. They avoid thinking simplistically about complicated issues and strive to appropriately consider the rights and needs of relevant others. They recognize the complexities in developing as thinkers, and commit themselves to life-long practice toward self-improvement. They embody the Socratic principle: *The unexamined life is not worth living*, because they realize that many unexamined lives together result in an uncritical, unjust, dangerous world.

A well cultivated critical thinker:

- raises vital questions and problems, formulating them clearly and precisely;

- gathers and assesses relevant information, using abstract ideas to interpret it effectively comes to well-reasoned conclusions and solutions, testing them against relevant criteria and standards;

- thinks openmindedly within alternative systems of thought, recognizing and assessing, as need be, their assumptions, implications, and practical consequences; and

- communicates effectively with others in figuring out solutions to complex problems.

Critical thinking is, in short, self-directed, self-disciplined, self-monitored, and self-corrective thinking. It presupposes assent to rigorous standards of excellence and mindful command of their use. It entails effective communication and problem solving abilities and a commitment to overcome our native egocentrism and sociocentrism.[187]

In a seminal study on critical thinking and education in 1941, Edward Glaser defines critical thinking as follows “The ability to think critically, as conceived in this volume, involves three things: (1) an attitude of being disposed to consider in a thoughtful way the problems and subjects that come within the range of one's experiences, (2) knowledge of the methods of logical inquiry and reasoning, and (3) some skill in applying those methods. Critical thinking calls for a persistent effort to examine any belief or supposed form of knowledge in the light of the evidence that supports it and the further conclusions to which it tends. It also generally requires ability to recognize problems, to find workable means for meeting those problems, to gather and marshal pertinent information, to recognize unstated assumptions and values, to comprehend and use language with accuracy, clarity, and discrimination, to

interpret data, to appraise evidence and evaluate arguments, to recognize the existence (or non-existence) of logical relationships between propositions, to draw warranted conclusions and generalizations, to put to test the conclusions and generalizations at which one arrives, to reconstruct one's patterns of beliefs on the basis of wider experience, and to render accurate judgments about specific things and qualities in everyday life.[188]

Morrison and Walsh-Free[110] asserted that CT incorporates assessment and multi-logical thinking as a key requirement for nurses to be able to relate and apply concepts to clinical situations. Giancarlo and Facione[111] asserted that CT is a disciplined, self-directed cognitive process leading to high quality decisions and judgments through the analysis, assessment and reformulation of thinking. “CT is widely recognized as an essential component of education and a powerful and vital resource in one’s personal and civic life”.[111]

Garrison’s[190] work on critical thinking describes five stages that critical thinkers engage in as they work through situations. These stages are not necessarily linear, but may represent a coiling of stages, stepping back into a previous stage as new information and concepts are introduced to the thinker and then moving further along in the five stages as the thinking progresses. Garrison’s five stages include problem identification when the learner experiences a triggering event that arouses curiosity, longing to determine more about the problem. This is followed by problem definition when the learner frames the problem and an approach to its solution using the experiences of others and themselves. Problem exploration involves the learner obtaining insight into the problem using inference, induction and deduction. Creative solutions to the problem are formulated, ideas are linked and assumptions made.

Applicability and problem evaluation is the next step. In this stage, evaluating what has been accomplished to this point occurs. Decision-making is a large component of this stage including an evaluation of the progress and mistakes made, and determining what else needs to be done. The last stage is problem integration. In this final stage, strategies are grounded in the actual situation and modifications are made allowing for sustained change. New knowledge is integrated into the individuals' tool kit as well as the solution to the problem being found. Despite such in-depth formulation of critical thinking by some researchers, Nursing and other professions have been unable to embrace one definition of the concept of critical thinking. This led to efforts to develop a consensus definition of critical thinking.

Critical thinking is described in many ways, but is most importantly viewed as a process rather than an endpoint or objective.[112] Critical thinking is not limited to disciplines, knowledge, or experience and occurs within and across all these domains.[113] Critical thinking is developed through reflection both on experience and knowledge.

According to Facione,[114] CT involves identifying problems, assessing resources and generating possible solutions. This definition has frequently been used in the fields of nursing and education. According to Facione,[114] CT skills include the ability to analyze, synthesize, infer, and evaluate situations.

"Education knits together critical thinking …with the fabric of students' experiences as a synthesizing process, providing students with the tools they will need to make sense of their world and the choices available to them and the insight they will need to make those choices wisely".[109]

The construct of critical thinking incorporates the application of knowledge and skills into clinical reasoning, clinical judgment or decision-making.

Numerous approaches to teaching and measuring the development of critical thinking skills of nurses and advanced practice nurses are recounted in the literature.[23] Few studies have been conducted in nursing settings to determine the effectiveness of any methods used in teaching critical thinking, and their results have been mixed.

One such person is John Dewey. He is often referred to in the literature as the philosopher, who, at the beginning of the 20th century, brought the concept of critical thinking to the forefront. Dewey[37] defined critical thinking as a reflective process, in which individuals are active, persistent and careful in the considerations in which they engage. Dewey[37] emphasized that it was necessary for an individual to suspend judgment until all aspects of the situation or concept were considered. He particularly stressed the role of the educational system as being responsible for preparing its students with critical thinking skills so they could be prepared to work in an ever-changing world. He believed that individuals should not only understand new information or elements of a situation, but must also understand the outcomes and implications of their beliefs and actions.[33]

Ennis,[115] philosopher and educator, described critical thinking as reasonably reflective thinking focused on deciding what to believe or do. In this definition, Ennis implied that critical thinking was necessary when problem solving or during the decision-making process.

Both Paul and Ennis[113,115] proposed that there were affective and behavioral aspects of critical thinking that must be considered in addition to the cognitive processes involved. The affective aspect must be stimulated in order for the individual

to begin thinking critically about a subject or situation. It is this affective aspect that activates the individual's critical thinking behaviors. Once activated, the individual becomes engaged in critical thinking. But the aspect that students must develop is the cognitive aspect.

Bloom, Englehart, Furst, Hill and Krathwohl[116] were first to present the six levels of cognition, commonly referred to as Bloom's Taxonomy. This taxonomy includes the levels of knowledge, comprehension, application, analysis, synthesis and evaluation. Bloom et al[116] postulated that these six levels were progressively more complex and mastery of the lower level had to be achieved before progressing to the next.

Bloom's Taxonomy refers to a framework facilitated by Benjamin Bloom that classifies the thinking behaviours that were deemed important to the process of learning. Bloom was concerned with the organization of educational objectives into such a structure that would allow for reliable and consistent assessment by instructors at the university/college level. Bloom, along with a group of educators, psychologists and school examiners, developed the framework between 1948 and 1953. This framework became Bloom's Taxonomy and encompassed three domains - the cognitive, the affective and the psychomotor. Bloom's Taxonomy is a hierarchical structure that identifies skills from lower order skills to higher order skills with the assumption that those possessing higher order skills must have already mastered the lower level skills below them. Bloom's Taxonomy is a useful framework for educators to keep in mind while they are designing learning environments.

Bloom's Taxonomy refers to three different domains of competence but is almost solely known for its framework of the cognitive domain. The cognitive domain is the most relevant in the discussion about educational design.

Affective

The affective domain is concerned with human attitudes and behaviours. Bloom's framework includes five levels that define the way in which humans process emotions, feelings, values, motivations and attitudes. These five levels are listed from most simple to most complex.

Psychomotor

The psychomotor domain is concerned with fine motor skills the ability to manipulate objects. It is important to note that Bloom and his colleagues never articulated sub-categories for the psychomotor domain although others have attempted to create their own hierarchical structure to represent the psychomotor domain.

Cognitive

The cognitive domain is the widely cited representation of Bloom's Taxonomy and the one most valued by educators. Framing the levels of knowledge, the cognitive domain has six levels divided into lower order thinking skills and higher order thinking skills that must be mastered in the following order:

Figure: 2.1. Bloom's Taxonomy

Table No. 2.1. Lower Order Thinking Skills

Level	Description	Keywords
1. Knowledge	The ability to recall information.	describe, define, list, state, identify, know that, outline, recall
2. Comprehension	The ability to understand.	explain, distinguish, summarize, interpret, translate
3. Application	The ability to use an understood concept in a new situation.	solve, apply, demonstrate, show, construct

Table No.2.2. Higher Order Thinking Skills

Level	Description	Keywords
4. Analysis	The ability to separate a concept into its components in order for greater understanding of how the parts affect the whole.	discriminate, differentiate, compare, contrast, break down
5. Synthesis	The ability to put understood parts together in order to create new meaning.	categorize, compose, generate, design, modify, create
6. Evaluation	The ability to make a judgment.	conclude, criticize, defend, justify, evaluate

National League for Nursing,[117] an accrediting body for nursing education programs, mandated that all educational programs include content on critical thinking and assess the critical thinking of their nursing graduates.

Profetto-McFrath J, Hesketh KL, Lang S, and Estabrooks CA[118] investigated the relationship between CT disposition scores and research utilization habits. Results found positive correlation between CT disposition score and overall research utilization.

Tommie, Nelms and Lane[119] state that according to the American Association of Colleges of Nursing, the diversity and complexity of nursing practice makes it essential to prepare nurses who can think critically and creatively, and who have substantial education in humanities, nursing and other sciences. As summarized by Schank,[31] critical skills for nursing are the ability to think, apply, analyze, synthesize and evaluate situations.

Rapps J, Riegel B, and Glasser D[121] conducted a study to determine if knowledge base, critical thinking skills, critical thinking dispositions, and experience could predict the cognitive development of registered nurses. Three levels of cognitive development (dualism, relativism, and commitment) were examined and found that Critical thinking skill was significant contributor to dualism; critical thinking dispositions contributed to all three levels of cognitive development. Experience contributed to commitment.

Miller and Malcolm[1] advocated the integration of instructional strategies to foster critical thinking into all levels of nursing curriculum.

Beckie TM, Lowry LW, and Barnett S[122] evaluated CT skills in students before and after curriculum revision (new curriculum with emphasis on CT); students were evaluated at entry and exit using California Critical Thinking Skills Test (CCTST). Students from old curriculum did not show statistically significant increase in CT scores between entry and exit. Students in new curriculum showed statistically

significant improvements between entry and exit, and were statistically significantly higher compared to old curriculum students (both at entry and exit).

Brown JM, Alverson EM, and Pepa CA[123] measured change in CT abilities over time using Watson-Glaser CT appraisal Significant differences (improvements) in CT ability found between program entry and exit for the traditional and RN-BSN students, but not with the accelerated students.

The purpose of the study conducted by Asako Kawashima and Marcia A Petrini[124] was to measure the dimensions of critical thinking (CT) of nursing students at baccalaureate nursing program and registered nurses at general hospital in Japan. The California Critical Thinking Disposition Inventory (CCTDI) was used to measure the dimensions of CT skills. The convenience sample consisted of three small groups: generic students (n=82) including freshmen and juniors; transfer students (n=16) at selected baccalaureate nursing program; and registered nurses (n=67) at selected general hospital were administered CCTDI. Descriptive statistics indicated that all groups had an ambivalent disposition towards CT in majority of sub-scale while they scored a positive disposition towards CT on several sub-scales. A one-way ANOVA indicated that registered nurses scored lower than other two groups of baccalaureate students on the total score and several sub-scale scores. The outcomes of this study propose recommendations regarding curriculum review for Japanese nursing education and reflection on professional boundaries for Japanese nursing practice.

Feng, Rung-Chuang, Chen, Mei-Jung, et al[125] conducted a study, in which Clinical nurses from four different clinical ladders selected from one medical center were stratified randomly. All qualified subjects who submitted valid questionnaires

were included in the study. A Taiwan version of the modified Watson-Glaser Critical Thinking Appraisal and Critical Thinking Disposition Inventory was developed to measure the critical thinking competence and critical thinking disposition of clinical nurses. Results showed that competence of interpretation was the highest critical thinking competence factor. Inference was the lowest and reflective thinking as a critical thinking disposition was more positive. In addition, age, years of nursing experience and experiences in other hospitals significantly influenced critical thinking competence *(* $p < 05$). Factors of age, years of experience, and nurses clinical ladder were shown to affect critical thinking disposition scores. Clinical ladder N4 nurses had the highest scores in both competence and disposition. A significant relationship was found between critical thinking competence and disposition scores, with 29.3% of the variance in critical thinking competence potentially explained by total years of nurse hospital experience. Clinical ladder and age were predictive factors for critical thinking disposition. Commonality was 27.9%.

Several researchers have attempted to determine the level of critical thinking of students in varying levels of nursing programs. A few have used analysis of journal writings to determine whether students have used critical thinking skills in their learning exercises. For example, Sedlak[126] set out to determine if nursing students enrolled in the first clinical course of their baccalaureate program thought critically after content on critical thinking was included in their curriculum. Critical thinking, in this study, was defined as a reasoning process in which individuals reflected on the ideas, actions and decisions of ones' self and others related to the clinical experiences in which they participated. Students (n=7) completed a weekly journal reflecting on the decision making they had done, and participated in three interviews throughout the semester and were observed in the fundamentals laboratory. Qualitative analysis

according to emerging themes showed that this small group of beginning nursing students thought critically. In addition, the use of reflective writing enhanced the individuals' meta-cognition and their perspectives on thinking changed over time.

Joanne Profetto-McGrath[127] conducted a study to find out the relationship of critical thinking skills and critical thinking dispositions of baccalaureate nursing students. The aim of the study was to investigate the critical thinking skills (CTS) and critical thinking dispositions (CTD) of students enrolled in a 4-year baccalaureate programme at a University in Western Canada. The study used a cross-sectional design. A volunteer sample of 228 students from all 4 years of the baccalaureate programme completed a background/demographic questionnaire, the California Critical Thinking Skills Test, and the California Critical Thinking Disposition Inventory. The reliability of the test and inventory were established using the Kuder Richardson 20 and Cronbach Alpha respectively. Both descriptive and inferential statistical analyses were carried out. The result showed increase in Critical thinking mean scores from years 1 to 4 with the exception of year 3. However, there was no statistically significant difference among the four student groups. Although differences in critical thinking disposition scores were not statistically significant, students' scores differed significantly on the systematicity subscale. There was a significant relationship between students' overall CTS and CTD scores. Approximately 38% of the students had adequate levels of CTS and 85·5% of the students had adequate levels of CTD.

In a study done by Joanne Profetto-McGrath, Kathryn L, Hesketh Sarah Lang and Carole A Estabrooks,[128] critical thinking dispositions and research utilization habits were detailed, and the relationship of critical thinking dispositions to research

utilization in a sample of 141 nurses working on two acute surgical units and five pediatric units in four tertiary care hospitals were examined. Results indicate a significant positive correlation between the total critical thinking disposition score and overall research utilization. Overall critical thinking disposition correlates significantly with all forms of research utilization, with the exception of symbolic research utilization. These findings indicate a need to foster critical thinking in both nursing education and the work environment.[128.]

In a study done by Shin K, Jung DY, Shin S, and Kim MS[129] Critical thinking dispositions and skills of senior nursing students in associate, baccalaureate, and RN-to-BSN programs were Compared using California Critical Thinking Disposition Inventory (CCTDI) and California Critical Thinking Skills Test (CCTST). The average score (for all 3 groups) on the CCTDI and the CCTST was less than the mean .There was a statistical difference between scores of the 3 groups with BSN students scoring best .There was a statistical relationship between the CCTDI and the CCTST. Lower-than-average scores may reflect authoritarian nature of Korean education.

Problem Solving Abilities

Problems - some people like them, some do not think they have any, while others shy away from them as if they were the plague. Opportunities, in the form of problems, are part of your life.

The most difficult decision is deciding to tackle a problem and implement a solution, especially as it is sometimes easier to ignore its existence. Problem-solving takes time and effort, but once a problem has been addressed the nurse can feel satisfied that the issue has been resolved and is therefore less likely to re-emerge.

Nurses make clinical decisions using two different approaches. The first is the rationalist approach, which involves an analysis of a situation so that subsequent actions are rational, logical and based on knowledge and judgement. The second approach is based on a phenomenological perspective, where a fluid, flexible and dynamic approach to decision-making is required, such as when dealing with an acutely ill patient.

Types of problems

Problems come in different guises and the solver can perceive them either as a challenge or a threat. One of the most common types of problem is when the unexpected happens. As a nurse you plan and implement care for a patient based on your knowledge and experience, only to find that the patient's reaction is totally different from that expected but without any apparent reason.

Another type of problem is an assignment where others set a goal or task. Throughout your working life you will be required to undertake duties on behalf of other people. For some this is difficult as they feel unable to control their workload. Others see it as an opportunity to develop new skills or take on additional responsibilities. Opportunities can be perceived as problems by those who fear failure.

A third type of problem is when a dilemma arises. This is when it is difficult to choose the best solution to a problem because the nurse is confronted with something that challenges his or her personal and/or professional values.

Diagnosing Problems

The sooner a problem is identified and solutions devised, the better for all involved. So try to anticipate or identify problems when they occur through continuously monitoring staff performance and patient outcomes.

Listening to and observing junior staff will help you to detect work or organisational concerns, because when there are problems staff are likely to behave in an unusual or inconsistent manner.

Initial Analysis

Remember that people view things differently, so what you perceive as a problem may not be one to anyone else. So before you begin thinking about what to do - whether to keep it under surveillance, contain it or find a solution - you should undertake an initial analysis. This will help you to understand the problem more clearly.

An analysis will also enable you to prioritise its importance in relation to other problems as problems do not occur one at a time.

Routine problems often need little clarification, so an initial analysis is recommended for non-routine problems only. Even then, not all problems justify the same degree of analysis. But where it is appropriate, an initial analysis will provide a basis from which to generate solutions.

Perception is also important when dealing with patients' problems. For example, if a patient gives up reading because he or she cannot hold the book

(objective), the nurse may assume it is because the patient has lost interest (subjective, one's own view).

Generating Solutions

It is essential for the problem-solver to remember that, where possible, solutions must come from those connected with the problem. If it is to be resolved, agreement must be owned by those involved as they are probably the best and only people who can resolve their differences. The manager should never feel that he or she must be on hand to deal with all disputes.

To solve a problem you need to generate solutions. However, the obvious solution may not necessarily be the best. To generate solutions, a mixture of creative and analytical thinking is needed.

Creativity is about escaping from preconceived ideas that block the way to finding an innovative solution to a problem. An effective tool for assisting in this process is the technique of lateral thinking, which is based largely on the work of Edward de Bono, who regards thinking as a skill.

There are several ways to encourage creative decision-making. One method that works best for specific or simple problems is brainstorming. If the ground rules of confidentiality and being non-judgemental are applied, it will produce a free flow of ideas generated without fear of criticism.

Time constraints and staff availability may make it difficult for all those involved in a problem to meet. In such cases an adaptation of brainstorming - where a blank piece of paper is given to those involved and each writes down four solutions to the problem - may be the answer. A similar technique is the collective notebook,

where people are asked to record their thoughts and ideas about a problem for a specified period.

An alternative is where one person writes down a list of solutions in order of priority, which is then added to by others. This helps to prioritise the ideas generated. All these methods produce data that can then be analysed by the problem-solver.

When the problem affects people in different geographical areas, solutions can be generated by obtaining the opinion of experts through the use of a questionnaire, which is known as the Delphi technique.

When an apparently insurmountable problem presents itself, it is often useful to divide it into smaller pieces. This is known as convergent thinking. Using divergent thinking - where you consider a problem in different ways to expand your view - may also help.

A final alternative is the stepladder technique, which is time-consuming but effective if the issue is stirring up strong feelings. This requires the people involved in the problem to be organised into groups. First, two people try to solve the problem, then a third member is drawn in, to whom the solution reached by the first two is presented. All three then try to agree a solution. More people are added to the group, if necessary, in a similar way, until there is agreement of all involved. Provided the individuals are motivated to solve the problem, this technique creates ownership and commitment to implementing the agreed solution.

Analytical thinking, which follows a logical process of eliminating ideas, will enable you to narrow the range down to one feasible solution.

Although someone has to make the ultimate decision on which solution to implement, there are advantages to group decision-making: a greater number of possible solutions are generated and conflicts are resolved, resulting in decisions being reached through rational discussion.

This does, however, require the group to be functioning well or the individuals involved may feel inhibited in contributing to the decision-making. One individual may dominate the group or competition between individuals may result in the need to win taking precedence over deciding on an agreed practical solution.

As nursing becomes less bureaucratic individuals are being encouraged to put forward their own ideas, but social pressures to conform may inhibit the group. We do not solve problems and make decisions in isolation, but are influenced by the environment in which we work and the role we fulfil in that environment. If group members lack commitment and/or motivation, they may accept the first solution and pay little attention to other solutions offered.

Making a decision

There are three types of decision-making environments: certain, risk and uncertain. The certain environment, where we have sufficient information to allow us to select the best solution, is the most comfortable within which to make a decision, but it is the least often encountered.

We usually encounter the risk environment, where we lack complete certainty about the outcomes of various courses of action.

Finally, the uncertain environment is the least comfortable within which to make decisions as we are almost forced to do this blind. We are unable to forecast the

possible outcomes of alternative courses of action and, therefore, have to rely heavily on creative intuition and the educated guess.

Taking this into consideration, you should not contemplate making a decision until you have all the information needed. Before you make your decision, remind yourself of the objective, reassess the priorities, consider the options and weigh up the strengths, weaknesses, opportunities and threats of each solution.

An alternative is to use the method that Thomas Edison used to solve the problem of the electric light bulb. Simply focus on your problem as you drift off to sleep, and when you wake up your subconscious mind will have presented you with the answer. But bear in mind that this is not a scientific way of solving problems - your subconscious can be unreliable.

If you are not sure about your decision, test the solution out on others who do not own the problem but may have encountered a similar dilemma. Once you have made your choice stick to it, or you may find it difficult to implement because those involved will never be sure which solution is current. They will also be reluctant to become involved in any future decision-making because of your uncertainty.

The next step is to ensure that all the people involved know what decision has been made. Where possible, brief the group and follow this up with written communication to ensure everyone knows what is expected of them. You may need to sell the decision to some, especially if they were not involved in the decision-making process or the solution chosen is not theirs.

Implementing the Solution

Finally, to ensure the solution is implemented, check that the people involved know who is to do what, by when and that it has happened.[189]

During the problem-solving process, the professional must analyze the problem using prior knowledge activation to determine what is known and unknown and seek a variety of sources to assist in finding the unknown information. The professional synthesizes a solution through critical thinking and reflects upon the experience through self-evaluation once all the pertinent information is collected and critiqued. In critical thinking, a person gives reasoned consideration to evidence, context, theories, methods, and criteria in order to form a purposeful judgment and simultaneously monitors, corrects, and improves the process through meta-cognitive self-regulation. Critical thinking experts define critical thinking as the process of purposeful, self regulatory, judgment; an interactive, reflective, reasoning process.[47] For example, The National League of Nursing has affirmed that professionalism requires thoughtful decision making founded on the ability to make purposeful, reflective judgments which involve analysis, interpretation, inference, evaluation and explanation i.e., critical thinking .[48]

Nurses are experts at problem solving. Whether collaborating with the healthcare team to find a "workaround" for a challenging patient need, juggling procedure schedules so that patients and families are minimally inconvenienced by the constant changes in the healthcare setting, or directly assisting patients to access the care they need despite barrier after barrier, nurses use problem-solving skills every day to overcome obstacles.

Generally, problem solving involves identifying a problem, weighing alternatives, and making a decision about how to manage the problem. Some problems are simple, but in the nursing practice environment, problems are typically very complex.

Tucker and Edmondson[130] actually investigated problem solving by nurses in the hospital environment. They found that nurses utilized problem-solving skills multiple times throughout a day to the point that problem solving was actually a routine aspect of a nurse's day. Unfortunately, they discovered that nurses tended to problem solve by using guidelines and algorithms that directed them toward what to do without pushing them to solve the underlying problem. Their study suggests that nurses should also address underlying issues that may be unique to the problem-solving situation they encounter. Solving a single problem with "routine" responses does not contribute to long-term resolution of the problem. Problem-solving strategies must be more than "second nature" for nurses. Nurses must push themselves to look beyond guidelines, algorithms, and institutional policy to identify underlying causes for problems we face repetitively in providing care and supporting patients' healthcare needs. Once underlying causes are identified, we must be well-versed on the latest evidence and present articulate, well-thought-out plans for solving problems to improve healthcare delivery at every level where we have influence. Implementing problem-solving strategies is inevitable for a nurse; however, learning to maximize problem-solving skills is critical if nurses are to lead the healthcare team in addressing the complex challenges affecting identification and utilization of "best" evidence.[131]

Achieving the goal of developing effective problem solving skills, includes the ability to apply appropriate meta-cognitive and reasoning strategies. For example, hypothetical–deductive reasoning is an appropriate strategy for medical problem solving whereas analogical or case based reasoning may be more appropriate in many design domains such as Meta-cognitive skills refer to the executive control processes of planning one's problem solving, monitoring one's progress, and evaluating whether one's goals have been met.[132,133]

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2.2. Studies related to Problem Based Learning

One must reconsider what students really need to learn and the environment in which they learn. Much of the enthusiasm for the problem-based approach to learning comes from instructors who feel revitalized by the creative energy it releases.

-Hal White, "'Creating Problems' for PBL"

Problem based learning (PBL) has been introduced into the curriculum of a number of nursing and medical education schools as a method of promoting the development of critical thinking skills, knowledge acquisition and understanding, deductive reasoning, independent learning, interpersonal skills and clinical problem solving skills.[134,135] Evaluations of PBL programs have generally been positive, with reports of higher levels of critical thinking skills,[27,136,137] autonomous learning and problem solving skills,[27,136] decision-making skills,[136]communication skills, reflection and motivation for continued learning.[27]

Problem based learning process is the best method for teaching nurse students underneath nursing care context. It is the method to make student to be active learner, enthusiastic person to seek for answering the question or solving problem. The method makes the meaningful of learning and makes the learner to develop skill to thinking critically as well as able to learn life long.[138]

Problem-based approaches to learning have a long history. They are one of many instructional approaches that situate learning in a meaningful task, such as case-based instruction and project-based learning. In the traditions of Kilpatrick[139] and Dewey,[140] these approaches argue for the importance of practical experience in learning. Problem-based learning (PBL) is part of this tradition of meaningful, experiential learning. In PBL, students learn by solving problems and reflecting on their experiences. PBL is well suited to helping students become active learners because it situates learning in real-world problems and makes students responsible for their learning. It has a dual emphasis on helping learners develop strategies and construct knowledge. PBL is focused, experiential learning organized around the investigation, explanation, and resolution of meaningful problems.[142,143]

In PBL, students work in small collaborative groups and learn what they need to know in order to solve a problem. The teacher acts as a facilitator to guide student learning through the learning cycle. Several features of PBL support increased motivation for learning. Students are more motivated when they value what they are learning and when their educational activity is implicated in personally meaningful tasks. Students are also more motivated when they believe that the outcome of learning is under their control. [144]

Problem based learning is often referred to as a total approach to education.[145] As a curriculum, PBL consists of carefully designed and scripted problems/scenarios that demand a number/range of skills from the learner. These skills include: self-directed learning, critical thinking, team participation and acquisition of critical knowledge[145] and as argued by Capon and Kuhn[146] the blending of acquisition, recall and an integration of newly acquired concepts with existing knowledge structures. This amalgamation promotes the possibility of restructuring and enhancing the student's conceptual coherence or helps to make more sense of an issue. The PBL process involves a systematic approach to resolving problems or meeting challenges that are encountered in real-life situations–including a person's career.[145] Student independence, self direction and the autonomy given to the students have been considered the hallmarks of PBL.[147]

In a broader sense, which encompasses a multitude of positive career options, PBL is also thought to increase motivation, as students feel empowered to have an impact on the outcome of the case study and are invested in the solution to the problem being embarked upon.[148] Schmidt and Marks[148,149] argue that there are also increased opportunities for students to elaborate on their own knowledge base through

more active involvement and verbalization within a team setting. Furthermore, PBL also encourages and shows the learner how to learn.

PBL is focused, experiential learning organized around the investigation, explanation, and resolution of meaningful problems.[142,143] In PBL, students work in small collaborative groups and learn what they need to know in order to solve a problem. The teacher acts as a facilitator to guide student learning through the learning cycle. In this cycle, also known as the PBL tutorial process, the students are presented with a problem scenario. They formulate and analyze the problem by identifying the relevant facts from the scenario. This fact-identification step helps students represent the problem. As students understand the problem better, they generate hypotheses about possible solutions. An important part of this cycle is identifying knowledge deficiencies relative to the problem. These knowledge deficiencies become what are known as the learning issues that students research during their self-directed learning (SDL). Following SDL, students apply their new knowledge and evaluate their hypotheses in light of what they have learned. At the completion of each problem, students reflect on the abstract knowledge gained. The teacher helps students learn the cognitive skills needed for problem solving and collaboration. Because students are self-directed, managing their learning goals and strategies to solve PBL's ill-structured problems (those without a single correct solution), they also acquire the skills needed for lifelong learning. PBL was originally developed in medical schools and has been used in a variety of settings from middle school to professional education.

Goals of PBL

Problem-based curricula provide students with guided experience in learning through solving complex, real-world problems. PBL was designed with several important goals.[150] It is designed to help students.

The goals are:

(1) Construct an extensive and flexible knowledge base;

(2) Develop effective problem-solving skills;

(3) Develop self-directed, lifelong learning skills;

(4) Become effective collaborators; and

(5) Become intrinsically motivated to learn.

Staff Development

Introducing PBL into a course makes new demands on tutors, requiring them to function as facilitators for small group learning rather than acting as providers of information. Staff development is essential and should focus on enabling the PBL tutors to acquire skills in facilitation and in management of group dynamics (including dysfunctional groups).

Tutors should be also given information about the institution's educational strategy and curriculum programme so that they can help students to understand the learning objectives of individual modules in the context of the curriculum as a whole. Methods of assessment and evaluation should be described, and time should be available to discuss anxieties.

Table No. 2.3. Advantages and disadvantages of PBL

Advantages of PBL	Disadvantages of PBL
Student centred PBL—It fosters	Tutors who can't "teach"—Tutors
active learning, improved understanding, and retention and development of lifelong learning skills	enjoy passing on their own knowledge and understanding so may find PBL facilitation difficult and frustrating
Generic competencies—PBL allows	Human resources—More staff
students to develop generic skills and attitudes desirable in their future practice	have to take part in the tutoring process
Integration—PBL facilitates an	Other resources—Large numbers
integrated core curriculum	of students need access to the same library and computer resources simultaneously
Motivation—PBL is fun for students	Role models—Students may be
and tutors, and the process requires all students to be engaged in the learning process	deprived access to a particular inspirational teacher who in a traditional curriculum would deliver lectures to a large group
"Deep" learning—PBL fosters deep	Informationoverload—Students
learning (students interact with learning materials, relate concepts to everyday activities, and improve their understanding)	may be unsure how much self directed study to do and what information is relevant and useful
Constructivist approach—Students	
activate prior knowledge and build on existing conceptual knowledge frameworks	

Staff may feel uncertain about facilitating a PBL tutorial for a subject in which they do not themselves specialise. Subject specialists may, however, be poor PBL facilitators as they are more likely to interrupt the process and revert to lecturing. None the less, students value expertise, and the best tutors are subject specialists who understand the curriculum and have excellent facilitation skills. However, enthusiastic non-specialist tutors who are trained in facilitation, know the curriculum, and have adequate tutor notes, are good PBL tutors. [191]

Evan E Benjamin, Mark S Schneider, and Kevin T Hinchey[151] conducted a controlled trial with 15-month follow-up in two outpatient clinics to study the effects of using the problem-based learning technique to implement a diabetes clinical practice guideline. A total of 144 patients with type 2 diabetes aged 25–65 years in two internal medicine outpatient clinics were enrolled in the study. African-Americans and Hispanics made up 75% of the patients. Doctors and staff in one of the clinics were trained in the use of a clinical practice guideline based on Staged Diabetes Management. A problem-based learning educational program was instituted to reach consensus on a stepped intensification scheme for glycemic control and to determine the standards of care used in the clinic. HbA1 c was obtained at baseline and at 9 and 15 months after enrollment. At 9 months, there was a mean 20.90% within-subject change in HbA1c in the intervention group, with no significant changes in the control group. The 15-month mean within-subject change in HbA1c of 20.62% in the intervention group was also significant .Among intervention patients, those with the poorest glycemic control at baseline realized the greatest benefit in improvement of HbA1c. The intervention group also exhibited significant changes in physician adherence with American Diabetes Association standards of care.

2.3. STUDIES RELATED TO PROBLEM BASED LEARNING ON CRITICAL THINKING SKILLS AND PROBLEM SOLVING ABILITIES

Problem based learning is the method which teach student to learn by simulated situation. The new atmosphere of learning will promote student to be reasonable learner. They will get freedom to explain their thoughts without scaring and take relaxation during learning. These make students get self confidence and self esteem. Problem based learning process is the best method for teaching nurse students underneath nursing care context. It is the method to make student to be active learner, enthusiastic person to seek for answering the question or solving problem. The method makes the learning meaningful and makes the learner to develop skill to thinking critically as well as able to learn life long.[138]

Reflecting on the relationship between problem solving and learning is a critical component of PBL and is needed to support the construction of extensive

and flexible knowledge.[152] This reflection should help learners understand the relationship between their learning and problem-solving goals. Thus, each problem-solving task is not an end in itself but rather a means to achieve a self-defined learning goal.[153] Reflection helps students (a) relate their new knowledge to their prior understanding, (b) mindfully abstract knowledge, and (c) understand how their learning and problem-solving strategies might be reapplied.[46]

Critical thinking ability is possibly nurtured by PBL, through the process of problem solving, particularly within group brainstorming sessions.[154,155] During these sessions, students critically consider one best possible solution for the problem at hand. The process is mediated by a facilitator, who is responsible for probing their

meta-cognitive thinking, in making any decision.[154,155] It is believed that probing questions may engage students in a systematic cognitive process that promotes the development of the students' reasoning ability. In addition, other processes, such as discussion, debating, sharing, and teaching one another, creates a platform for students to experience an environment that is conducive for critical thinking to grow.[115,156]

In a study done by Semerci,[157] the author studied the effects of PBL on critical thinking for students in the Professional Education Course. The comparison was in favour of the PBL group, where the students' critical thinking ability had increased after PBL treatment. The critical thinking was measured based on students' ability to focus and clarify the solutions, analyse, understand, and infer with self-regulatory judgment and assumptions.

In a quasi-experimental study done by Yuan H, Kunaviktikul W, Klunklin A, and Williams BA,[158] the effect of problem-based learning on the critical thinking skills of 46 numbers of 2nd year undergraduate nursing students in the People's Republic of China was studied. The California Critical Thinking Skills Test Form A, Chinese-Taiwanese version was used as both a pretest and as a post-test for a semester-long nursing course. The result showed that there was no significant difference in critical thinking skills at pretest, whereas, significant differences in critical thinking skills existed between the problem-based learning and lecture groups at post-test. The problem-based learning students had a significantly greater improvement on the overall California Critical Thinking Skills Test, analysis, and induction subscale scores compared with the lecture students. Problem-based learning fostered nursing students' critical thinking skills.

In studying a characteristic of critical thinkers, Derry SJ, Levin JR, Osana HP, Jones MS, et al[48] investigated the students' ability to scientifically and statistically to reason in problem solving in the University of Wisconsin-Madison. The interview processes were employed to assess students' reasoning skills, before and after the new statistical course implementation. Students worked in small groups in solving problems that were simulated based on real-world scenarios. They worked collaboratively with group members, while the tutor responsible in providing suitable instructional method and guidance to the respective groups. The post-interview showed that students improved their ability to reason statistically. This was clearly observed when students presented their problem solutions.

. PBL embodies the principle that the starting point of learning is a problem. By presenting students with a problem for which no certain answer exists, their interest is captured. As the students reason their way through the learning process, questioning and debating through each stage of the problem-solving, they are engaging in meaningful discussion. PBL encourages students to share their analyses of the problem situation, and to consider theirs as well as alternative analyses. Finally, PBL acknowledges students as key players in their own learning and capable of thinking for themselves. This philosophy of recognizing students' ability in independent thinking and active learning fosters trust and respect in the learning environment. Thus, it can be argued that PBL creates suitable conditions for students to develop their critical thinking. Indeed, it has been suggested that PBL is one of the most effective ways of fostering critical thinking in nursing students. [94]

2.4. Studies related to problem based learning Vss lecture method on critical thinking skills and problem solving abilities

Information–heavy presentation within a lecture likely results in students cramming to simply memorize information in order to pass examinations. Such instructional methods may not result in long-term knowledge retention.[44]

Long-term knowledge is acquired through activation of prior knowledge, discussion, application, and reflection. Cognitive psychology principles suggest that prior knowledge is the key in determining what additional knowledge can be learned.[45] Instructional methods must allow the activation of prior knowledge in order to process and garner new knowledge. One method to activate prior knowledge may be small-group discussion. During small-group discussion, students have the opportunity to elaborate on the knowledge at the time of learning.[45]

Furthermore, presenting a situation or an opportunity to learn within a specific context will foster group discussion and ultimately long-term knowledge and effective problem solving skills.

Magnussen, Ishida, and Itano[18] have showed that inquiry-based learning as a teaching methodology can develop critical thinking abilities. In addition, it has been indicated that these abilities are not developed during routine educational programs of nursing, which reveals the ineffectiveness of traditional teaching models in this regard.

One suggested way to bridge the gap between education and medical practice is to change the traditional education system (lecture based learning) into a problem-based learning (PBL) approach which historically can be traced back to Socrates. PBL

introduces a problem as part of learning and can be used as a means of self-study and a way of increasing critical thinking skills and attitudes in students.[94]

In recent decades, PBL has been proposed as an alternative to learning by the traditional lecture method.[160] Increasing retention, interest, and motivation are some benefits of PBL. Learning by the PBL method also improved clinical reasoning skills, clinical knowledge, learning motivation, and learning autonomy.[161]

As performance of nursing requires a cognitive ability that includes problem solving, decision making, and clinical judging, it is important for nurse educators to find appropriate teaching methods to enhance students' performance of these tasks for clinical nursing. Correspondingly, PBL and lecture-based learning were compared in an adult health nursing course by Hwang and Kim.[81] Both the PBL group (n=35) in groups of seven and lecture group (n = 36) were tested prior to and after the course on respiratory and cardiac nursing using a 32-item test. Questions were selected from the guidebooks of the Korean National Examination for Registered Nurses. In identifying a baseline comparison between the two groups, pre-test results indicated no significant difference between groups resulting in the same level of knowledge and application for both groups. After the course, a posttest found the PBL group had a significantly higher test score than the lecture group. These results indicate that PBL is a better instructional method for knowledge and application.

In addition, PBL is more student-centered and focuses on comprehensive learning of nursing concepts without regard to specialties of nursing courses. Ali Hassanpour Dehkordil and Saeed Heydarnejad M[162] in a study aimed to compare the effect of education through problem-based learning (PBL) or lectures on behavior, attitude and learning of nursing students. A total of 40 second-year nursing students

participated, in which 20 students were in the PBL group and 20 students were in the traditional lecture (control) group. The students underwent a one-semester course using the two methods of education. The level of knowledge in the PBL group was significantly higher than that of students in the lecture group. In addition, a significant difference was found between the PBL and lecture groups in the level of attitude toward learning. The present study suggests a significant difference between PBL and traditional lecture groups with a more positive learning attitude and higher learning motivation in the PBL group.

Tiwari A, Lai P, So M, and Yuen K[70] conducted a study to compare the effects of problem-based learning and lecturing on the development of students' critical thinking. The primary outcome measure was students' critical thinking disposition as measured by the California Critical Thinking Disposition Inventory (CCTDI). Individual interviews were also conducted to elicit the students' perceptions of their learning experience. Result proved that there were significant differences in the development of students' critical thinking dispositions between those who undertook the PBL and lecture courses, respectively.

Recent studies have examined how PBL students performed on a problem-solving task. Schmidt H G, Machiels-Bongaerts M, Hermans H, Ten Cate TJ, et al[163] conducted a quasi-experimental study that compared students who self-selected into traditional and PBL tracks at a Midwestern medical school. The students generated causal explanations for each of two problems at each of three testing sessions that occurred during the 1st week of classes, and again after 3 and 7 months. The students' explanations were scored for accuracy, coherence, and use of science concepts. The students did not differ on any of these measures at the initial testing session. The students in the PBL curriculum were more likely to produce accurate hypotheses and coherent explanations than students in the traditional curriculum. In addition, they

were more likely to use science concepts in their explanations. This suggests that the PBL students were constructing knowledge that they could bring to bear in accurately solving problems. Their science knowledge was flexible in that they were able to transfer it to new problem situations. The accuracy effect appears robust. When students in PBL and traditional curricula were compared in terms of diagnostic accuracy for 30 case vignettes, PBL students were more accurate than students in a traditional curriculum.[163]

One indicator of effective problem-solving skills is the ability to transfer reasoning strategies to new problems. Patel VL, Groen GJ and Norman GR[164] asked traditional and PBL students to provide diagnostic explanations of a clinical problem. They showed that students in the PBL curriculum were more likely to use hypothesis-driven reasoning (as they were taught) than were students in a traditional curriculum. The students in the traditional medical school used predominately data-driven reasoning, a form of reasoning that is more characteristic of experts, but only on familiar problems. Although experts often use this type of reasoning, it is not likely to be effective for novices. Data-driven reasoning relies on having an extensive knowledge base, which is unlikely for novices. In a laboratory experiment designed to test the notion that hypothesis-driven reasoning supports learning, Norman G R, Trott AD, Brooks LR and Smith E K[165] found that having students learn how to read electrocardiograms using a hypothesis-driven strategy led to greater accuracy on a transfer task than using a data-driven strategy. This finding suggests that a hypothesis driven reasoning strategy is a mechanism for learning. In two studies, students in PBL curricula transferred the hypothesis-driven reasoning strategy to unrelated problems and generated more coherent explanations than students without PBL experience.[141,166]

Another aspect of problem-solving skills is being able to define what the problem actually is, especially with ill-structured problems. This is called problem finding and is the aspect of problem solving that refers to identifying the problem. When comparing gifted students who were traditionally instructed with students in a PBL class on problem-solving skills, Gallagher S A, StepienW J and Rosenthal H[167] found that PBL students were more likely to include problem finding as a step when presented with a novel ill-structured problem. Although research on the influence of PBL on strategy transfer is limited, it does provide some evidence that students in PBL learn problem-solving and reasoning strategies that are transferable to new problems.

In a study comparing traditional and PBL medical students in terms of the learning resources they used, Blumberg and Michael[168] found that PBL students were more likely to use self-chosen learning resources whereas students in the conventional curriculum used faculty-chosen resources. PBL students were more likely to report selecting the material to study themselves, whereas conventional curriculum students reported reading specific teacher-generated assignments.

Albanese and Mitchell,[90] in their comparison of PBL with conventional medical school instruction found that the PBL students received better scores for clinical performance than the students taught using conventional instruction.

Sendaq and Odabas,[169] in their study, found that the students in PBL approach increased in their critical thinking ability compared to the students in the traditional learning approach. The critical thinking was measured using Watson Glaser Critical Thinking Appraisal (WGCTA), which is based on the ability in making inference, recognition of assumptions, deduction, interpretation, and evaluation of ideas.

The purpose of the study done by Mahmoud A Kaddoura[159] was to examine critical thinking (CT) abilities of nursing students from two different curricular approaches, CBL and didactic teaching. The design used in this research was a comparative descriptive survey. The sample included 103 participants; 65 students from the CBL nursing program and 38 students from the didactic nursing program offered by the MOH Schools of Nursing in the United Arab Emirates (UAE). Data were collected using the California Critical Thinking Skills Test (CCTST) Form B to measure the CT abilities of the participants. The data were analyzed using the SPSS. The independent t-test results revealed that the CBL participants performed better in the total CT score and all CT subscales than the didactic program participants.

A range of studies show that PBL students generally do as well as more traditionally educated counterparts under exam situations, and are seen as better practitioners.[145] Studies by the San Diego State University (1996) found that students enrolled in problem based learning courses had a more favourable attitude towards their course than students educated in a more traditional manner. Problem based learning courses have also been reported as having an increase in course enrolment and more positive feedback from faculty and employers; reduced student dropout rates; and a range of comments from students concerning the advantages of PBL after their learning experience.[71] Also 'problem based curricula do appear to provide a friendlier and more inviting educational climate'. Rideout E, England-Oxford V, Brown B, Fothergill-Bourbonnais F, et al[147] carried out a comparison study between a conventional teaching program and a PBL course. There were statistically significant differences between the two groups, with PBL receiving higher ratings in regard to the role of the facilitators, program outcomes, student assessment, level of independence.

2.5. CONCEPTUAL FRAMEWORK

The present study aims at investigating the efficacy of Problem Based Learning (PBL) approach on nursing students in enhancing their critical thinking skills and problem solving ability with that of lecture method.

The conceptual framework for this present study was based on Ernestine Wiedenbach's clinical nursing practice theory.[85]

She proposed her theory in 1964 as a prescriptive theory of nursing. According to this prescriptive theory, nursing-account must be taken of the motivating factors that influence the nurse not only in doing what she does but also in doing it the way she does it with the realities that exist in the situation in which she is functioning. Prescriptive theory directs action toward an explicit goal.

It consists of 3 essential factors. They are; Central purpose, Prescription and Realities. The nurse develops a prescription based on a central purpose and implements it according to the realities of the situation.

1. Central Purpose

It denotes nurse's professional commitment. The central purpose is what the nurse wants to accomplish. It is the overall goal towards which a nurse strives; it specifically directs activities towards the patient's benefits. It is based on nurse's personal philosophy, which is unique and personal; it motivates action, guides thinking and influences decisions.

In this study, the central purpose is to promote critical thinking skills and problem solving ability among nursing students, since the possession of critical thinking skills and problem solving ability are essential for nurses in order to make

sound judgment when solving clinical problems and thereby provide excellent clinical outcomes and patient safety.

2. Prescription

Prescription indicates broad general action that the nurse deems appropriate to fulfillment of her central purpose. It refers to the plan of care for a patient. It specifies the nature of the action that will fulfill the nurse's central purpose and the rationale for that action. After the prescription is established the nurse can implement it through the nursing care plan.

In this present study, the appropriate action to fulfill the central purpose was prescribed as Problem Based Learning, an active teaching strategy, which will enhance critical thinking skills and problem solving ability of nursing students. After the prescription (PBL) is established, the nurse can implement the plan of care for a patient effectively.

3. Realities

Realities are the aspects of the immediate nursing situation that influence the results the nurse achieves through what she does. In this study realities are the level of educational input in critical thinking skills and problem solving ability of a nursing student, needed to solve problems involving nursing action. Wiedenbach views nursing as an art based on goal-directed care. Factual and speculative knowledge judgment and skills are necessary for effective nursing practice.

In this study it is assumed that critical thinking skills and problem solving ability of a nursing student are essential for factual and speculative knowledge judgment and skills that are necessary for effective nursing practice.

According to Wiedenbach, nursing practice consists of identifying a patient's need for help, ministering the needed help, and validating that the need for help was met.

Identification

Involves viewing the patient as an individual with unique experiences and understanding the patient's perception of the condition. Determining a patient's need for help based on the existence of a need whether the patient realizes the need, what prevents the patient from meeting the need, and whether the patient could meet the need alone.

In this present study, it involves identification of the critical thinking skills and problem solving ability of nursing students, assessed through the developed tool.

Ministration

Refers to the provision of needed help. It requires an identified need and a patient who wants help.

In this study, PBL approach was administered to the interventional group and the routine traditional lecture method was administered to the control group.

Validation

Refers to a collection of evidence that shows whether a patient's needs have been met and his functional ability has been restored as a direct result of the nurse's actions. It is based on patient oriented evidence.

This study evaluates the effectiveness of PBL approach of teaching method in enhancing critical thinking skills and problem solving ability of nursing students. This

study assumes that the students who underwent the PBL approach will have an enhanced.

Critical thinking skills and problem solving ability, whereas, the students in the control group who were taught by lecture method will not show any improvement in critical thinking skills and problem solving ability. Further, there will be a positive perception on the influence of PBL method of teaching in developing critical thinking skills and problem solving ability and a negative perception will be elicited in the control group.

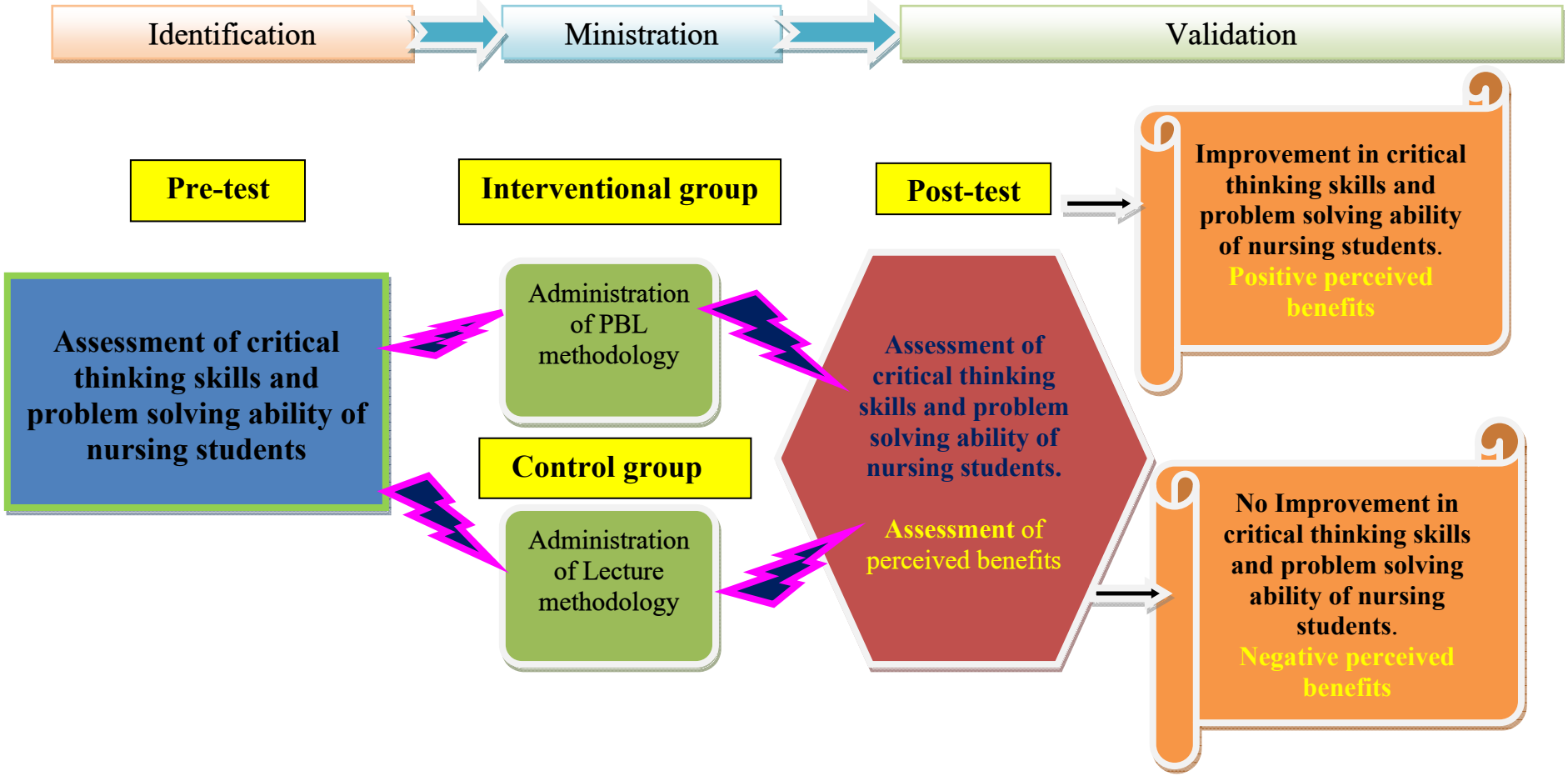


Figure:2.2 Conceptual Framework Based On Modified Wiedenbach Clinical Nursing Practice Model (1964)

CHAPTER-III

MATERIALS AND METHODS

This study is designed to evaluate the effectiveness of PBL over lecture method in order to enhance critical thinking skills and problem solving abilities among Nursing Students. This chapter describes the methodology adopted by the investigator to evaluate the effectiveness of PBL.

3.1. RESEARCH APPROACH

The approach used for this study was a quantitative approach.

3.2. RESEARCH DESIGN

A Quasi Experimental study with control group pre test and post test design was adopted to determine the effectiveness of PBL in enhancing critical thinking skills and problem solving abilities among Nursing Students. Quasi experiments, like true experiments, involve the manipulation of an independent variable, that is, the institution of an experimental treatment. In this study, the study subjects were allocated to control and interventional groups by purposive sampling technique. PBL was used as an innovative intervention for the interventional group. The purpose of this study was to investigate the impact of PBL on critical thinking skills and problem solving abilities of nursing students with that of the students undertook the lecture method.

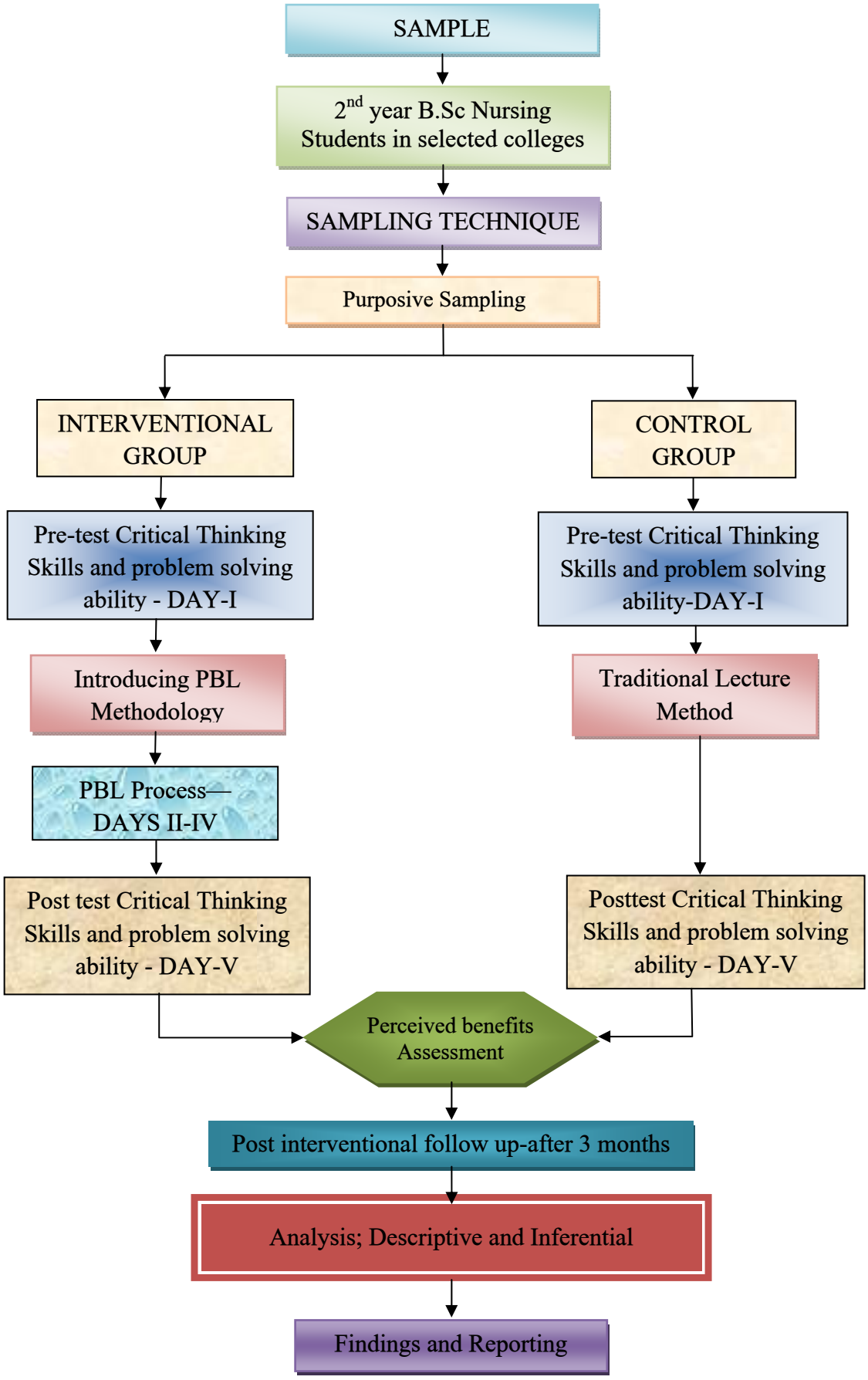
The design adopted for this study has been represented as follows:

Group	Pre test	Experimental stage	Post test	Post experimental stage
E	O_1	X	O_2	O_3
C	O_1	-	O_2	O_3

E = Interventional group, C = Control group, X = PBL Intervention,

O_1, O_2 , O_3= Observations

Figure: 3.1. SCHEMATIC REPRESENTATION OF THE RESEARCH DESIGN



3.3.VARIABLES

Independent variables - are the (i) Problem Based Learning, an innovative teaching method introduced to the Interventional group and (ii) Lecture method, introduced to the Control group.

Dependent variables - are the critical thinking skills and problem solving ability of nursing students and their perceived benefits.

3.4. SETTING OT THE STUDY

The study was conducted in Nursing colleges at Coimbatore. There were around 15 Nursing colleges having B.Sc.Nursing programme in Coimbatore. Letters were sent to various Institutions seeking permission to conduct the study. But, only few colleges gave written consent, out of which six colleges were selected. From the selected colleges, sample from three colleges were collected for Interventional group and the other three for Control group.

3.5. POPULATION

Target population

Nursing students studying from Colleges of Nursing in Tamil Nadu that are affiliated to the Tamil Nadu Dr. M.G.R .Medical University, Chennai.

Accessible population

B.Sc. Nursing students from the selected Colleges of Coimbatore.

3.6. SAMPLE

II year B.Sc Nursing students from the selected Colleges of Coimbatore who fulfilled the inclusion criteria.

3.6.1. SAMPLE SIZE

The sample size was determined using power analysis. Based on the results of the pilot study, a two tailed test with an effect size of 0.54, the obtained sample size for this study was 129 for each group, with an Alpha error of 5% and a power of 99%. So, a total sample of 260- II year B.Sc. Nursing students were selected from six selected Colleges of Nursing, out of which 130 sample studying from three colleges were allotted to the interventional group and the remaining 130 were allotted to the control group from the other three colleges.

3.6.2. SAMPLING TECHNIQUE

Purposive Sampling Technique was adopted for this study. The colleges under control group were namely Tex City College of Nursing (47 Nos), Ellen College of Nursing (41 Nos), and Royal College of Nursing (42 Nos), and the colleges under interventional group were namely Sree Abirami College of Nursing (35 Nos), RVS College of Nursing, Sulur (51Nos), and RVS College of Nursing, Kannampalayam (44 Nos). As a measure to avoid bias in the findings, the total sample from the selected class was either allotted to control group or interventional group. Actually, the sample size was 134 in control group and 132 in interventional group, whereas, due to the incomplete responses from 6 of them, four students in the interventional group and two students in the control group were excluded. Therefore, data from those subjects were not collected, thereby making the sample size equally i.e., 130 in each group. While all students had previously experienced lecture delivery, none had any prior exposure to PBL.

3.6.3. CRITERIA FOR SAMPLE SELECTION

Inclusion criteria

1. II year B.Sc. Nursing students.

2. Those who are willing to participate in the study.
3. Both male and female students are included.
4. Colleges that give permission to conduct the study.

Exclusion criteria

1. Colleges that are not willing to participate.
2. Students from other batches of B.Sc. Nursing (I, III and IV years).
3. Students of other Nursing courses.
4. Colleges where PBL was introduced.

3.7. INSTRUMENT

3.7.1. Development of the Instrument

Tool for data collection was developed by the investigator after reviewing a wide range of literature**.**

1. A blue print having objectives and content areas was developed.
2. A structured questionnaire to assess the higher level of cognitive skills was developed under the following areas of Bloom's Taxonomy.
    - Knowledge
    - Comprehension
    - Application
    - Analysis
    - Synthesis
3. A five point Rating scale was developed to assess the perceived benefits of the teaching method used.
4. A teaching module on PBL process was developed using power point.

5. A problem scenario was developed which need to be solved through PBL Process. The problem chosen was based on Diabetes Mellitus, a topic from Medical- Surgical Nursing-I (Unit-VII) of 2nd year B.Sc (N).

The content of the tool was checked and validated by around 12 experts in the field of Nursing, Medicine, Education and Statistics. The instrument was modified based on the suggestions given by the experts. The developed tool was found to be reliable.

3.7.2. Description of the Instrument

Part I – Demographic variables included Age, Sex, Religion, Parents' education, Occupation of parents, Income of the family/month, Place of residence, Medium of language during schooling, Type of board studied in schooling, Percentage of marks obtained in +2, Marks obtained in I year B.Sc (N), Aptitude to join nursing, Sector of the college, Courses offered in the college, Clinical training obtained through and Number of years since institution was started.

Part II - Consisted of 40 multiple choice questions on diabetes mellitus to assess critical thinking skills and problem solving ability of nursing students that were based on the cognitive levels of Bloom's Taxonomy. Bloom's Taxonomy encompasses three domains - the cognitive, the affective and the psychomotor, but is almost solely known for its framework of the cognitive domain**.** Framing the levels of knowledge, the cognitive domain has six levels divided into lower order thinking skills (Knowledge, Comprehension and Application) and higher order thinking skills (Analysis, Synthesis and Evaluation).

The solved NCLEX questions served as a framework for developing the questions used under this study, since the examination for licensure as a registered nurse includes questions at the cognitive levels of knowledge, comprehension, application, analysis and synthesis. However, the majority of the questions were framed at the higher levels of cognitive ability, because the practice of nursing requires critical thinking in decision making.

The instrument developed for this study was designed based on the levels of cognitive domain. It comprised of five sections. Each section carries 8 questions from the relevant area.

Section- A **Knowledge** [It is the ability to recall information]

Section- B **Comprehension** [refers to the ability to understand]

Section- C **Application** [It is the ability to use an understood concept in a new situation].

Section- D **Analysis** [The ability to separate a concept into its components in order for greater understanding of how the parts affect the whole]

Section- E **Synthesis** [The ability to put understood parts together in order to create new meaning combining various parts to form a new whole]

For sections **C,D, and E**, the respondents were expected to answer with rationale

Part –III

It consisted of 40 statements to assess the perceived benefits of the teaching method used on the development of critical thinking skills and problem solving ability, which were assessed by a five point Likert scale. The Likert scale responses were scaled as: strongly agree, agree, uncertain, disagree and strongly disagree.

3.7.3. Scoring Procedure

Part II- Score 1 was given for every correct answer.

Score 0 was given for every wrong answer.

Based on the overall score, the level of critical thinking skills and problem solving ability was graded as follows:

Score of 1-10 (1-25%)	:	Low
Score of 11-20 (26-50%)	:	Moderate
Score of 21-30 (51-75%)	:	Well
Score of 31-40 (76-100%)	:	Excellent

Part III

A Likert type 5 points scale was used, in which responses in the interventional group were scored from 5 to 1 (Strongly agree -5, Agree-4, Undecided-3, Disagree-2, and Strongly disagree- 1) and the responses in the control group were scored in reverse order with a maximum score of 200.

Overall, the relative frequency of scores 1 to 3 represent disagreement and scores 4 to 5 represent positive agreement with statement.

The final scores were interpreted as follows:

Score of 1-120 (1- 60%)	: Unfavourable
Score of 121-200 (61-100%)	: Favourable

Part IV -Teaching Module.

A teaching module on PBL process was developed using power point. It comprised of information regarding critical thinking skills and problem solving ability and PBL. A problem scenario was developed which required to be solved through

PBL Process. The problem chosen was based on diabetes mellitus, a topic from Medical- Surgical Nursing-I of 2nd year B.Sc.(N).

The Problem Scenario designed is as follows:

PROBLEM SCENARIO

"You are in the outpatient clinic. Your nursing instructor asks you to be involved in the care of Mrs. Mary, a 50 year old woman. You enter the room and her husband Mr. Tom is attending her. You enquire about Mrs. Mary's condition and he states that Mrs. Mary has complaints of vomiting, diarrhoea, palpitation , headache and altered consciousness since the previous day after attending a party where she had eaten some cakes, pastry and ice creams. He also informs that she is a known diabetic for the past 20 years and takes insulin 30 units twice a day using insulin pen. Further, he informs that as she was having vomiting and diarrhoea, she did not take any food, due to which she has stopped to take her regular doses of insulin. On examination, you find her skin is very cold and clammy and her breath is fruity odoured. You are also noticing lipodystrophy over her abdomen and she is dehydrated. Her BP is 80/50 mmHg. Pulse is weak and rapid. Urine testing shows presence of ketones. Results of her blood investigation shows that her PH level is 6.7mg/dl, glucose level 640mg/dl, Hgb A1c 7.8%, plasma bicarbonate is 14mEqu/L. Her glycemic index is high. ECG is taken and the finding is evident for hypokalemia. Identify the problem of Mrs.Mary and treat the patient. Further, plan a teaching on discharge."

The subjects in the interventional group were asked to solve the problem through adapting the seven steps of PBL. The PBL steps are:

1. Clarify concepts
2. Define the problem
3. Analyze the problem- Brainstorm
4. Organize facts and knowledge
5. Formulate learning objectives
6. Self- study
7. Discuss

3.8. VALIDITY AND RELIABILITY

a) Content validity of the tool:

The content of the tool was checked and validated by around 12 experts in the field of nursing, medicine, education and statistics .

b) Reliability of the tool:

The tool was administered to 10 sample representing the characteristics of the population. Test-retest method was done. The reliability co-efficient obtained was r=0.83, for the questionnaire on critical thinking skills and problem solving ability. Crohnbach-Alpha was used for perceived benefits scale and the obtained value was 0.78, indicating that the tool was highly reliable.

c) Item analysis:

Items were analysed in terms of item difficulty and discriminating index. Items which did not fall between the acceptable range were modified.

3.9. PILOT STUDY

Pilot study was conducted with 30 sample (i.e.,15 in interventional group and 15 in control group). It was found that the mean percentage was 53% in interventional

group and 28% in control group, which reveals a significant gain in critical thinking skills and problem solving abilities of nursing students who were taught using PBL method of teaching. No problem was encountered during the study. The pilot study subjects were excluded from the main study.

3.10. DATA COLLECTION PROCEDURE

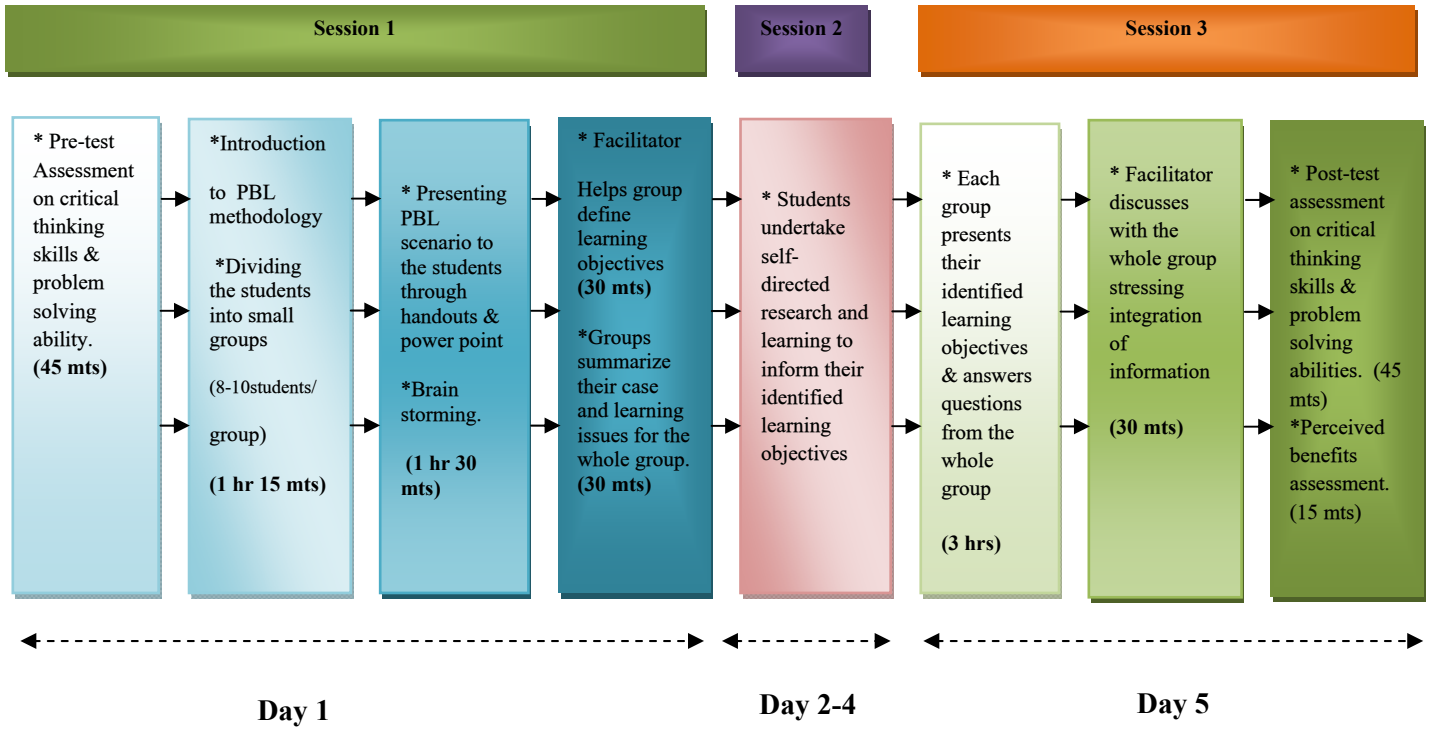
The total data collection period was I year (Mar 2011-Feb 2012). Official permission to conduct the study was obtained from the respective Heads of the selected Nursing Colleges. After obtaining consent from the Institutions, the investigator established good rapport with the subjects by explaining to them the purpose of the study. Oral consent was obtained from the subjects. Subjects were allotted to Interventional or Control group using purposive sampling. Pre test was administered to both the groups. Then, the interventional group was given an orientation to PBL. The total group was divided into small groups. Each group was asked to choose a chairperson and scribe. The Chairperson of the group planned the schedule for each day for discussion. The scribe recorded the discussion carried out each day based on their groups' learning objectives. The record was used by the group for the final day discussion. Whereas in the control group, the same topic was taught using lecture method of teaching by the concerned subject faculty of the respective Institution in a routine way.

Faculty Orientation:

Along with the primary investigator, two more faculties were trained to facilitate the PBL process. Further, the faculty of the respective class was also oriented to implementation of PBL in order to follow up the students during their self study.

The actual procedure of data collection has been represented as follows:

Figure: 3.2. Clustered PBL methodology.(Administered to the interventional group)



Session I

Day 1

Pre test was administered to the interventional group and they were assessed for their critical thinking skills and problem solving ability **(45 mts).** Then the students were oriented to PBL methodology using power point presentation. **(1 hr 15 mts).** The group was divided into small groups (8-10 students / Group). Each group selected a leader and a scribe for recording the learning issues. A problem scenario on diabetes mellitus was given to the students and were asked to brainstorm and formulate learning objectives using PBL methodology **(1 hr 30 mts).** Facilitator helped the groups define their learning objectives **(30 mts).** Then each group summarized their learning needs to the whole group **(30mts).**

Total Duration (4 ½ hrs)

Session II

Days: 2 to 4

Students undertook self-directed learning to inform their identified learning objectives. They were asked to gather more information through various resources based on the relevant learning objectives. During those days, each group met daily as planned by their group leader in order to discuss the learnt issues. The scribe recorded the discussed information.

Session III

Day: 5

Discussion:

Each PBL group gave a formal, timed presentation to, and responded to questions from the whole group. They presented their identified learning objectives**.**

(Total Hr:3 hrs)

This was followed by a brief summary and discussion led by the facilitator to highlight the integrated approach in the case.

(Total Hr :30 mts)

After that post test was administered to assess their critical thinking skills and problem solving ability.

(Total Hr :45 mts)

Then, the subjects were assessed for their perceptions on the influence of PBL on their critical thinking skills and problem solving ability**.**

(Total Hr 15 mts)

Total Duration (4 ½ hrs)

Post- Interventional follow- up:

A post- interventional follow- up was done after 3 months after the intervention using the same questionnaire to see if the effect of the intervention (PBL) is retained after an intervening period.

Lecture method (Administered to the control group):

Control group was taught on diabetes mellitus using traditional lecture method as a routine method of teaching by their concerned subject faculty. Pre test, post test and post-interventional follow-up were done using the same tool. After the post-interventional follow-up, the control group students and the faculty were taught about PBL methodology for ethical reasons.

3.11. PLAN FOR DATA ANALYSIS

The data collected from 260 students (130 in control group and 130 in interventional group) were grouped, summarized and inferred using descriptive and inferential statistics based on the objectives and hypotheses.

Descriptive statistics (frequency and percentages) were used to present the socio-demographic variables and were used to present the level of critical thinking skills and problem solving abilities of nursing students during pretest and post test in both the groups and their perceived benefits. Chi-square was used to find out the association of critical thinking skills and problem solving abilities among nursing students and their perceived benefits with their demographic variables.

Inferential Statistics:

The paired ‘t’ test was used to compare the pre test and post test levels on the critical thinking skills and problem solving abilities among nursing students within the control group as well as within the interventional group to find the effectiveness of problem based learning.

The unpaired 't' test was used to compare the differences between the control and the interventional group on the effectiveness of problem based learning in enhancing critical thinking skills and problem solving abilities among nursing students.

Pearson's correlation coefficient ('r') was used to find the relationship between the level of critical thinking skills and problem solving abilities among nursing students in control and interventional group.

ANOVA was used to compare the differences on the level of critical thinking skills and problem solving abilities of nursing students between the control and the interventional groups at different points of time.

Multiple Regression was used to identify the relationship between the level of critical thinking skills and problem solving abilities of nursing students and their perceived benefits with their selected demographic variables.

3.12. ETHICAL CONSIDERATION

1. Written permission was obtained from the head of the institutions to conduct the study.
2. All participants were informed adequately about the nature and purpose of the study.
3. Oral consent was obtained from each subject and the whole procedure was explained to them before starting the data collection.
4. Subjects were assured of their anonymity and confidentiality of their information. To ensure anonymity, each participant had a unique code

number, which was used in the study. Use of a numeric code instead of names on the surveys and tests ensured confidentiality of the data.

5. No physical or emotional risks were caused to any of the participants.
6. The subjects were told about the freedom of withdrawing from the study at any stage.
7. PBL method of teaching was taught to the control group after the post test period got over.

CHAPTER IV

RESULTS AND INTERPRETATION

This chapter deals with the analysis and interpretation of the collected data to determine the effectiveness of Problem Based Learning on critical thinking skills and problem solving ability among nursing students.

The data collected from 260 students (130 in control group and 130 in interventional group) were grouped, summarized and inferred using descriptive and inferential statistics based on the objectives and hypotheses.

Descriptive statistics (frequency and percentages) were used to present the socio-demographic variables and the level of critical thinking skills and problem solving ability of nursing students during pretest and post test in both the groups and their perceived benefits. Chi-square was used to find out the association of critical thinking skills and problem solving ability among nursing students and their perceived benefits with their demographic variables.

Inferential statistics;

The paired 't' test was used to compare the pretest and posttest levels on the critical thinking skills and problem solving ability among nursing students within the control group as well as within the interventional group to find the effectiveness of Problem Based Learning.

The unpaired t' test was used to compare the differences between the control and the interventional groups on the effectiveness of Problem Based Learning in enhancing critical thinking skills and problem solving ability among nursing students.

Pearson's correlation coefficient ('r') was used to find the relationship between the level of critical thinking skills and problem solving ability among nursing students in control and interventional groups.

Repeated Measures ANOVA was used to compare the differences on the level of critical thinking skills and problem solving ability of nursing students between the control and the interventional groups at different points of time.

Multiple Regression was used to identify the relationship between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits with their demographic variables.

OBJECTIVES

1. To assess the pre test level of critical thinking skills and problem solving ability of nursing students among the control and the interventional groups.
2. To assess the post test level of critical thinking skills and problem solving ability of nursing students among the control and the interventional groups.
3. To determine the effectiveness of PBL on critical thinking skills and problem solving ability of nursing students.
4. To assess the students' perception on the influence of PBL and Lecture method on their critical thinking skills and problem solving ability in both control and the interventional groups.
5. To associate the level of critical thinking skills and problem solving ability of both the groups with selected demographic variables.
6. To associate the students' perception on the influence of PBL and Lecture method on critical thinking skills and problem solving ability in the control and the interventional groups with selected demographic variables.

HYPOTHESES

H_1- There is a significant difference in the level of critical thinking skills and problem solving ability of nursing students between the control group and the interventional group

H_2- There is a significant difference in the level of perceived benefits on the influence of teaching method on critical thinking skills and problem solving ability of nursing students between the control group and the interventional group.

H_3- There is a significant relationship between the critical thinking skills and problem solving ability of nursing students and their perceived benefits on the influence of teaching method.

H_4- There is a significant association between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits with selected demographic variables.

The findings are summarized and classified under the following sections.

Section I: Demographic variables of nursing students.

Distribution of nursing students according to their selected demographic variables.

Section II: Pre test and the post test levels of critical thinking skills and problem solving ability and the level of perceived benefits of nursing students in the control and the interventional groups.

a. Area wise distribution of mean, SD and mean percentage of pre-test and post-test scores in control group and interventional group on critical thinking skills and problem solving ability of nursing students .

b. Area wise distribution of mean, SD and mean percentage of post test scores of control group and interventional group on perceived benefits of the influence of the teaching method on critical thinking skills and problem solving ability.

c. Distribution of nursing students based on their pre test and the post test levels of critical thinking skills and problem solving ability and their perceived benefits on the influence of the teaching method in the control and the interventional groups.

Section III: Effectiveness of PBL on critical thinking skills and problem solving ability of nursing students.

a. Item wise comparison of pre and post test levels of critical thinking skills and problem solving ability of nursing students in control group and the interventional group.

b. Item wise comparison of the perceived benefits of nursing students on the influence of the teaching method between the control and the interventional groups.

c. Comparison of pretest and posttest levels of critical thinking skills and problem solving ability of nursing students within the control and the interventional groups.

d. Comparison of the difference between the control and the interventional group on the effectiveness of Problem Based Learning on critical thinking skills and problem solving ability among nursing students.

e. Comparison of differences on the level of critical thinking skills and problem solving ability of nursing students between the control and the interventional groups at different points of time.

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Section IV: Relationship between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits of the teaching method in control and the interventional groups.

a. Correlation between the level of critical thinking skills and problem solving ability and their perceived benefits among nursing students in control group and interventional group.
b. Multiple Regression to identify the relationship between critical thinking skills and problem solving ability of nursing students and their selected demographic variables.

Section V: Association between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits of the teaching method in control and the interventional groups with selected demographic variables.

a) Association between the level of critical thinking skills and problem solving ability of nursing students and their selected demographic variables in control and the interventional groups.
b) Association between the level of perceived benefits on the influence of teaching method of nursing students and their selected demographic variables in control and the interventional groups.

SECTION I

This section deals with distribution of demographic data of 260 subjects (i.e., 130 were from interventional group and 130 were from control group respectively) and is explained in frequency and percentage**.** The data are presented in Table-4.1.1. and figures 4.1.1. to 4.1.13**.**

Table No. 4.1.1.

Distribution (frequency and percentage wise) of nursing students based on their demographic variables N=260

Demographic data	INTERVENTIONAL GROUP n=130		CONTROL GROUP n=130	
	frequency	Percentage	frequency	Percentage
Age:				
17-20 years	130	100	130	100
21-24 years	-	-	-	-
25-28 years	-	-	-	-
29-32 years	-	-	-	-
33-36 years	-	-	-	-
Sex:				
Male	10	8	12	9
Female	120	92	118	91
Religion:				
Hindu	90	69	77	59
Christian	34	26	47	36
Muslim	6	5	6	5
Others	-	-	-	-
Education of mother:				
Non-literate	16	12	4	3
Primary	32	25	32	25
Secondary	53	41	76	58
College	29	22	18	14
Education of father:				
Non-literate	10	8	1	1
Primary	28	22	30	23
Secondary	70	54	73	56
College	22	16	26	20

Contd….

Occupation of mother:				
Daily wages	25	19	27	21
Non-Executive	10	8	8	6
Executive	2	2	6	5
Business/Self Employed	10	8	23	18
Professional	20	15	9	7
Skilled	2	2	8	6
Un-employed	61	47	49	38
Occupation of Father:				
Daily wages	48	37	36	28
Non-Executive	10	8	10	8
Executive	7	5	9	7
Business/Self Employed	45	35	55	42
Professional	5	4	11	8
Skilled	11	8	6	5
Un-employed	4	3	3	2
Income of the family:				
1000-3000	36	28	22	17
3001-6000	32	25	42	32
6001-9000	38	29	46	35
9001 & above	24	18	20	15
Residence:				
Urban	41	32	47	36
Rural	56	43	31	24
Semi-urban	33	25	52	40
Medium of Language during schooling:				
Tamil	43	33	46	35
English	46	35	32	25
Malayalam	38	29	49	38
Others	3	2	3	2
Type of Board studied in schooling:				
State	94	72	98	75
Matriculation	24	18	15	12
Central	10	8	15	12
Any others	2	2	1	2

Contd….

% of marks in +2:				
<40%	1	1	4	3
41-60%	20	15	14	11
61-80%	100	77	98	75
>81%	9	7	14	11
% of marks in 1st year B.sc(N):				
<40%	11	8	3	2
41-60%	47	36	42	32
61-80%	70	54	83	64
>81%	2	2	2	2
Aptitude to join Nursing:				
Self interest	102	78	80	62
Parents	18	14	23	18
Friends	5	4	12	9
Relatives	3	2	7	5
Any others	2	2	8	6
Sector of the college:				
Private	130	100	130	100
Government	-	-	-	-
Deemed	-	-	-	-
Courses offered in the college:				
UG only	44	34	42	32
UG & Diploma	35	27	47	36
UG & PG	51	39	41	32
All the above	-	-		
Clinical training obtained				
Parent hospital	-	-	-	-
Affiliated hospitals	-	-	47	36
Both the above	130	100	83	64
No. of years institution was started:				
1-3 yrs	79	61	42	32
4-6 yrs	-	-	41	32
7-9 yrs	--	-	-	-
10yrs and above	51	39	47	36

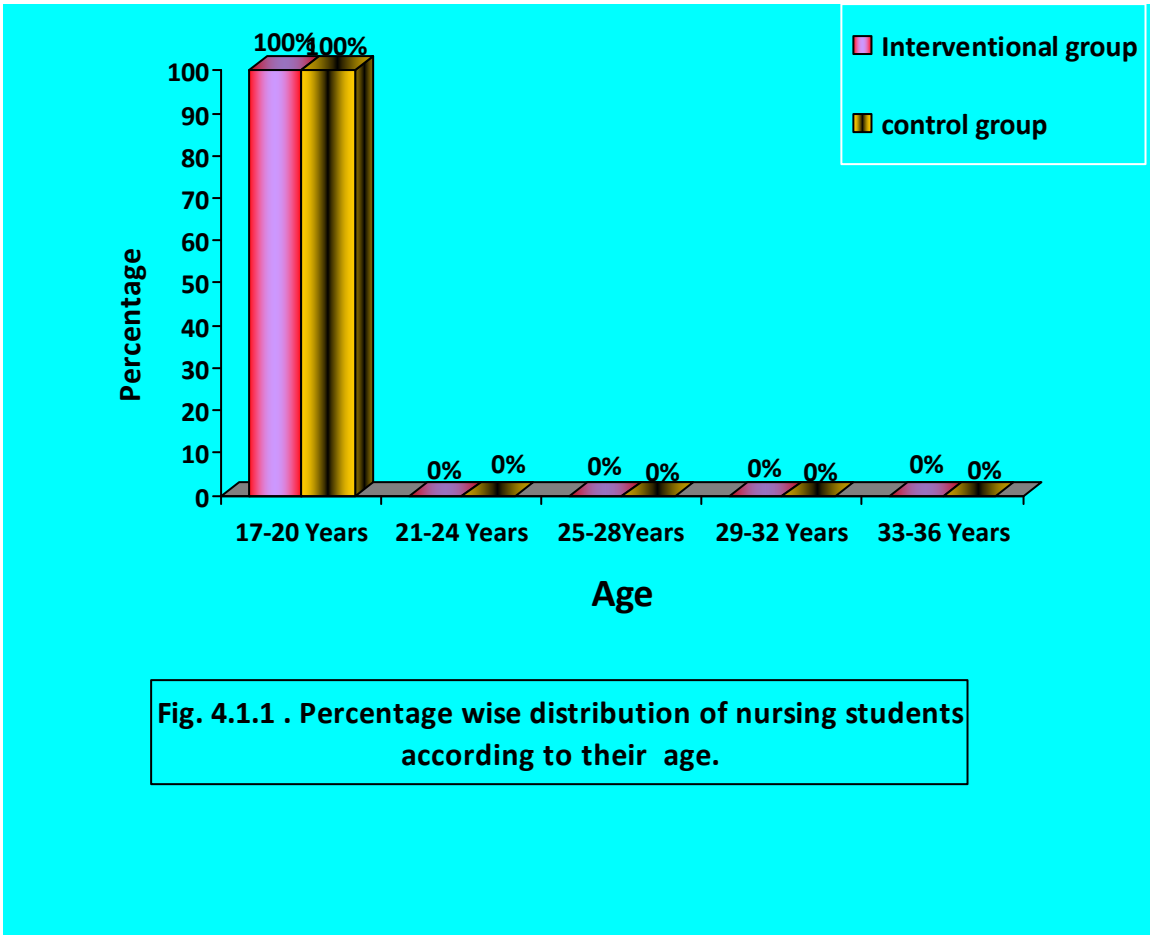

Fig. 4.1.1 . Percentage wise distribution of nursing students according to their age.

Fig- 4.1.1. shows that all the students i.e., 260(100%) were in the age group of 17 to 20 years both in the control and the interventional groups.

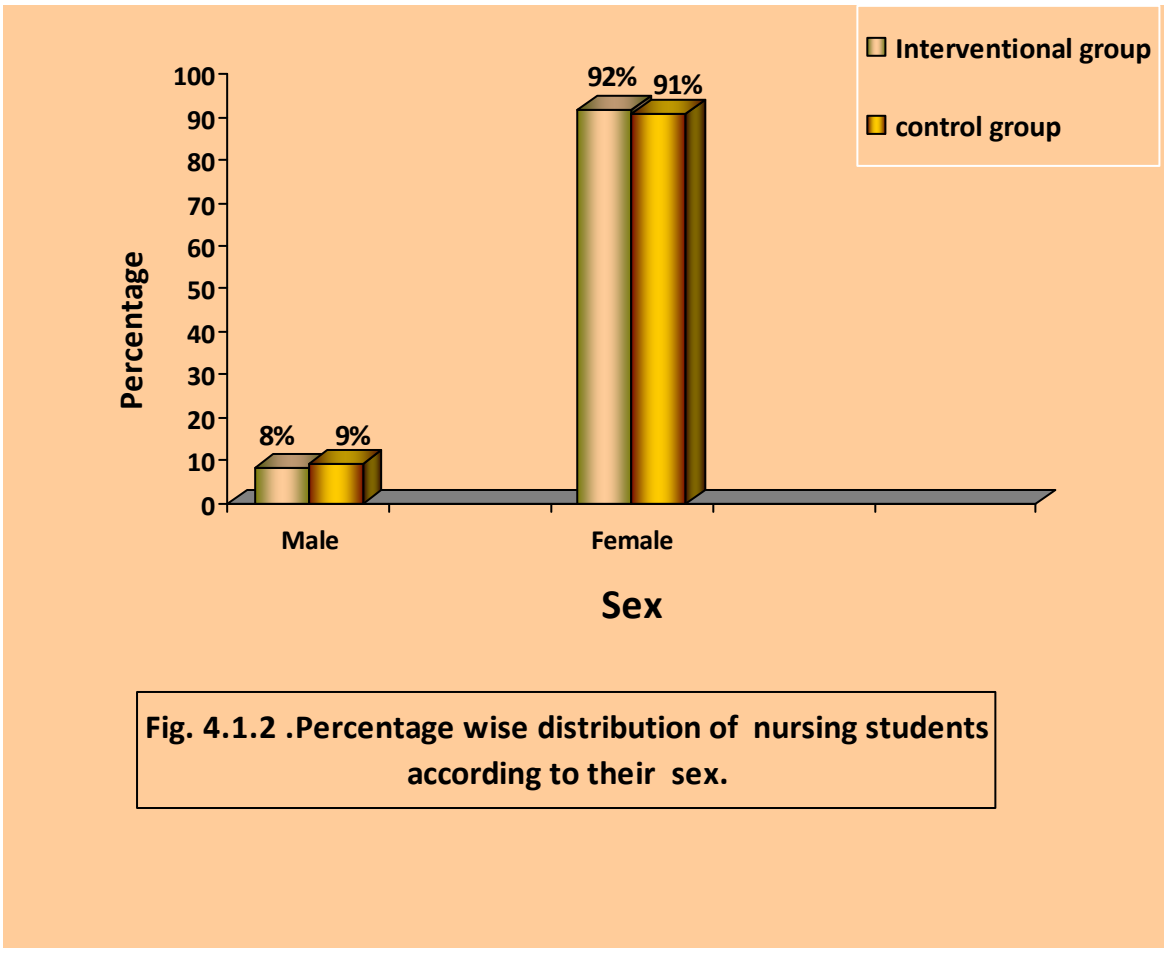

Fig. 4.1.2 .Percentage wise distribution of nursing students according to their sex.

Fig- 4.1.2. reveals that majority of the students i.e., 92% in interventional group and 91% in control group were females and only 8% in interventional group and 9% in control group were males.

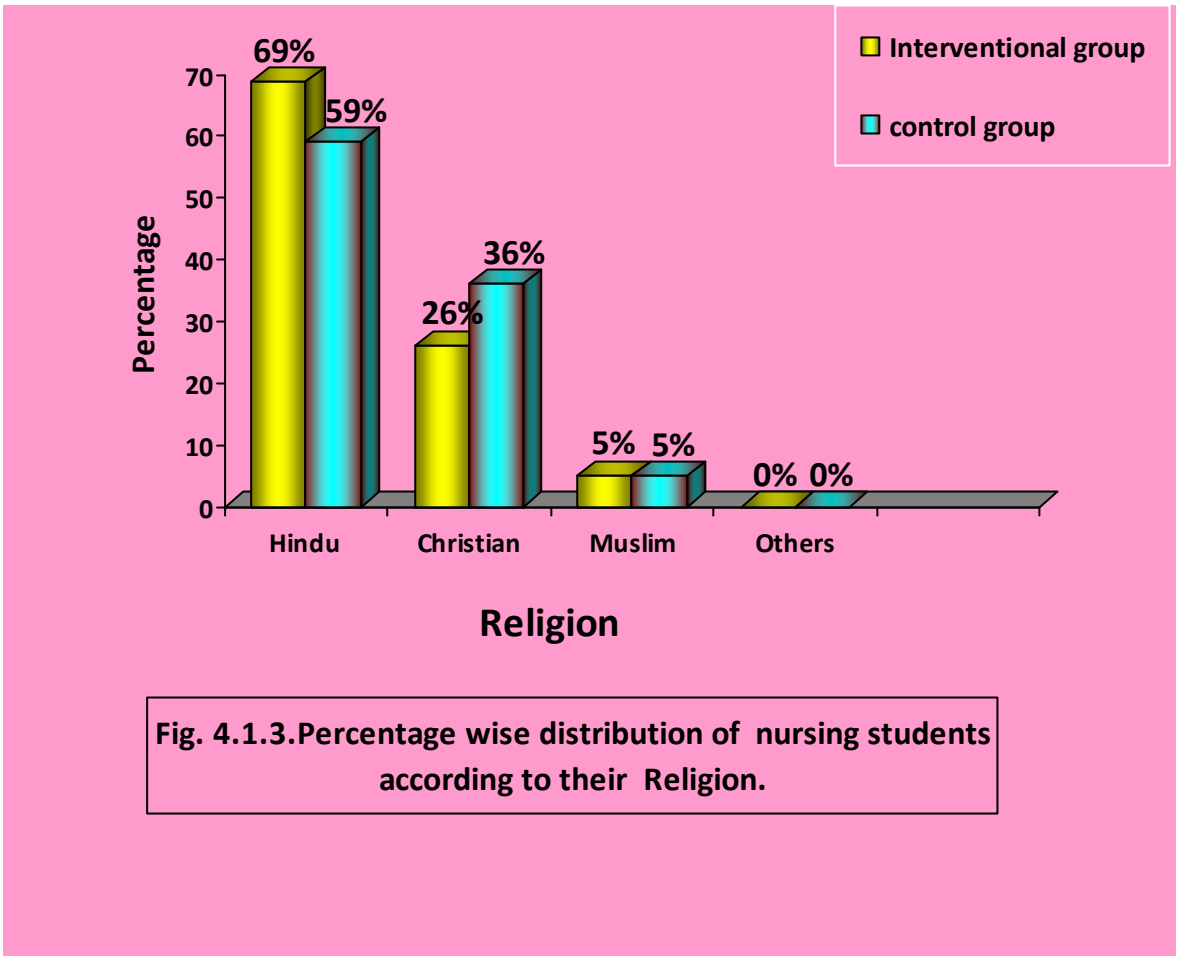

Fig. 4.1.3.Percentage wise distribution of nursing students according to their Religion.

Fig- 4.1.3. projects that majority of 69% students in interventional group and 59% in control group were Hindus. Further, 26% in interventional group and 36% in control group belonged to Christian religion and a minority of 5% were Muslims equally in both the groups.

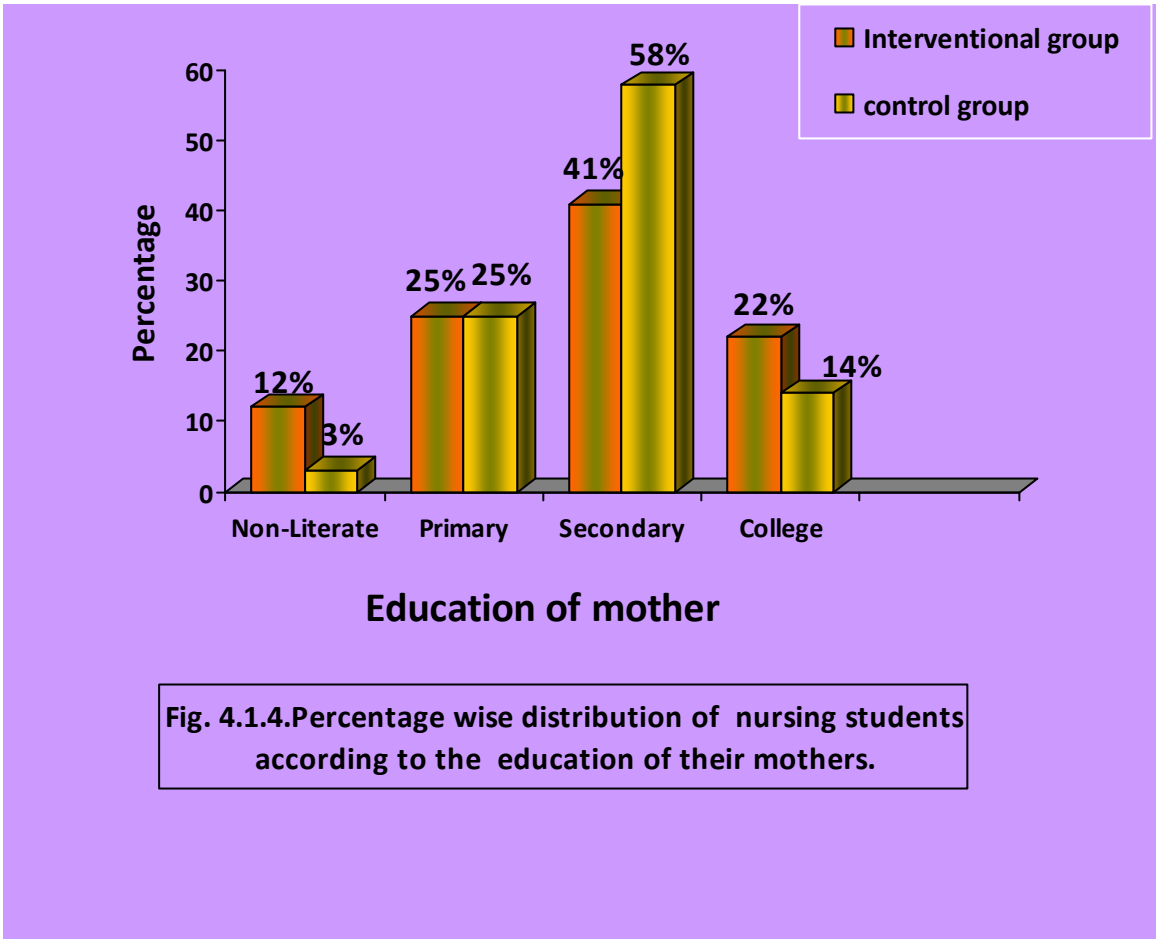

Fig. 4.1.4.Percentage wise distribution of nursing students according to the education of their mothers.

Fig- 4.1.4. depicts that majority of the mothers of the nursing students have studied up to secondary education both in interventional (41%) and control (58%) groups.

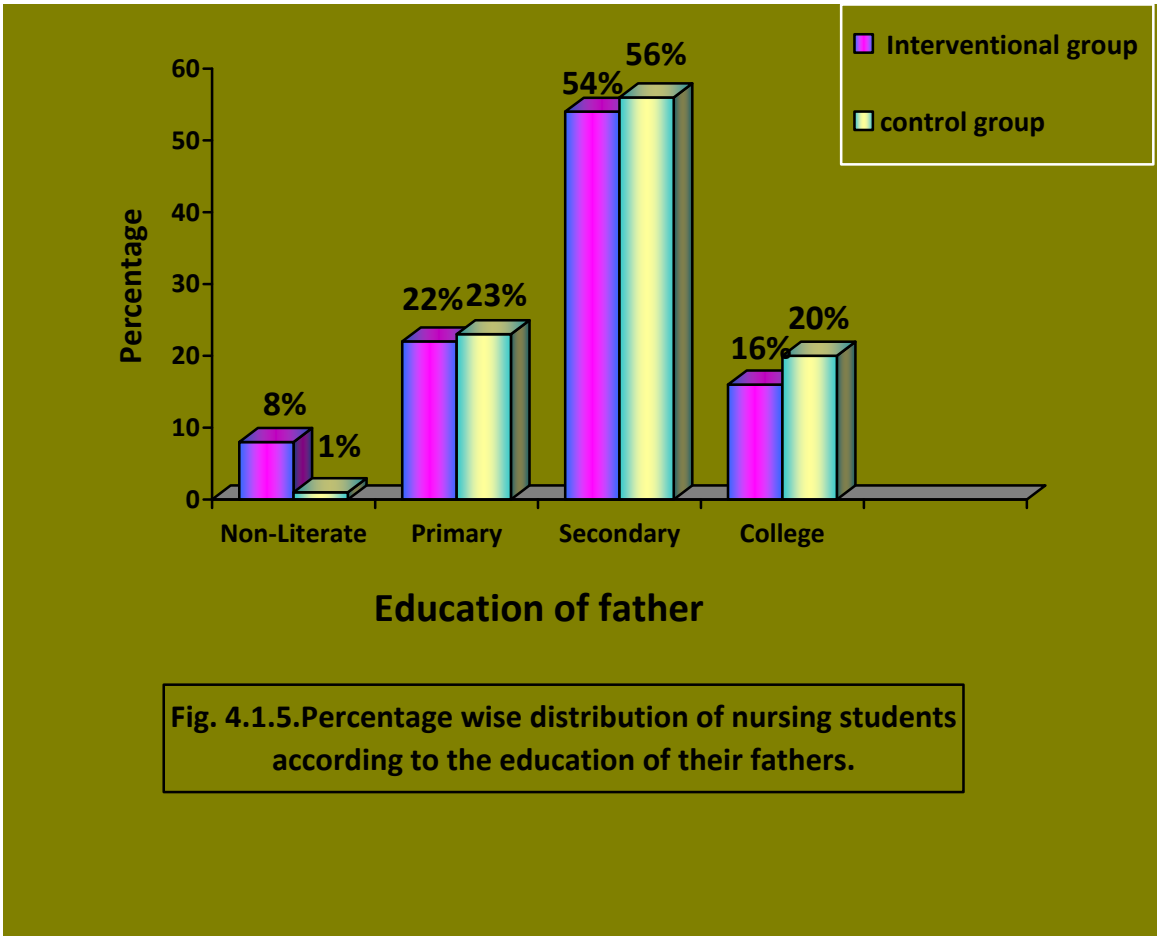

Fig. 4.1.5.Percentage wise distribution of nursing students according to the education of their fathers.

Fig-4.1.5. reveals that majority of the fathers of the nursing students have studied up to secondary education both in interventional (41%) and the control (58%) groups.

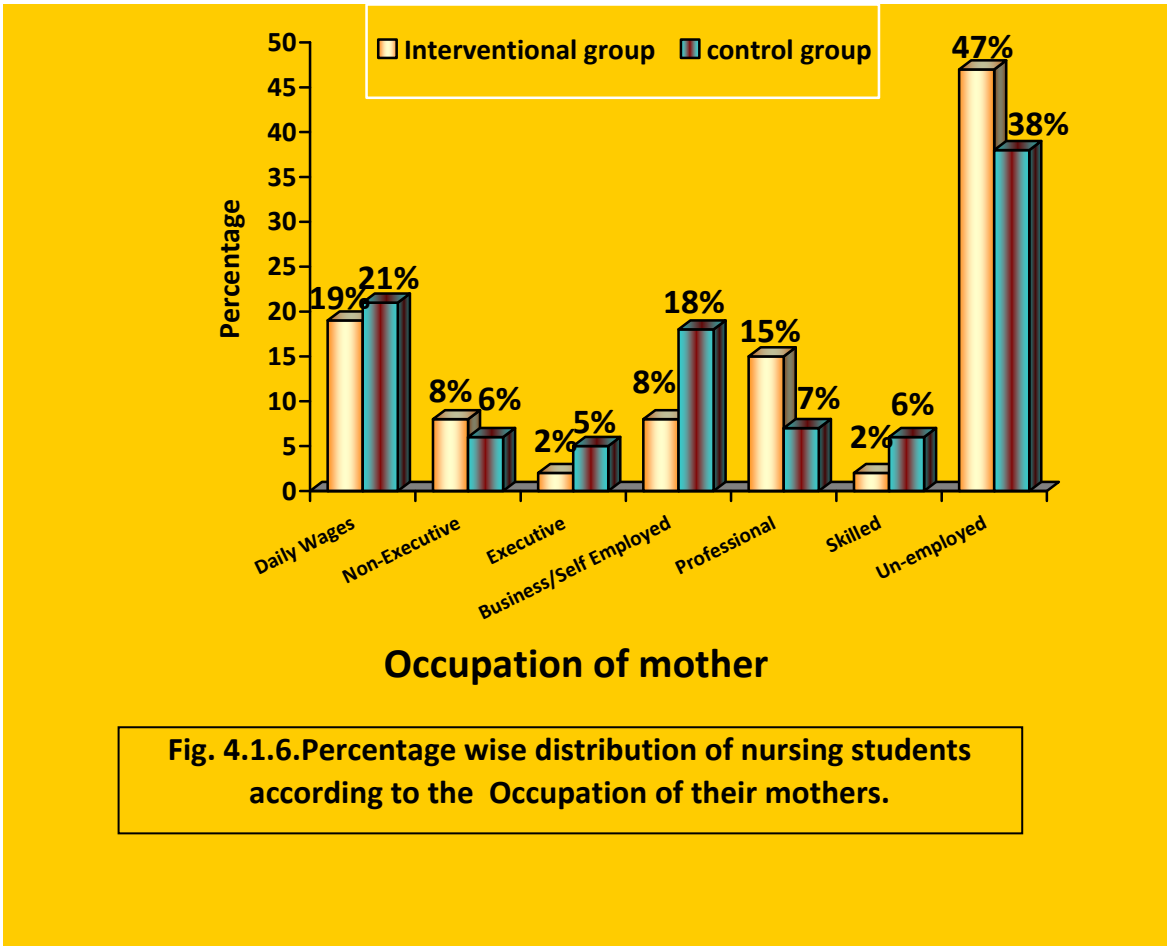

Fig. 4.1.6.Percentage wise distribution of nursing students according to the Occupation of their mothers.

Fig- 4.1.6. projects that majority 47% of mothers of the nursing students in interventional group and 38% in control group were un-employed. Around 19% and 21% were daily wagers in interventional and control groups respectively.

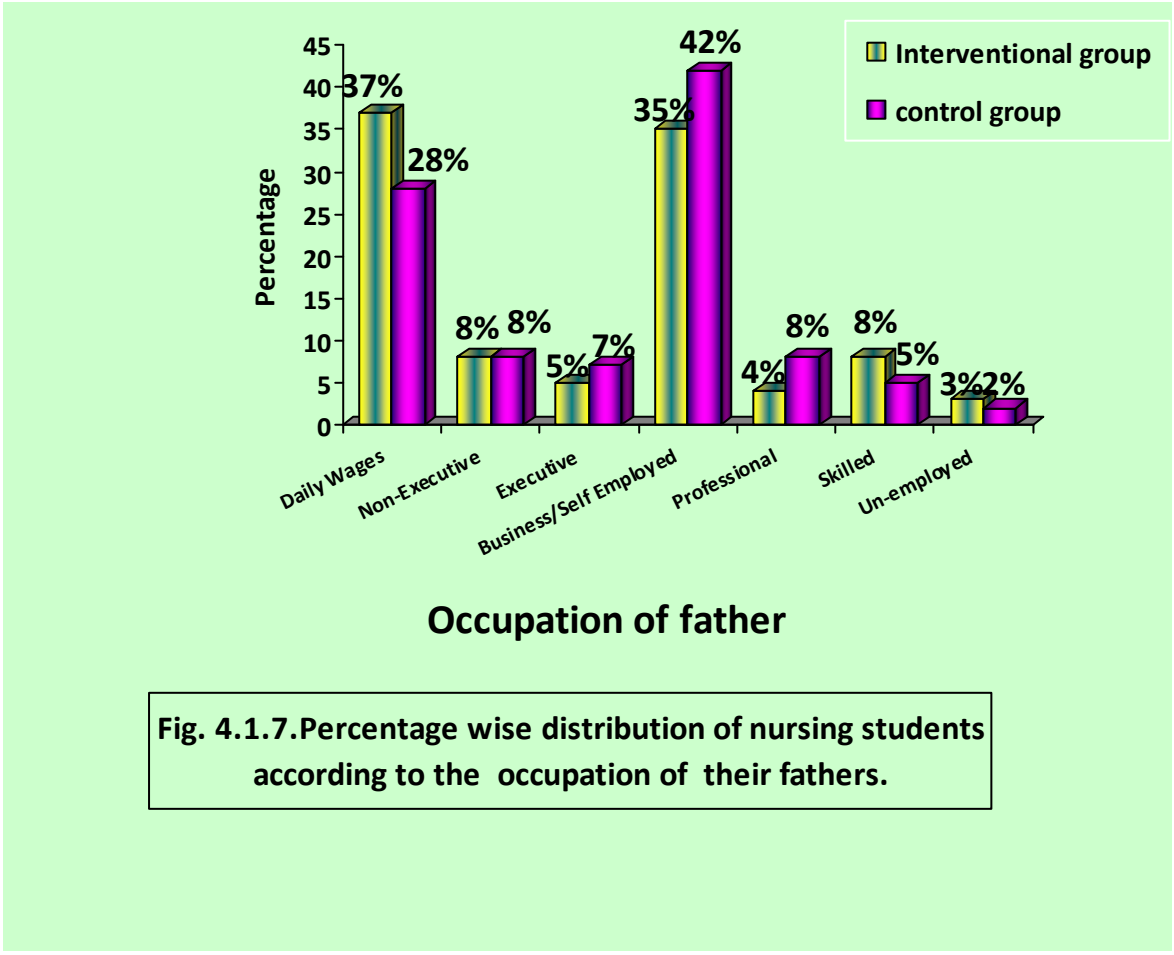

Fig. 4.1.7.Percentage wise distribution of nursing students according to the occupation of their fathers.

Fig- 4.1.7. shows that majority 37% of the sample in the interventional group were daily wagers and 42% in control group were self employed. A minimum of 3% and 2% were unemployed in the interventional and the control groups respectively.

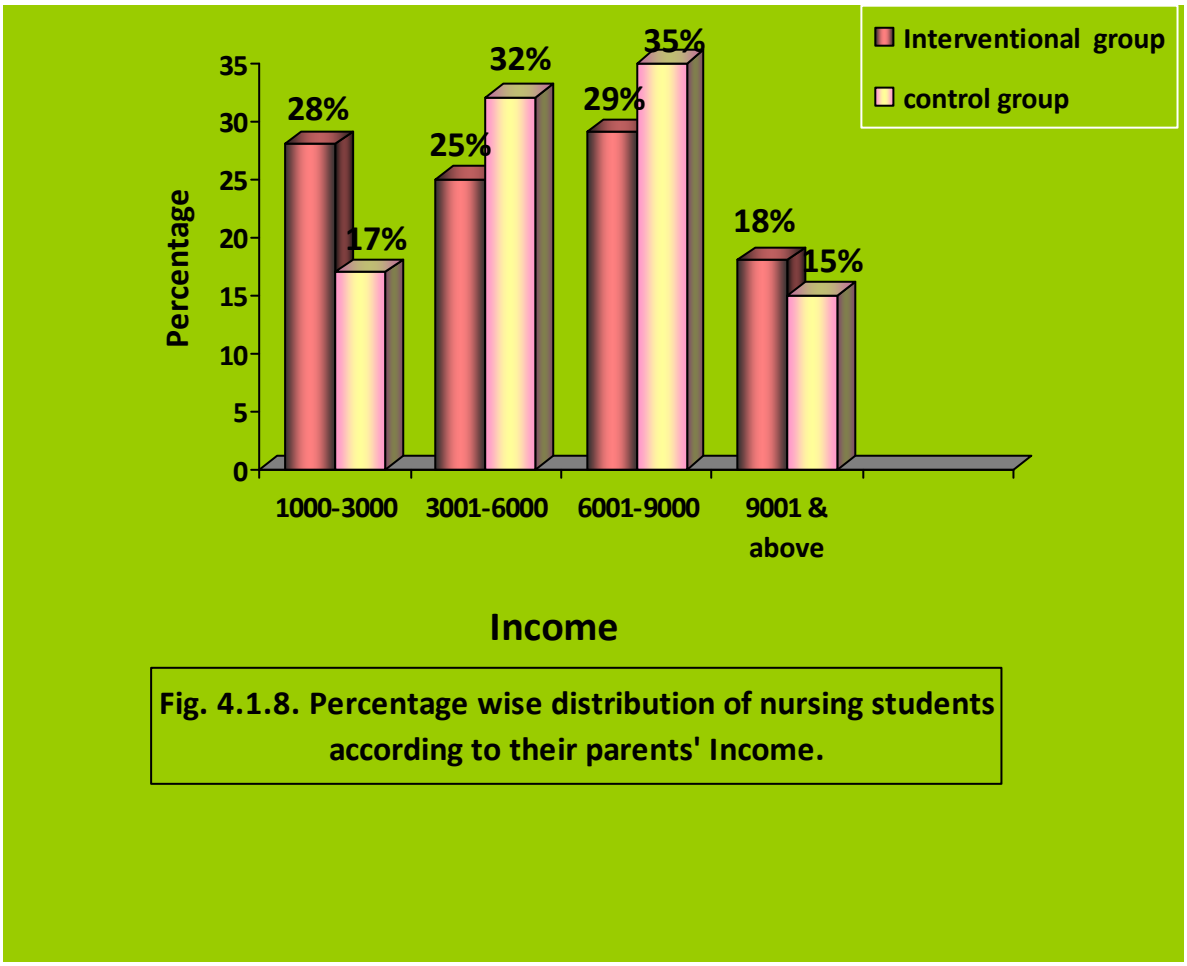

Fig. 4.1.8. Percentage wise distribution of nursing students according to their parents' Income.

Fig- 4.1.8. reveals that with regard to income, majority 29% of subjects in interventional group and 35% in control group earned between Rs.6001 to 9000 per month. Only 18% and 15% had an income of 9001 and above.

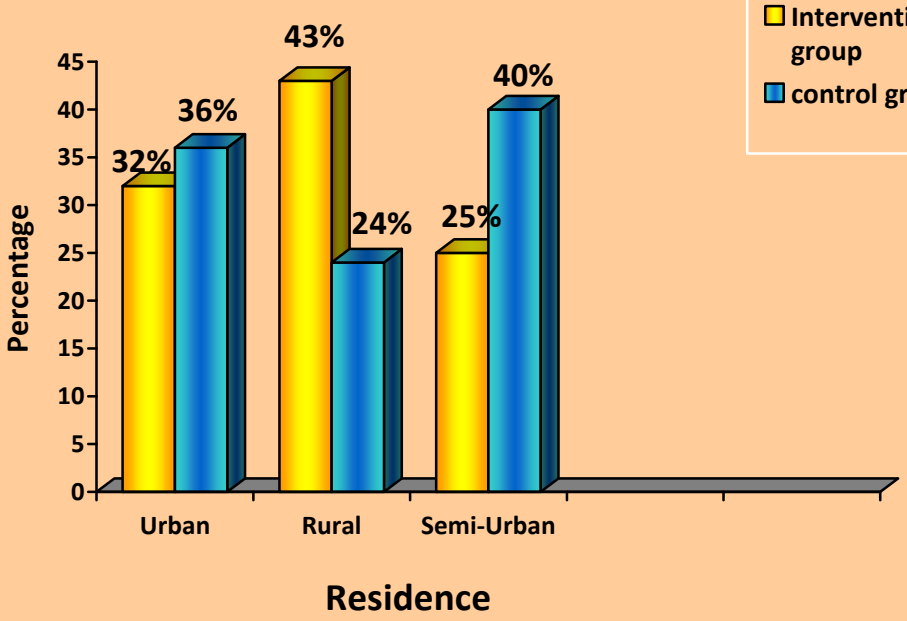

Fig. 4.1.9.Percentage wise distribution of nursing students according to their residence.

Fig- 4.1.9. shows majority of 43% from interventional group belonged to rural areas and 40% from control group belonged to semi-urban area. The lowest 24% in control group and 25% in interventional group hail from rural and semi-urban areas respectively.

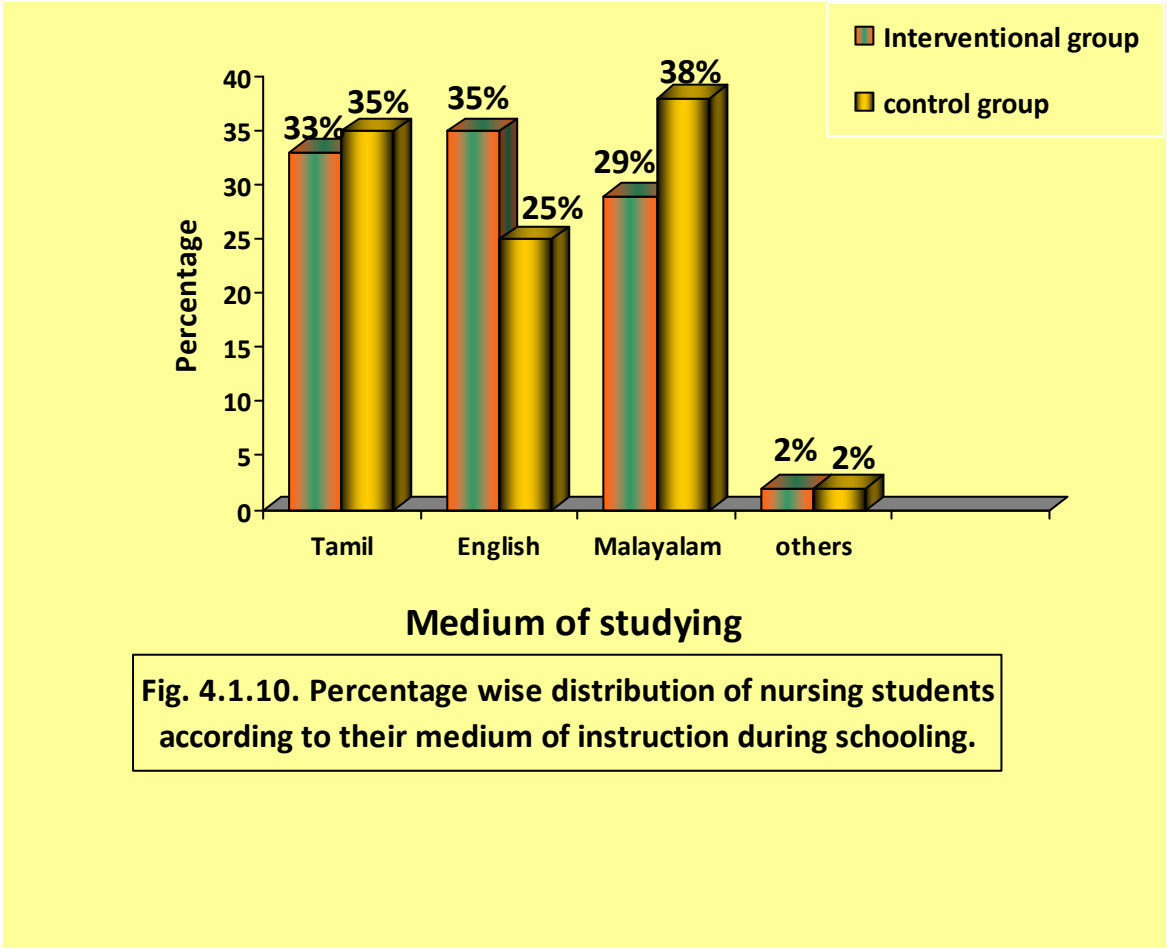

Fig. 4.1.10. Percentage wise distribution of nursing students according to their medium of instruction during schooling.

Fig- 4.1.10. projects the medium of instruction, the students underwent during schooling. It is evident that 33% and 35% studied from Tamil medium, 35% and 25% from English medium and 29% and 38% from Malayalam medium.

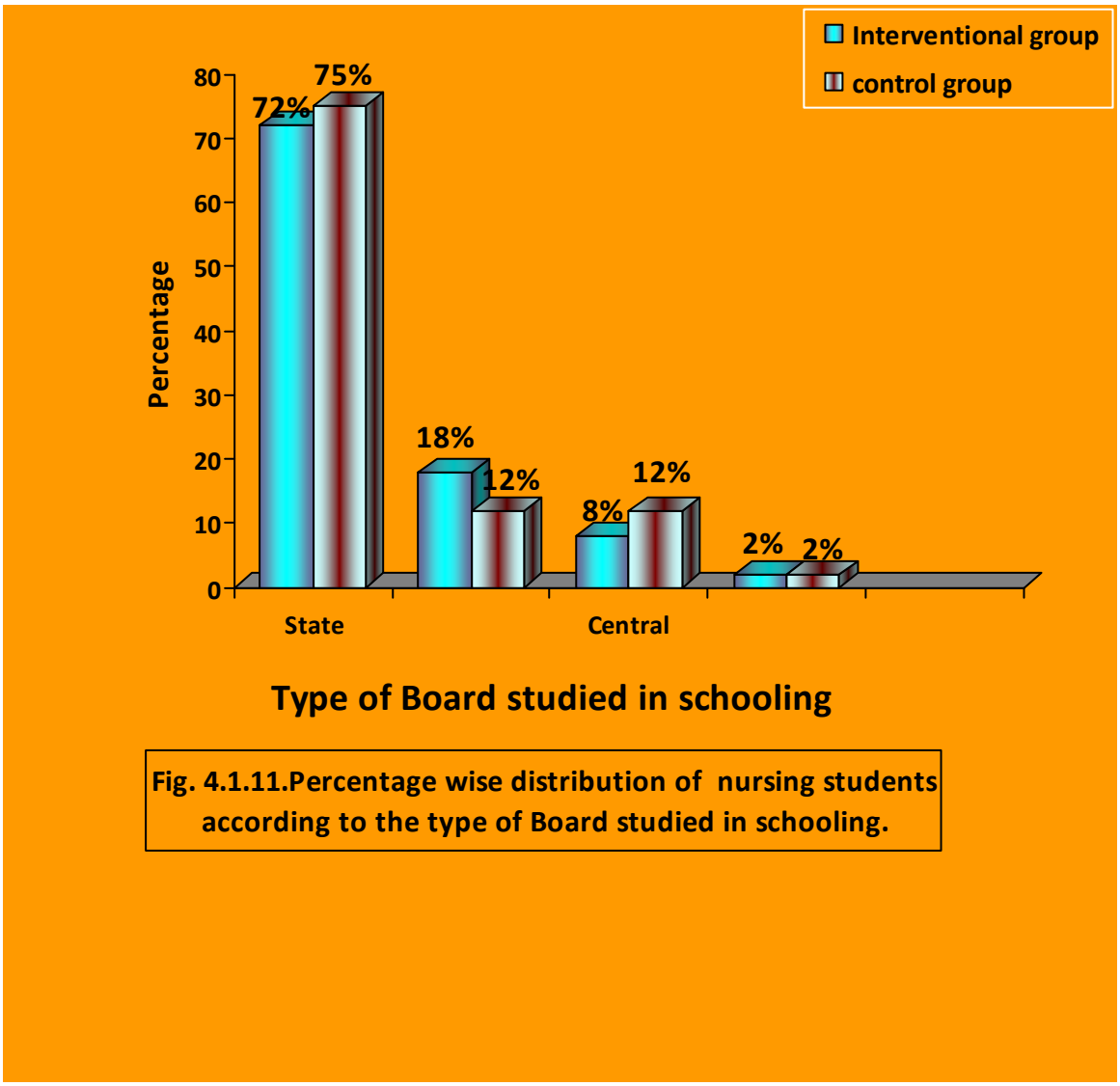

Fig. 4.1.11.Percentage wise distribution of nursing students according to the type of Board studied in schooling.

Fig- 4.1.11. shows that maximum 72% and 75% had completed their schooling from state board, 18% and 12% from Matriculation, 8% and 12% from Central board in interventional and control groups respectively.

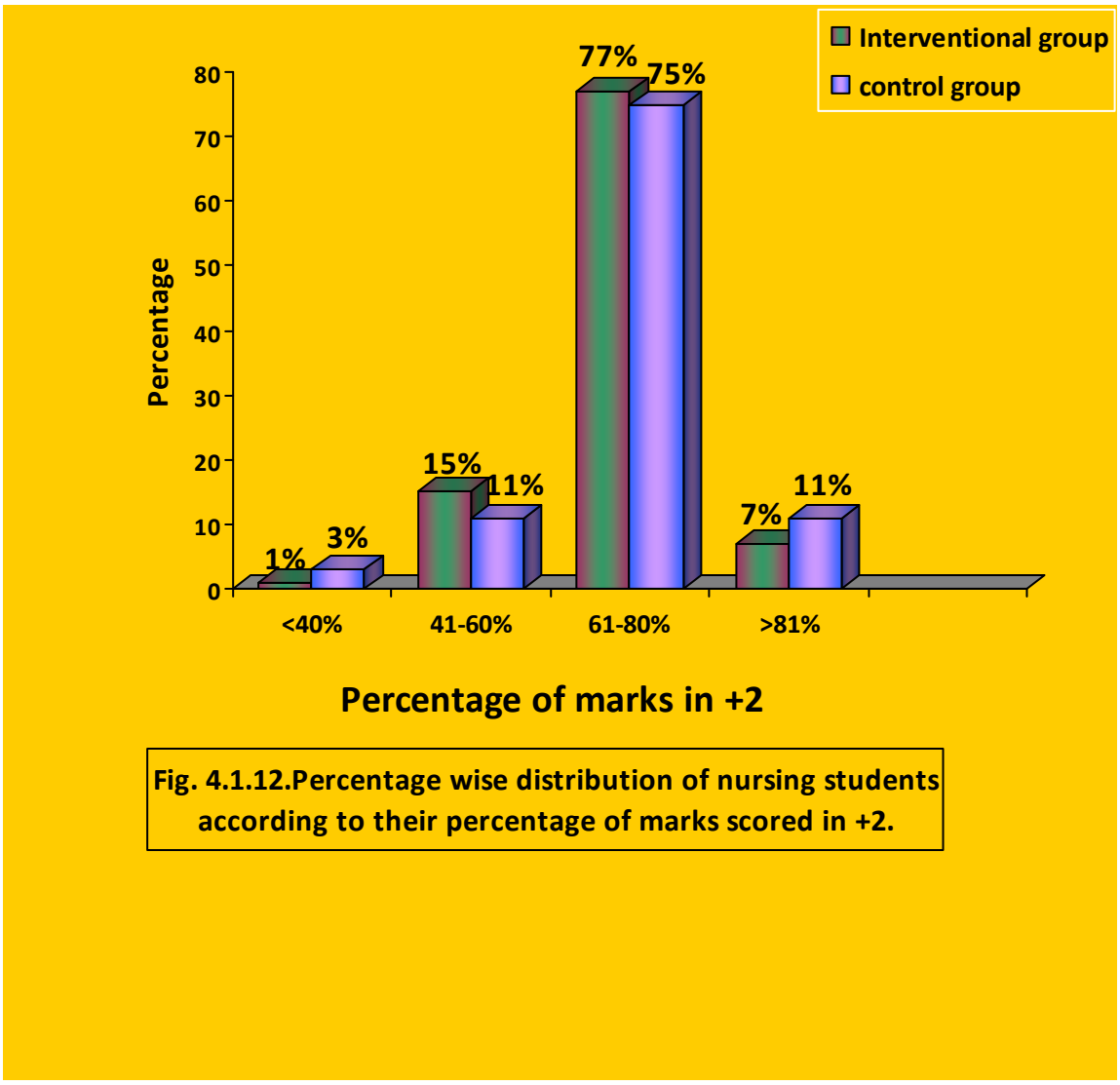

Fig. 4.1.12.Percentage wise distribution of nursing students according to their percentage of marks scored in +2.

Fig- 4.1.12. reveals 77% in interventional group and 75% in control group had obtained 61 to 80% of marks in their higher secondary examinations. It is noted that only 7% and 11% had scored above 81% in the interventional and control groups respectively.

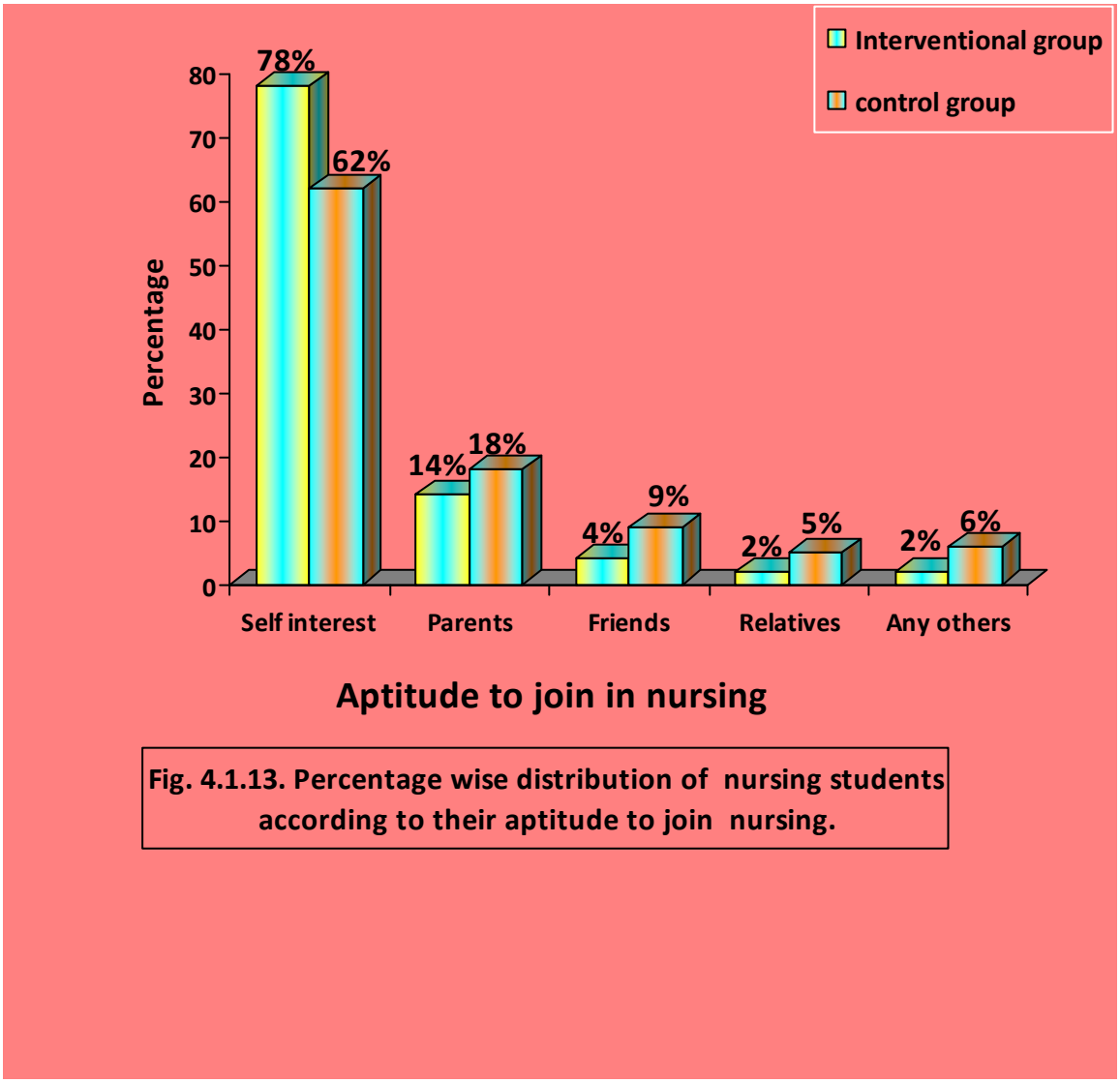

Fig. 4.1.13. Percentage wise distribution of nursing students according to their aptitude to join nursing.

Fig - 4.1.13. depicts the aptitude of students to join nursing. It was interesting to note that majority of the students in interventional (78%) and control group(62%) joined nursing out of self interest. Further, 14% in interventional group and 18% in control group joined nursing through motivation by parents. 4% and 9% being influenced by friends, a minimum of 2% and 5% by relatives and 2% and 6% by other sources in interventional and control groups respectively.

SECTION II

This section deals with the pre test and post test levels of critical thinking skills and problem solving ability of nursing students and their levels of perceived benefits in the control and the interventional groups. The results are presented in Tables 4.2.1. to 4.2.6.

Table No.4.2.1.

Area wise distribution of mean, SD and mean percentage of pre test and post test-2 scores in control group on critical thinking skills and problem solving ability

Area	Max score	Control Pre test scores n=130			Control; Post test-2 scores n=130			Difference in mean %
		Mean	SD	Mean %	Mean	SD	Mean %	
Knowledge	8	4.77	1.68	60	5.26	1.49	66	6
Comprehension	8	2.85	1.70	36	4.13	2.05	52	16
Application	8	4.02	1.79	50	4.34	1.95	54	4
Analysis	8	2.7	2.07	34	3.83	2.35	48	14
Synthesis	8	3.07	2.05	38	4.16	2.09	52	14
Overall	40	17.41	5.94	44	21.73	7.55	54	10

It is evident through this table that in the control group, the highest mean percentage (60%) was scored in the area of knowledge and the least (34%) was scored for analysis in pretest. It was noted that in the post test-2, there was no much improvement found, as the highest mean percentage was 66% for knowledge and the least 48% for analysis. Mean difference in the areas of knowledge (6%), comprehension (16%), application (4%), analysis(14%) and synthesis(14%) with an overall mean difference of 10 denotes no much improvement in critical thinking skills and problem solving ability among the students in the control group.

Table No.4.2.2.

Area wise distribution of mean, SD and mean percentage of pre-test and post test-2 scores in interventional group on critical thinking skills and problem solving ability

Area	Max score	Interventional; Pre test scores n=130			Interventional; Post test-2 scores n=130			Difference in mean %
		Mean	SD	Mean %	Mean	SD	Mean %	
Knowledge	8	3.55	1.59	44	6.52	1.21	82	38
Comprehension	8	2.61	1.42	33	5.64	1.18	71	38
Application	8	3.08	1.91	39	5.99	0.95	75	36
Analysis	8	2.34	1.61	29	5.9	1.13	74	45
Synthesis	8	3.01	2.09	38	6.26	1.01	78	40
Overall	40	14.59	5.54	36	30.31	2.73	76	40

It is seen from this table 4.2.2. that the subjects in the interventional group had scored mean percentage of 44% and 82% for Knowledge, 33% and 71% for Comprehension, 39% and 75% for Application, 29% and 74% for Analysis and 38% and 78% for Synthesis in the pretest and post test respectively with an overall mean difference of 40%, which proves that there was a significant gain in all the areas of critical thinking skills and problem solving ability of nursing students after undergoing PBL process.

Table No.4.2.3.

Area wise distribution of mean, SD and mean percentage of post test-2 scores of interventional and control groups

Area	Max score	Control group Post test-2 scores n=130			Interventional group Post test-2 scores n=130			Difference in mean %
		Mean	SD	Mean %	Mean	SD	Mean %	
Knowledge	8	5.26	1.49	66	6.52	1.21	82	16
Comprehension	8	4.13	2.05	52	5.64	1.18	71	19
Application	8	4.34	1.95	54	5.99	0.95	75	21
Analysis	8	3.83	2.35	48	5.9	1.13	74	26
Synthesis	8	4.16	2.09	52	6.26	1.01	78	26
Overall	40	21.73	7.55	54	30.31	2.73	76	22

Table 4.2.3. reveals that in the post test-2 of interventional group, the overall mean was 76%, which is higher, compared to the overall mean score of control group (54%). Further, the mean percentage was higher in all the areas of post test-2 in the interventional group than in the control group, which proves a significant gain in critical thinking skills and problem solving ability in the interventional group after undergoing PBL process.

Table No.4.2.4.

Area wise distribution of mean, SD and mean percentage of post test scores of interventional and control groups on perceived benefits of the influence of the teaching method on critical thinking skills and problem solving ability

Area	Max score	Control group Post test scores n=130			Interventional group Post test scores n=130			Difference in mean %
		Mean	SD	Mean %	Mean	SD	Mean %	
Overall	200	104.34	14.05	52	175.11	5.27	88	36

Table-4.2.4. shows an overall 36% of difference in mean scores with a mean percentage of 52% and 88% in control group and interventional group respectively, which shows a positive perception in the interventional group towards PBL.

Table No.4.2.5.

Pre test and post test levels of critical thinking skills and problem solving ability of nursing students between control and the interventional groups

Level of critical thinking	Control group n =130						Interventional group n =130					
	pre test		Post tes-1		post test -2		pre test		post test-1		post test-2	
	f	%	f	%	f	%	f	%	f	%	f	%
Low	11	8	4	3	10	8	29	22	-	-	-	-
Moderate	80	62	42	32	45	34	78	60	-	-	-	-
well	37	28	18	14	57	44	23	18	84	65	73	56
Excellent	2	2	66	51	18	14	-	-	46	35	57	44

This table shows percentages of students' level of critical thinking skills and problem solving ability for both study groups. It was observed that in the pre test of control group, the highest score was 80(62%) for moderate skill, and the lowest score being 2(2%) for excellent skill. In the pre test of interventional group, the highest score was 78(60%) for moderate skill, and the lowest score of 23(18%) for well skill and none of them had excellent skill.

In the post test-1 of control group, the maximum sample 66(51%) possessed excellent skill and in post test-2 the highest score was 57(44%) for well skill, and the score for excellent skill was reduced to 18(14%),which is evident for having reduced in the level of critical thinking skills and problem solving ability in the post test-2 period. Whereas, it was amazing to note that in the post test-1 and post test-2 of experimental group, none of the subjects had neither low nor moderate skill. In post test-1, out of 130 subjects, 84(65%) had well skill, 46 (35%) had excellent skill and in posttest-2, the level of critical thinking skills and problem solving ability in excellent skill had hiked to 57(44%), which is higher than that of the post test-1.

Table No.4.2.6.

Levels of perceived benefits of the teaching method on critical thinking skills and problem solving ability among nursing students between control and the interventional groups

Level of perceived benefits	Control group n =130		Interventional group n =130	
	Post test		Post test	
	F	%	f	%
Un favourable	112	86	-	-
Favourable	18	14	130	100

This table demonstrates the difference in the level of perceived benefits between the control and the interventional groups. As shown, all 130(100%) had favorable perception in the interventional group, whereas only 18(14%) had favorable and 112(86%) had unfavorable perception in the control group. This finding proves that the students who underwent PBL process had a favorable attitude towards PBL method of learning.

SECTION III

This section presents the Item wise comparison of pre test and post test levels of critical thinking skills and problem solving ability of nursing students in control group and the interventional group and their perceived benefits of the teaching method.

It also deals with comparison of pre test and post test levels within the control and the interventional groups (paired 't' test) and between groups (Un-paired 't'-test). Further, it compares the differences on the levels of critical thinking skills and problem solving ability of nursing students between the control and the interventional groups at different points of time (ANOVA). The data are presented in Tables 4.3.1. to 4.3.12.

Table No. 4.3.1.

Item wise comparison of pre test - post test scores of control group and pre test - post test scores of interventional group in the area of "Knowledge "on critical thinking skills and problem solving ability of nursing students N=260

Items	Control group n=130			Interventional group n=130		
	Pre test X (%)	Post test Y (%)	E = Y – X	Pre test X (%)	Post test Y (%)	E = Y – X
A1.Insulin is secreted from pancreas by	88	95	7	68	98	30
A2.Insulin's action on the cells	23	63	40	36	56	20
A3.Type I diabetic mellitus	62	65	3	54	79	25
A4.Type I Diabetes mellitus develops in people who have the tendency found in Antigen	78	60	18	48	82	34
A 5. Diabetes mellitus is a group of	79	82	3	47	88	41
A 6.The characteristics of type I diabetes mellitus	22	45	23	27	74	47
A7.Type I diabetes mellitus is the result of	62	56	6	48	89	41
A8.The expansion of the term IFG	62	59	3	28	86	58

E=Effectiveness

Table 4.3.1. reveals that in the area of knowledge, the differences between pre test and post test in the control group (Y-X) were 7,40,3,18,3,23,6, and 3 and in the interventional group (Y-X) 30,20,25,34,41,47,41 and 58 for the items A1,A2,A3,A4,A5,A6,A7 and A8 respectively. This shows that there was increased number of correct responses in the interventional group during the post test period than in the control group, which proves the effectiveness of PBL.

Table No. 4.3.2.

Item wise comparison of pre test - post test scores of control group and pre test - post test scores of interventional group in the area of "Comprehension" on critical thinking skills and problem solving ability of nursing students

N=260

Items	Control group n=130		E = Y – X	Interventional group n=130		E = Y – X
	Pre test X (%)	Post test Y (%)		Pre test X (%)	Post test Y (%)	
B1. Insulin waning	44	65	21	51	74	23
B2. The laboratory test that indicates compliance of the diabetic client and insulin therapy	27	52	25	18	73	55
B3. The tests used to diagnose diabetic ketoacidosis	24	63	39	27	84	57
B4. Jet injector	19	50	31	23	78	55
B5. glycemic index	45	50	5	45	78	33
B6. Acute complications of Diabetes mellitus	27	41	14	32	58	26
B7. Signs & symptoms that indicates hyperglycemia in a client with diabetes mellitus	39	38	1	15	51	36
B8. Health education for a patient in hyperglycemia	60	55	5	51	69	18

E=Effectiveness

This table displays that in the area of “Comprehension” the scores for effectiveness in the Interventional group were 23,55,57,55,33,26,36, and 18 and in the control group 21,25,39,31,5,14,1 and 5 for the items B1,B2,B3,B4,B5,B6,B7 and B8 respectively. The scores gained in the post test period of control group are lesser than the scores gained in the interventional group. This ultimately proves an improvement in the level of Comprehension among the students of interventional group after undergoing PBL process.

Table No. 4.3.3.

Item wise comparison of pre test - post test scores of control group and pre – post test scores of interventional group in the area of "Application" on critical thinking skills and problem solving ability of nursing students

N=260

Items	Control group n=130		E = Y – X	Interventional group n=130		E = Y – X
	Pre test X (%)	Post test Y (%)		Pre test X (%)	Post test Y (%)	
C1. Emergency management of DKA	55	75	20	47	77	30
C2.Teaching plan for Diabetes Mellitus regarding proper foot care	48	60	12	36	53	17
C3. Peak action of NPH insulin	62	56	6	35	73	38
C4. Potency of NPH insulin	33	55	22	26	87	61
C5.Discharge teaching plan regarding insulin administration	58	51	7	41	88	47
C6. Teaching plan to prevent recurrence of DKA	36	38	2	50	65	15
C7. Management of a patient with HHNS	45	54	9	35	82	47
C8. Functioning of an external insulin pump	65	45	20	36	74	38

E=Effectiveness

Table No 4.3.3., depicts item wise comparison of pre test and post test scores between control and interventional groups in the area of “Application”. This table reveals a significant improvement in the scores in interventional group, as the scores of 30,17,38,61,47,15,47, and 38 were higher than the scores of 20,12,6,22,7,2,9 and 20 in control group for the items C1,C2,C3,C4,C5,C6,C7 and C8 respectively. This proves the effectiveness of PBL method of teaching.

Table No.4.3.4.

Item wise comparison of pre test - post test scores of control group and pre test – post test scores of interventional group in the area of "Analysis" on critical thinking skills and problem solving ability of nursing students

N=260

Items	Control group n=130		E = Y – X	Interventional group n=130		E = Y – X
	Pre test X (%)	Post test Y (%)		Pre test X (%)	Post test Y (%)	
D1. Confirmative diagnosis of DKA	45	68	23	55	88	33
D2.Teaching on management of type one Diabetes mellitus in case of dehydration	18	52	34	18	72	54
D3.physical assessment on a client with type II DM	40	52	12	35	78	43
D4.Client teaching on insulin administration-preventing lipodystrophy	41	47	6	34	86	52
D5.Differentiation between hypoglycemia and ketoacidosis	32	48	16	22	71	49
D6.teaching to prevent hypoglycemia with exercising	14	41	27	22	68	46
D7.Mixing regular insulin and NPH insulin	48	35	13	24	68	44
D8.Diagnosing complication of type II Diabetes mellitus	32	40	8	25	58	33

E=Effectiveness

This table shows a significant increase in scores gained in the interventional group in the area of Analysis for the items D1,D2,D3,D4,D5,D6,D7 and D8. Comparatively, the scores gained for correct response in interventional group are 33,54,43,52,49,46,44 and 33,which are higher than the scores 23,34,12,6,16,27,13 and 8 in control group respectively for the items D1,D2,D3,D4,D5,D6,D7 and D8. Such increased correct response in interventional group is evident for the efficacy of PBL process.

Table No. 4.3.5.

Item wise comparison of pre test - post test scores of control group and pre test – post test scores of interventional group in the area of "Synthesis "on critical thinking skills and problem solving ability of nursing students

N=260

Items	Control group n=130		E = Y – X	Interventional group n=130		E = Y – X
	Pre test X (%)	Post test Y (%)		Pre test X (%)	Post test Y (%)	
E1. Encounter the problem	32	66	34	46	86	40
E2. Specify the problem	26	54	28	37	83	46
E3. Collect relevant data	72	64	8	62	92	30
E4. Analyze data to specify the problem	35	48	13	42	79	37
E5. Determine plan of action	55	48	7	32	87	55
E6. Prioritize	20	38	18	23	76	53
E7. Execute action plan	18	40	22	26	65	39
E8. Evaluate	49	58	9	33	58	25

E=Effectiveness

The Table 4.3.5. displays the item wise comparison of pre test - post test scores of control group and pre test– post test scores of interventional group in the area of “Synthesis ” on critical thinking skills and problem solving ability. In the area of Synthesis, the difference of scores between pre test and post test in the interventional group are 40,46,30,37,55,53,39 and 25 and in the control group, 34,28,8,13,7,18,22 and 9 for the items E1,E2,E3,E4,E5,E6,E7 and E8 respectively. This finding confirms that the PBL students performed much better than the students in the control group.

Table No. 4.3.6.

Item wise comparison between control and interventional groups on their perceived benefits of the teaching method on critical thinking skills and problem solving ability. **N=260**

	Control group - post test n=130										Interventional group - post test n=130									
	SA		A		U		D		SD		SA		A		U		D		SD	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Motivation to work	1	1	24	18	92	71	11	8	2	2	34	26	95	73	1	1	-	-	-	-
Opportunities to search for information	-	-	15	11	81	62	27	21	7	5	58	45	70	54	2	2	-	-	-	-
Motivation to do own learning	1	1	26	20	70	54	27	21	6	5	42	32	83	64	5	4	-	-	-	-
Think more possibilities to solve problems	1	1	18	14	54	41	46	35	11	8	47	36	79	61	4	3	-	-	-	-
helped to find the best way to solve problems	2	2	24	18	72	55	24	18	8	6	50	38	73	56	7	5	-	-	-	-
Able to Look at concepts from different angles	1	1	16	12	70	54	35	27	8	6	56	43	71	55	3	2	-	-	-	-
Learned to Analyze situation in differently	4	3	13	10	60	46	37	28	16	12	52	40	74	57	4	3	-	-	-	-
Thinking has improved in different ways	1	1	14	11	82	63	27	21	6	4	45	35	79	61	6	5	-	-	-	-
Stimulated to think critically	1	1	10	8	69	53	36	28	14	11	47	36	79	61	3	2	1	1	-	-
Thinking area is extended	7	5	12	9	68	52	35	27	8	6	59	45	69	53	2	2	-	-	-	-

Contd….

Motivated to get new perspectives	1	1	15	12	59	45	40	31	15	12	56	43	70	54	4	3	-	-	-	-
Could think systematically	2	2	7	5	63	48	41	32	17	13	59	53	57	44	4	3	-	-	-	-
Motivated to share the opinions with others	2	2	13	10	66	51	33	25	16	12	56	43	68	52	6	5	-	-	-	-
Oral and written skills developed	1	1	14	11	76	58	30	23	9	7	48	37	77	59	5	4	-	-	-	-
Encouraged to express own opinions in the group	2	2	16	12	75	58	31	24	6	5	63	48	64	49	3	2	-	-	-	-
Able to communicate effectively with others	4	3	18	14	61	47	33	25	14	11	51	39	75	58	4	3	-	-	-	-
More involved with classmates	7	5	16	12	71	55	29	22	7	5	57	44	68	52	5	4	-	-	-	-
Able to collaborate with others effectively	6	5	20	15	65	50	29	22	10	8	47	36	79	61	4	3	-	-	-	-
Motivated to work as a team effectively	5	4	8	6	65	50	38	29	14	11	51	39	75	58	4	3	-	-	-	-
Motivated to effectively interact with peers	2	2	8	6	73	56	34	26	13	10	44	34	83	64	3	2	-	-	-	-
Enabled to teach each other	4	3	12	9	71	55	34	26	9	7	47	36	82	63	1	1	-	-	-	-
Facilitated in getting the feedback	3	2	12	9	51	39	37	28	27	21	60	46	65	50	5	4	-	-	-	-
Fostered Both oral and written communication skills	4	3	6	5	53	41	43	33	24	18	52	40	72	55	6	5	-	-	-	-
Fostered the ability of dealing with confidence	-	-	12	9	57	44	40	31	21	16	49	38	74	57	6	5	1	1	-	-
The sessions provoked self directed learning	3	2	1	1	62	48	46	35	18	14	54	42	69	53	7	5	-	-	-	-
The unit enhanced understanding of the content	1	1	6	5	62	48	39	30	22	17	53	41	69	53	8	6	-	-	-	-
Enabled to focus on learning needs	3	2	14	11	64	49	26	20	23	18	62	48	65	50	3	2	-	-	-	-

Contd….

More relaxed atmosphere for problem solving	1	1	10	8	56	43	41	32	22	17	60	46	66	51	4	3	-	-	-	-
Felt warm during working as a team	-	-	13	10	63	48	40	31	14	11	53	41	74	57	3	2	-	-	-	-
Greater responsibilities for self and the group	4	3	10	8	70	54	22	17	24	18	50	38	76	58	4	3	-	-	-	-
Could know each other well	4	3	11	8	62	48	32	25	21	16	44	34	81	62	5	4	-	-	-	-
Enjoyed debating issues and new ideas	3	2	14	11	61	47	30	23	22	1	59	45	65	50	6	5	-	-	-	-
Could respect others opinion	1	1	18	14	60	47	27	21	24	18	60	46	68	52	2	2	-	-	-	-
Could learn much from text books	3	2	12	9	47	36	31	24	37	28	66	51	59	45	5	4	-	-	-	-
The clinical programme was not time consuming	1	1	12	9	49	38	36	28	32	25	62	48	64	49	4	3	-	-	-	-
It was not hard to understand deeply	-	-	12	9	44	34	33	25	41	31	65	50	61	47	4	3	-	-	-	-
Felt no much stress	1	1	19	15	42	32	36	28	32	25	44	34	83	64	3	2	-	-	-	-
Not experienced greater work load	1	1	16	12	49	38	36	28	28	22	57	44	70	54	3	2	-	-	-	-
Had sufficient time to complete tasks	-	-	13	10	56	43	27	21	34	26	52	40	72	55	52	40	-	-	-	-
Not time waste explaining material to others	-	-	13	10	42	32	30	23	45	34	59	45	64	49	7	5	-	-	-	-

This table 4.3.6. reveals the perceived benefits of the subjects on the teaching method used. Almost all the subjects in interventional group have disclosed positive responses for all the statements, except 2 respondents who have disagreed to the statements “being stimulated to think critically” and “It fostered the ability of dealing with confidence”.

In the control group, only few have given positive responses to the statements asked, which shows that the students are not enjoying their learning by pure lecture method of teaching.

Therefore, it is evident that the PBL method of teaching has enhanced their learning skills. Moreover, it is proved that the students have enjoyed the PBL learning process which was disclosed from their overall response.

Table No.4.3.7.

Comparison of pre test and post test-2 levels of critical thinking skills and problem solving ability of nursing students in Control group

n =130

Area	't'-test	P-value
Knowledge	2.49	0.01*
Comprehension	5.202	0.000***
Application	1.35	0.17
Analysis	3.92	0.000***
Synthesis	4.65	0.000***
Overall	4.97	0.000***

* P<0.05, *** P<0.001

It is seen from table 4.3.7 that in the control group, there was a significant difference found in the level of Knowledge (P<0.05), and there was a highly significant difference found in the levels of Comprehension (P<0.001), Analysis(P<0.001), Synthesis(P<0.001) and overall between the pretest and the post test. However, no significant difference was found in the area of Application.

Table No.4.3.8.

Comparison of pre test and post test-2 levels of critical thinking skills and problem solving ability of nursing students in Interventional group

n =130

Area	't'-test	P-value
Knowledge	16.9	0.000***
Comprehension	19.48	0.000***
Application	15.86	0.000***
Analysis	19.67	0.000***
Synthesis	15.68	0.000***
Overall	32.87	0.000***

*** P<0.001

Table 4.3.8. shows that, there was a highly significant difference (P<0.001) found between the pre test and post test scores in all the areas i.e., Knowledge, Comprehension, Application, Analysis and Synthesis in the interventional group.

Further, the overall 't' level in all the areas was 32.87 and the 'P' value was 0.000, which shows a highly significant difference between the pre test and post test scores of interventional group. This proves that PBL method of teaching improves the thinking skills widely in all the domains. Therefore, research hypothesis H_1 was accepted.

Table No.4.3.9.

Un-paired 't'-test for control group; pre test and interventional group ; post test-2 for the level of critical thinking skills and problem solving ability among nursing students

n =130

Area	't'-test	P-value
Knowledge	9.61	0.000***
Comprehension	15.35	0.000***
Application	11.03	0.000***
Analysis	15.47	0.000***
Synthesis	15.91	0.000***
Overall	22.49	0.000***

*** P<0.001

The findings from this table reveals that the calculated overall 't' value was 22.49, which is higher than the table value and the 'P' value was highly significant at 0.001 level. Therefore, it is proved that there was a significant difference between the control group; pre test and interventional group; post test-2 in all the areas of critical thinking skills and problem solving ability of nursing students. It can be inferred that the higher scores gained in the interventional group in all the areas were due to the PBL method of teaching applied.

Table No. 4.3.10.

Un-paired 't'-test for post test-2 of control group and post test-2 of interventional group on the level of critical thinking skills and problem solving ability among nursing students

n =130

Area	't'-test	P-value
Knowledge	7.46	**0.000*** **
Comprehension	7.26	**0.000*** **
Application	8.64	**0.000*** **
Analysis	9.054	**0.000*** **
Synthesis	10.28	**0.000*** **
Overall	12.17	**0.000*** **

*** P<0.001

This table 4.3.10. reveals that there is a significant difference between post test-2 of control group and post test-2 of interventional group in the level of critical thinking skills and problem solving ability. The obtained overall 't'value 12.17, is higher than the table value, which is highly significant at 0.001 level of significance. Thus, the research hypothesis is accepted. It can be concluded that the interventional group, who underwent PBL process scored higher in critical thinking skills and problem solving ability than the control group, who were taught in lecture method. Hence, it was revealed that the highly significant result was by true difference, not by chance.

Table No. 4.3.11.

Un-paired 't'-test for the level of perceived benefits on the teaching method between control and the interventional groups

n =130

Area	't'-test	P-value
overall	53.76	0.000***

*** P<0.001

The result of the unpaired 't' test reveals the difference between control and the interventional groups for the level of perceived benefits on the method of teaching used. It was found that there was a statistically highly significant difference existed between the control and the interventional groups (t=53.76, P=0.000). It was observed that the interventional group had more favorable response towards PBL process of learning, whereas the lecture group revealed un favorable response towards lecture method of teaching. It can be interpreted that the true difference was not by chance between groups. So, the PBL method of teaching was found to be effective. Hence the research hypothesis is accepted.

Table No. 4.3.12.

Analysis of variance (ANOVA) for the effectiveness of PBL in enhancing the level of critical thinking skills and problem solving ability of nursing students

N=260

Group	"F"-value	P-value
Control; pre test and Interventional; post test 1,post test 2	379.16	0.000***
Control; post test-1 and Interventional; post test-1,post test-2	12.04	0.000***
Control; post test-2 and Interventional; post test 1,post test 2	116.34	0.000***

*** P<0.001

This table reveals that a statistically significant difference was found in both the control group (P < 0.001) and the interventional group (P < 0.001). "F" value was highly significant in Interventional group compared to control group. Thus, it can be interpreted that the intervention (PBL method of teaching) was found to be most effective than the traditional method of teaching (Lecture).

SECTION IV

This section presents the findings of the correlation between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits of the teaching method in control and the interventional groups.

Also, Multiple Regression was done to identify the relationship between the level of critical thinking skills and problem solving ability of nursing students, their perceived benefits and their selected demographic variables in both the groups. The findings are presented in Tables 4.4.1. to 4.4.6.

Table No. 4.4.1.

Correlation between the level of critical thinking skills and problem solving ability and their perceived benefits among nursing students in control group

n =130

Control group	"r"-value	P-value
Critical thinking skills, problem solving ability and their perceived benefits; post test-1	0.36	0.000***
Critical thinking skill, problem solving ability and their perceived benefits; post test-2	0.34	0.000***

*** P<0.001

The finding of this table reveals that there was a positive correlation found in the control group between critical thinking skills and problem solving ability and their perceived benefits at $p < 0.001$ level of significance. It could be interpreted that as the critical thinking skills and problem solving ability decrease, the perceived benefits also decrease further.

Table No. 4.4.2.

Correlation between the level of critical thinking skills and problem solving ability and their perceived benefits among nursing students in interventional group

n =130

Interventional group	"r"-value	P-value
Critical thinking skills, problem solving ability and their perceived benefits; post test-1	-0.004	0.96
Critical thinking skills, problem solving ability and their perceived benefits; post test-2	0.1	0.57

*** P<0.001

Table 4.4.2. shows that in the interventional group, there was no correlation found between the two variables (critical thinking skills and problem solving ability; post test-1 and their perceived benefits) as 'r' value was near to '0'. Further, there was possibly no relationship between critical thinking skills and problem solving ability (post test- 2) and their perceived benefits.

Table No.4.4.3.

Multiple Regression for the level of critical thinking skills and problem solving ability of nursing students with their demographic variables in control group; post test-2. n=130

Variable	β- coefficient	Std .Error	P-value	95% C.I	
Sex	3.34	2.11	0.115	-0.81	7.52
Age	-	-	-	-	-
Religion	-0.27	1.04	0.788	-2.33	1.77
Education of mother	-1.07	0.96	0.26	-2.96	0.82
Education of father	1.95	0.98	0.05	-0.001	3.90
Occupation of mother	0.03	0.27	0.92	-0.51	0.56
Occupation of father	0.288	0.42	0.49	-0.54	1.11
Income	0.35	0.72	0.63	-1.07	1.76
Residence	-0.82	0.77	0.29	-2.33	0.71
Medium of language during school	1.05	0.72	0.15	-0.38	2.49
Type of Board Studied in schooling	1.01	0.91	0.267	-0.78	2.79

Contd….

% of marks in +2	1.21	1.09	0.27	-0.94	3.36
% of marks in 1st Year B.Sc(N)	1.37	1.18	0.419	-1.38	3.29
Aptitude to join in nursing	0.55	0.61	0.363	-0.64	1.74
Sector of the college	-	-	-	-	-
Courses offered in college	-2.03	0.88	0.02*	-3.79	-0.278
Clinical trained obtained	-	-	-	-	-
No. of years institution was started	-2.49	5.85	0.000***	-3.61	-1.39

(R^2-0.35)

Table.4.4.3. reveals relationship between critical thinking skills and problem solving ability of nursing students with their selected demographic variables in post test-2 of control group.

From this finding, R^2 was 0.35, which can be interpreted that PBL accounts for 35% of the variance in criterion variable. Further, a statistically significant negative relationship was observed in critical thinking skills and problem solving ability of nursing students with 'courses offered in college' (β= -2.03, p=0.02), and 'No. of years Institution was started'(β= -2.49, p=0.000).

Table No. 4.4.4.

Multiple Regression for the level of critical thinking skills and problem solving ability of nursing students with their demographic variables in interventional group; post test-2 **n = 130**

Variable	β- coefficient	Std .Error	P-value	95% C.I	
Sex	0.72	0.83	0.34	-0.91	2.35
Age	-	-	-	-	-
Religion	-0.95	0.42	0.02*	-1.77	-0.12
Education of mother	-0.47	0.31	0.122	-1.08	0.12
Education of father	0.71	0.34	0.04*	-0.021	0.4
Occupation of mother	0.206	0.11	0.057	-0.006	0.41
Occupation of father	0.047	0.14	0.734	-0.22	0.322
Income	0.12	0.25	0.628	-0.37	0.626
Residence	0.12	0.33	0.69	-0.52	0.77
Medium of language during school	-0.09	0.29	0.76	-0.671	0.51
Type of Board Studied in schooling	0.48	0.32	0.13	-0.15	1.11

Contd….

% of marks in +2	-0.55	0.47	0.232	-1.47	0.36
% of marks in 1st Year B.Sc(N)	-0.48	0.36	0.176	-1.18	0.228
Aptitude to join in nursing	-0.22	0.29	0.462	-0.80	0.359
Sector of the college	-	-	-	-	-
Courses offered in college	-2.90	0.59	0.000***	-4.09	-1.71
Clinical trained obtained	-	-	-	-	-
No. of years institution was started	1.22	0.35	0.001**	0.522	1.93

(R^2-0.34)

Table.4.4.4. shows $R^2 = 0.34$, which accounts for 34% of the variance in criterion variable. From this analysis, a statistically significant positive relationship was found for 'Education of father' (β=0.71, P=0.04) and 'No. of years Institution was started'(β=1.22, P=0.001)**.** Further, a significant negative relationship was found for 'Religion'(β = -0.95, P= 0.02) and 'Courses offered in college'(β= -2.90, P=0.000)**.**

Table No. 4.4.5.

Multiple Regression for the level of perceived benefits of teaching method on critical thinking skills and problem solving ability of nursing students with their demographic variables in control group; post test

n = 130

Variable	β- coefficient	Std .Error	P-value	95% C.I	
Sex	-.12	4.34	0.978	-8.74	8.49
Age	-	-	-	-	-
Religion	-0.01	2.14	0.997	-4.25	4.24
Education of mother	-1.53	1.97	0.44	-5.44	2.38
Education of father	5.19	2.03	0.01*	1.16	9.23
Occupation of mother	-.05	0.56	0.35	-1.63	0.59
Occupation of father	-.42	0.87	0.63	-2.13	1.29
Income	-1.88	1.45	0.21	-4.80	1.05
Residence	-1.53	1.58	0.34	-4.67	1.61
Medium of language during school	-1.65	1.49	0.27	-4.61	1.31
Type of Board Studied in schooling	-2.32	1.86	0.22	-6.01	1.38

Contd….

% of marks in +2	5.38	2.24	0.02*	0.90	9.79
% of marks in 1st Year B.Sc(N)	0.48	2.41	0.84	-4.29	5.26
Aptitude to join in nursing	1.19	1.24	0.34	-1.26	3.64
Sector of the college	-	-	-	-	-
Courses offered in college	-2.39	1.83	0.195	-6.02	1.24
Clinical trained obtained	-	-	-	-	-
No. of years institution was started	-0.29	1.16	0.802	-2.59	2.01

(R^2- 0.19)

Table.4.4.5. From this table, R^2 =0.19, denotes that the intervention (PBL) has accounted for 35% of the variance in criterion variable. Further, a significant positive relationship was observed for 'Education of father' (β=5.19, P=0.01) and for % of marks in +2 (β= 5.38, P=0.02).

Table No. 4.4.6.

Multiple Regression for the level of perceived benefits of teaching method on critical thinking skills and problem solving ability of nursing students with their demographic variables in interventional group; post test

n =130

Variable	β- coefficient	Std .Error	P-value	95% C.I	
Sex	-1.53	1.87	0.414	-5.25	2.17
Age	-	-	-	-	-
Religion	-1.08	0.96	0.25	-2.95	0.79
Education of mother	-0.53	0.69	0.45	-1.91	0.85
Education of father	0.48	0.79	0.538	-1.07	2.04
Occupation of mother	-0.13	0.24	0.586	-0.63	0.62
Occupation of father	-0.001	0.32	0.994	-0.67	0.58
Income	0.64	0.57	0.264	-0.49	1.77
Residence	0.28	0.74	0.71	-1.19	1.75
Medium of language during school	-0.24	0.69	0.724	-1.59	1.11
Type of Board Studied in schooling	-0.49	0.73	0.495	-1.94	0.95

Contd….

% of marks in +2	0.411	1.05	0.704	-1.68	2.49
% of marks in 1st Year B.Sc (N)	0.05	0.81	0.95	-1.56	1.65
Aptitude to join in nursing	-0.03	0.67	0.95	-1.35	1.29
Sector of the college	-	-	-	-	-
Courses offered in college	-0.66	1.36	0.629	-3.37	2.04
Clinical trained obtained	-	-	-	-	-
No. of years institution was started	-0.44	0.81	0.621	-1.99	1.199

(R^2-0.1)

Table.4.4.6. reveals no significant relationship between dependent variable and selected demographic variables

SECTION V

This section presents the association between the level of critical thinking skills and problem solving ability of nursing students during the pre test and post test periods and also their perceived benefits of the teaching method in control and the interventional groups with selected demographic variables. Chi-square was done and the results are presented in Tables 4.5.1 to 4.5.5.

Table No. 4.5.1.

Association between the level of critical thinking skills and problem solving ability of control group; pre test with their selected demographic variables. **n =130**

Demographic Variable		Low level	Moderate level	Well level	Excellent level	$\chi 2$ value	p-value
Occupation of father	Daily wages	2	31	2	1	35.93	0.007**
	Non-Executive	0	5	4	1		
	Executive	0	6	3	0		
	Business/Self Employed	8	31	16	0		
	Professional	0	4	7	0		
	Skilled	0	3	3	0		
	Un-employed	1	0	2	0		
Medium of language during school	Tamil	4	39	3	0	23.36	0.005*
	English	2	18	11	1		
	Malayalam	4	22	22	1		
	Others	1	1	1	0		
% of marks in 1st Year B.Sc(N)	<40%	2	1	0	0	23.06	0.006*
	41-60%	1	33	8	0		
	61-80%	8	44	29	2		
	>81%	0	2	0	0		

Contd….

Courses offered in college	UG only	0	42	0	0	42.86	0.000***
	UG & Diploma	7	20	20	0		
	UG & PG	4	18	17	2		
	All the above	-	-	-	-		
Clinical trained obtained	Parent hospital	-	-	-	-	14.17	0.002**
	Affiliated						
	Affiliated private hospital	7	20	20	0		
	government hospital	4	60	17	2		
	All the above	-	-	-	-		
No. of years institution was started	1-3 yrs	0	42	-	-	42.86	0.000***
	4-6 yrs	4	18	17	2		
	7-9 yrs	-	-	-	0		
	10yrs and above	7	20	20	0		

*P < 0.05, ** P < 0.01, *** P < 0.001 Significant

Table 4.5.1. shows that significant association was found between critical thinking skills and problem solving ability of nursing students with Occupation of father (P < 0.01), Medium of language during school (P < 0.05), % of marks in 1st Year B.Sc(N) (P < 0.05), Courses offered in college (P < 0.001), Clinical trained obtained (P < 0.01) and No. of years institution was started (P < 0.001).

Table No. 4.5.2.

Association between the level of critical thinking skills and problem solving ability of control group; post test-2 with their selected demographic variable. **n =130**

Demographic variable		low level	Moderate level	well level	Excellent level	χ^2 value	p-value
Occupation of father	Daily wages	5	12	17	2	31.89	0.023*
	Non-Executive	0	6	2	2		
	Executive	0	5	2	2		
	Business/Self Employed	5	16	29	5		
	Professional	0	2	5	4		
	Skilled	0	1	2	3		
	Un-employed	0	3	0	0		
Residence	Urban	6	8	23	10	14.76	0.02*
	Rural	1	16	13	1		
	Semi-urban	3	21	21	7		
Medium of language during school	Tamil	2	18	24	2	28.15	0.001**
	English	2	8	17	5		
	Malayalam	6	19	16	8		
	Others	0	0	0	3		
Type of Board Studied in schooling	State	9	36	39	14	19.77	0.01*
	Matriculation	0	4	11	0		
	Central	1	5	7	2		
	Any others	0	0	0	2		

Contd….

Aptitude to join in nursing	Self interest	6	29	38	7	25.29	0.014*
	Parents	0	11	7	5		
	Friends	1	4	5	2		
	Relatives	0	1	5	1		
	Any others	3	0	2	3		
Courses offered in college	UG only	0	1	38	3	73.38	0.000***
	UG & Diploma	10	18	10	9		
	UG & PG	0	26	9	6		
	All the above	-	-	--	-		
Clinical trained obtained	Parent hospital Affiliated	-	-	-	-	27.99	0.000***
	Affiliated private hospital	10	18	10	9		
	government hospital	0	27	47	9		
	All the above	-	-	-	-		
No. of years institution was started	1-3 yrs	0	1	38	3	73.38	0.000***
	4-6 yrs	0	26	9	6		
	7-9 yrs	0	-	-	-		
	10yrs and above	10	18	10	9		

*$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ Significant

Table 4.5.2. reveals significant association between critical thinking skills and problem solving ability of nursing students with Occupation of father ,Residence, Medium of language during school ,Type of Board Studied in schooling, Aptitude to join in nursing, Courses offered in college , Clinical trained obtained and No. of years institution was started.

Table No. 4.5.3.

Association between the level of critical thinking skills and problem solving ability of interventional group; pre test with their selected demographic variables. **n =130**

Demographic Variable		low level	Moderate level	well level	χ^2 value	P-value
Education of mother	Non-literate	3	12	1	19.57	0.003**
	Primary	11	20	1		
	Secondary	12	32	9		
	College	3	14	12		
Education of father	Non-literate	3	6	1	16.5	0.011*
	Primary	12	15	1		
	Secondary	10	41	19		
	College	4	16	2		
Occupation of mother	Daily wages	9	15	1	53.67	0.000***
	Non-Executive	1	8	1		
	Executive	0	1	1		
	Business/Self Employed	1	7	2		
	Professional	3	3	14		
	Skilled	0	2	0		
	Un-employed	15	42	4		
Income	1000-3000	7	16	13	18.29	0.006*
	3001-6000	11	19	2		
	6001-9000	4	28	6		
	9001 & above	7	15	2		

Contd….

Residence	Urban	8	30	3	25.08	0.000***
	Rural	14	37	5		
	Semi-urban	7	11	15		
Medium of language during school	Tamil	15	27	1	29.09	0.000***
	English	8	33	5		
	Malayalam	6	17	15		
	Others	0	1	2		
Type of Board Studied in schooling	State	26	63	5	46.11	0.000***
	Matriculation	1	8	15		
	Central	2	5	3		
	Any others	0	2	0		
Courses offered in college	UG only	4	26	14	14.59	0.004**
	UG & Diploma	10	19	6		
	UG & PG	15	33	3		
	All the above	-	-	-		
No. of years institution was started	1-3 yrs	14	45	20	8.82	0.01*
	4-6 yrs	-	-	-		
	7-9 yrs	-	-	-		
	10yrs and above	15	33	3		

*P < 0.05, ** P < 0.01, *** P < 0.001 Significant

Table 4.5.3. depicts significant association between critical thinking skills and problem solving ability of nursing students with Education of mother, Education of father, Income, Residence, Medium of language during school, Type of Board Studied in schooling, Courses offered in college, No. of years institution was started.

Table No. 4.5.4.

Association between the level of critical thinking skills and problem solving ability of interventional group; post test-2 with their selected demographic variable.

n =130

Demographic variable		Well level	Excellent level	χ^2 value	P-value
Courses offered in college	UG only	11	33	32.72	0.000***
	UG & Diploma	31	4		
	UG & PG	31	20		
	All the above	-	-		

*P < 0.05, ** P < 0.01, *** P < 0.001 Significant

This table reveals association between the level of critical thinking skills and problem solving ability with demographic variables. The result showed significant association with only one demographic variable i.e., “courses offered in the college”. Other than that no association was found between any other selected demographic variable.

Table No. 4.5.5.

Association between the level of perceived benefits on the influence of teaching method of control group; post test with their selected demographic variables.

n =130

Demographic variable		un-favourable	favourable	χ^2 value	p-value
Courses offered in college	UG only	31	11	9.88	0.006**
	UG & Diploma	41	6		
	UG & PG	40	1		
	All the above	-	-		
No. of years institution was started	1-3 yrs	31	11	9.88	0.006***
	4-6 yrs	40	1		
	7-9 yrs	-	-		
	10yrs and above	41	6		

** P < 0.01, *** P < 0.001 Significant

With regard to association between the level of perceived benefits on the influence of teaching method of control group; post test with demographic variables, the result showed significant association with “courses offered in the college” and “No. of years institution was started” . Other than that no association was found between any other selected demographic variable.

CHAPTER V

DISCUSSION

This chapter deals with the discussion of the results based on the objectives and hypotheses of the study.

Nursing education has as one of its major objectives teaching critical thinking to its students. Nurses are responsible for assessing, diagnosing, prescribing and implementing plans of care. Hence, it is essential that nurses possess critical thinking skills and are prepared to respond to unfamiliar situations by applying principles and lessons learned from similar clinical situations to the one presently faced. Studies focusing on finding an effective approach to teaching critical thinking and clinical decision-making are found in the literature and are ongoing in nursing, medical and other clinically focused professions.

Clinical decision-making involves higher cognitive skills (critical thinking), that are crucial to obtaining positive patient outcomes. Critical thinking is an essential skill for nurses to have because patient situations vary as much as the individuals themselves do. It is impossible to prepare nurses during their training programs for every situation that could be encountered

Measuring the construct of critical thinking has been a challenge to all who have tried. Educators in nursing and other clinically focused fields have tried to measure it, determine whether it changes over time and decide if a particular teaching approach enhances it.

PBL was developed in the mid-sixties as a useful instructional alternative to conventional (lecturing) teaching. It is designed to help students construct an

extensive and flexible knowledge base, develop self-directed learning skills, and become intrinsically motivated to learn. The PBL in fact, establishes a format through which students learn. In recent decades, PBL has been proposed as an alternative to learning by the traditional lecture method. Many studies confirm that learning by the PBL method improves critical thinking skills, clinical reasoning skills, clinical knowledge, learning motivation, and learning autonomy. Increasing retention, interest, and motivation are some of the benefits of PBL. As performance of nursing requires a cognitive ability that includes problem solving, decision making, and clinical judging, it is important for nurse educators to find appropriate teaching methods to enhance students' performance of these tasks for clinical nursing.

Based on many supportive studies, the author has taken up an initiative to implement PBL method of teaching as an innovative method to increase critical thinking skills and problem solving ability among nursing students. In Indian context, maximum student learning is achieved through lecture method of teaching, which suppresses the critical thinking skills of students. Moreover, the curriculum also is planned accordingly. In Indian setup, there are no much supportive studies done on PBL method of teaching, which instigated the interest of the investigator to choose this particular aspect of study.

A Quasi Experimental study with control group pre test and post test design was adopted to determine the effectiveness of PBL in enhancing critical thinking skills and problem solving ability among Nursing Students. The sampling technique used was purposive sampling technique with a sample size of 260, out of which 130 sample were allotted to the interventional group and the remaining 130 were allotted to the control group.

The results of the data are discussed under the following subheadings:

5.1 Instrument development

5.2. Demographic variables of nursing students

5.3. Effectiveness of PBL on critical thinking skills and problem solving ability of nursing students

5.4. Relationship between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits of the teaching.

5.5. Association between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits of the teaching method with selected demographic variables.

5.1. Instrument Development

Tool for data collection was developed after reviewing a wide range of literature**.**

1. A blue print having objectives and content areas was developed.
2. A structured questionnaire to assess the higher level of cognitive skills was developed under the following areas based on Bloom's Taxonomy.
    - Knowledge
    - Comprehension
    - Application
    - Analysis
    - Synthesis
3. A five point Rating scale was developed to assess the perceived benefits of the teaching method used.
4. Power point presentation regarding PBL process was developed.

5. A problem scenario was developed which need to be solved through PBL Process. The problem chosen was based on Diabetes Mellitus, a topic from Medical- Surgical Nursing-I (Unit-VII) of 2nd year B.Sc(N).

The content of the tool was checked and validated by around 12 experts in the field of Nursing, Medicine, Education and Statistics. The instrument was modified based on the suggestions given by the experts. The developed tool was found to be reliable.

a) Content validity of the tool

The content of the tool was checked and validated by around 12 experts in the field of nursing, medicine, education and statistics .

b) Reliability of the tool

The tool was administered to 10 sample representing the characteristics of the population. Test-retest method was done. The reliability co-efficient was obtained as r=0.83, for the questionnaire on critical thinking skills and problem solving ability and the obtained value for perceived benefits scale was 0.78, indicating that the tool was highly reliable.

c) Item analysis

Items were analysed in terms of item difficulty and discriminating index. Items which did not fall between the acceptable range were modified.

5.2. Demographic Variables of Nursing Students

On analyzing the socio-demographic characteristics of the nursing students, it was seen that all the subjects were in the age group of 17-20 years both in the control

(100%) and interventional group (100%). With regard to sex, majority of the students were females both in the control (91%) and interventional group (92%), since it is a well known fact that nursing is a female dominated profession. It was observed that more than half of the subjects in the control (59%) and interventional group (69%) were Hindus, 36% and 26% were Christians respectively in control and the interventional group and only 5% were Muslims equally in both the groups. Majority of the subjects' mothers (58%, and 41%) and fathers (56% and 54%) had education up to secondary level both in control and the interventional groups respectively. It was interesting to note that only a minimum of the subjects' mothers (3% and 12%) and fathers (1% and 8%) were non-literate in the control group and the interventional group respectively. Regarding occupation, majority of the mothers in the control group (38%) and the interventional group (47%) were unemployed and the minority in the control group (5%) and the interventional group (2%) were executives. Most of the fathers in the control group (42%) were self employed and in the interventional group (37%) were daily wagers and the least percentage were un-employed both in the control group (2%) and the interventional group (3%). Most of the subjects' monthly family income was between Rs.6001-9000 both in control group (35%) and the interventional group (29%). It was noted that majority of subjects were from semi-urban locality in the control group (40%) and from rural in the interventional group (43%). It was observed in the present study that the majority of 38% of the subjects in the control group had Malayalam as medium of instruction and 35% in the interventional group were from English medium. With regard to type of board studied, majority in both control (75%) and interventional group (72%) had completed their schooling from State Board. It was revealed that majority of the subjects in control group (75%) and in interventional group (77%) had obtained 61 to 80% of

marks in their higher secondary examinations and only 11% and 7% had scored above 81% in the control group and the interventional group respectively. Similarly, majority 64% of the subjects in the control group and 54% in the interventional group had scored 61 to 80% of marks in 1st year B.Sc. Nursing. With regard to aptitude to join nursing, it was interesting to note that majority of the students in control group (62%) and interventional group (78%) joined nursing out of self interest. Further, 18% and 14% joined nursing through motivation by parents, 9% and 4% being influenced by friends, a minimum of 5% and 2% by relatives and 6% and 2% by other sources in interventional and control groups respectively.

All the colleges (100%) in control group and the interventional group were private sectors. Regarding courses offered in the college, highest percentage (36%) of subjects in control group were from the institutions that offered UG and Diploma in Nursing courses and 32% equally offered UG only and UG and PG courses. In interventional group, the highest percentage (39%) were from the institutions with UG and PG courses and the least percentage (34%) were from the institutions that offered only UG courses. It was also observed that in control group, 36% obtained clinical training in affiliated hospitals only and 64% had clinical training at both affiliated and parent hospitals. Whereas in interventional group, all the subjects (100%) obtained clinical training in both affiliated and parent hospitals. Regarding " No. of years institution was started", majority of 36% in control group and 61% in interventional group were from institutions that were 10 years and above old and 1-3 years old respectively.

5.3. Effectiveness of PBL on critical thinking skills and problem solving ability of nursing students

Pre test on diabetes mellitus was administered to the interventional group and the control group by the investigator and were assessed for their critical thinking skills and problem solving ability. Then the students in the interventional group were oriented to PBL methodology and underwent PBL process. Students after undergoing self-directed learning gathered more information through various resources based on the relevant learning objectives. Control group was taught on diabetes mellitus using traditional lecture method as a routine method of teaching. Post test was administered to both the groups on the 5^{th} day. A post- interventional follow- up was done 3 months after the intervention using the same questionnaire to see if the effect of the intervention (PBL) is retained after an intervening period. In order to find out the effectiveness of PBL on critical thinking skills and problem solving ability of nursing students, the pre and post test levels of critical thinking skills and problem solving ability of nursing students in control group and interventional group were compared.

Hypothesis I (H_1)

There is a significant difference in the level of critical thinking skills and problem solving ability of nursing students between the control group and the interventional group.

5.3.1. Overall level of critical thinking skills and problem solving ability of nursing students

It was observed that the majority of the subjects 80(62%) had moderate skill and only 2(2%) had excellent skill in the pre test of control group. In the pre test of interventional group, majority of the subjects 78(60%) had moderate skill, and 23(18%) had well skill and none of them had excellent skill.

In the post test -1 of control group, the maximum sample 66(51%) possessed excellent skill and in post test-2 the highest score was 57(44%) for well skill, and the score for excellent skill was reduced to 18(14%), which is evident for having reduced in the level of critical thinking skills and problem solving ability in the post test -2 period. Whereas, it was amazing to note that in the post test -1 and post test -2 of interventional group, none of the subjects had neither low nor moderate skill. In post test -1,out of 130 subjects, 84(65%)had well skill ,46 (35%)had excellent skill and in post test -2,the level of critical thinking skills and problem solving ability in excellent skill had hiked to 57(44%), which is higher than that of the post test-1.

In the present study, it was observed that there was a significant increase

in the overall the level of critical thinking skills and problem solving ability in the interventional group than in control group. Through this study, it was evident that the PBL method of teaching was not only effective in enhancing critical thinking skills and problem solving ability of nursing students, but also the retention power as the post test-2 level in interventional group was higher than post test-1 level.

The finding was supported by the study done by Sendaq and Odabas.[169] These authors had used an exact instrument in measuring students' critical thinking changes in PBL experiment. The result, students in PBL approach increased in their critical thinking ability compared to the students in the traditional learning approach.

These findings were consistent with a quasi-experimental study done by Yuan H, Kunaviktikul W, Klunklin A and Williams BA,[158] in which two-group pre test-post test design was used to examine the effect of problem-based learning on the critical thinking skills of 46 Year 2 undergraduate nursing students in the People's Republic of China using the Chinese-Taiwanese version of the California Critical

Thinking Skills Test (CCTST) Form A. Groups were not significantly different in CT skills at pre test, whereas, the problem-based learning students had a significantly greater improvement on the overall CCTST total score, analysis subscale, and induction subscale scores compared with the lecture students at post test.

5.3.2. Area wise scores on critical thinking skills and problem solving ability

In the control group, the highest mean percentage (60%) was scored in the area of knowledge and the least (34%) was scored for analysis in pre test. It was noted that in the post test-2, there was no much improvement found, as the mean percentage was 66% for knowledge and 48% for analysis. Mean difference in the areas of knowledge (6%), comprehension (16%), application (4%), analysis (14%) and synthesis (14%) with an overall mean difference of 10 denotes no much improvement in critical thinking skills and problem solving ability among the students in the control group.

The subjects in the interventional group had scored a mean percentage of 44% and 82% for Knowledge, 33% and 71% for Comprehension, 39% and 75% for Application, 29% and 74% for Analysis and 38% and 78% for Synthesis in the pre test and post test-2 respectively with an overall mean difference of 40%, which proves that there was a significant gain in all the areas of critical thinking skills and problem solving ability of nursing students after undergoing PBL process.

In support to this finding, a study conducted by Ali Hassanpour Dehkordil and Saeed Heydarnejad,[162] indicated that PBL was more efficient than lectures. Particularly there was a significant difference between the evaluation, application and understanding with learning. It can be inferred that PBL may lead to better learning in the recognition, especially in the evaluation, application and understanding, and this

facilitates learning, an increase in self-learning skills, lifelong learning and social skills. In addition, it causes an increase in the power of matters analysis, learning skills, connecting with each other, and an increase in the level of knowledge in the nursing students.[15,171]

Comparing the post test -2 scores of interventional and control groups, the overall mean was 76% in interventional group , which is higher, compared to the overall mean score of control group (54%). Further, the mean percentage was higher in all the areas of post test-2 in the interventional group than in the control group, which proves a significant gain in critical thinking skills and problem solving ability in the interventional group after undergoing PBL process.

Ozturk C, Muslu GK, Dicle A,[173] in a descriptive analytic study compared levels of critical thinking among senior nursing students (N=147) in two educational programs in Turkey, one of which used a Problem Based Learning (PBL) model while the other used a traditional model. Using the California critical thinking disposition inventory (CCTDI) to measure CT disposition, there were significantly higher ($p<0.05$) scores in Truthseeking and Openmindedness in seniors in the PBL school when compared to those in the school implementing the traditional model.

5.3.3.Item wise scores on critical thinking skills and problem solving ability in the area of "Knowledge "

In the area of knowledge, the differences between the pre test and post test scores (Y-X) found for the items respectively in the control and the interventional groups are "Insulin is secreted from pancreas by" (7,30), " Insulin's action on the cells " (40,20), " Type I diabetic mellitus " (3,25)," Type I diabetes mellitus develops in people who have the tendency found in Antigen" (18, 34), "Diabetes mellitus is a group of"(3, 41), "The characteristics of type I diabetes mellitus" (23, 47), "Type I

diabetes mellitus is the result of" (6,41) and " The expansion of the term IFG" (3,58) . This shows that there were increased numbers of correct responses for knowledge in the interventional group during the post test period than in the control group, which proves the effectiveness of PBL.

Similar finding was observed by Ali Hassanpour Dehkordi and Saeed Heydarnejad,[162] who compared the effect of education through Problem Based Learning (PBL) or lectures on behavior, attitude and learning of nursing students. A total of 40 second-year nursing students participated: 20 students in the PBL group and 20 students in the traditional lecture (control) group. The students underwent a one-semester course using the two methods of education. The level of knowledge in the PBL group was significantly higher than that of students in the lecture group.

This present study found that the knowledge scores of students in the PBL group were significantly higher than those in the lecture group. The results of this study are consistent with those of previous studies of Gibson, Campbell RM and Yang ND,[174,175] that reported improved learning and self-confidence among PBL students compared to lecture students. The PBL students had significantly higher overall scores on the completion of the semester compared with the lecture students.

Similarly Koleini et al[176] showed that there was a significant difference between the traditional-based learning and PBL, in which it was noted that PBL led to better learning than to the lecture method.

5.3.4. Item wise scores on critical thinking skills and problem solving ability in the area of "Comprehension"

The items under the area of comprehension were insulin waning, laboratory test that indicates compliance of the diabetic client and insulin therapy, tests used to diagnose diabetic ketoacidosis, Jet injector, glycemic index, acute complications of

diabetes mellitus, signs and symptoms that indicate hyperglycemia in a client with diabetes mellitus, and health education for a patient in hyperglycemia. The scores gained in the post test period of interventional group were higher than the scores gained in the control group in each item. This ultimately proves an improvement in the level of "Comprehension" among the students of interventional group after undergoing PBL process.

5.3.5.Item wise scores on critical thinking skills and problem solving ability in the area of "Application"

A significant improvement was found in each item under "Application" in the interventional group than in the control group. This proves the effectiveness of PBL method of teaching.

This finding is supported by a study done by Doucet et al.,[75] in which it was found that PBL students performed significantly better on applying knowledge in clinical reasoning than did the traditional students in a headache diagnosis and management course. Similar findings resulted in the study conducted by Lohman, and Finkelstein,[177] who found that the first-year dental education students in a 10-month PBL program improved significantly in their near transfer of problem-solving skills by an average of 31.3%, and their far transfer of problem-solving skills increased by an average of 23.1%. Based on their data, they suggested that repeated exposure to PBL was the key for facilitating the development of problem-solving skills.

Several studies have shown that PBL has very positive effects on students' transfer of problem-solving skills to workplaces; for example, Woods[178] reported that employers praised McMaster University's PBL chemical engineering graduates' outstanding problem-solving skills and job performance.

Schlundt et al.,[179] observed an improvement of self-efficacy in insulin administration management, problem-solving skills, and flexibilities in choosing coping strategies to overcome the difficulty of dietary adherence among adolescent diabetic patients who received a 2-week PBL summer program. They concluded that, instead of just teaching the facts, the PBL course helped the patients rationalize the self-care guidelines and consider more alternatives to seek better solutions and strategies to cope with the difficult lifestyle.

5.3.6. Item wise scores on critical thinking skills and problem solving ability in the area of "Analysis"

There was a significant increase in the scores gained in interventional group in all the 8 items under the area of Analysis. The scores gained for correct responses in interventional group (33,54,43,52,49,46,44 and 33) were higher than the scores in control group (23,34,12,6,16,27,13 and 8). Such increased correct response in interventional group is evident for the efficacy of PBL process.

5.3.7.Item wise scores on critical thinking skills and problem solving ability in the area of "Synthesis "

In the area of Synthesis, the difference of scores between pre test and post test in the interventional group were 40,46,30,37,55,53,39 and 25 and in the control group, the scores were 34,28,8,13,7,18,22 and 9 for the items "Encounter the problem", "Specify the problem", "Collect relevant data", "Analyze data to specify the problem", "Determine plan of action", "Prioritize", "Execute action plan" and "Evaluate" respectively. This finding reveals, higher range of scores in all the items of Synthesis compared to control group, which confirms that the PBL students performed much better than the students in the control group.

Kuhn's[180] study also illustrated the rapid development of expertise of first-year PBL residents in the emergency room. A superior ability to synthesize basic knowledge and clinical experience in addition to applying and transferring the knowledge and skills into the workplace, may explain why PBL students outperformed traditional students.

5.3.8. Comparison of pre test and post test levels of critical thinking skills and problem solving ability of nursing students within both the groups

In the control group, there was a significant difference found in the level of Knowledge ($P<0.01$), and there was a highly significant difference found in the levels of Comprehension ($P<0.001$) , Analysis($P<0.001$) , Synthesis ($P<0.001$) and in the overall level between the pre test and the post test. However, no significant difference was found in the area of Application.

In the Interventional group, there was a highly significant difference ($P<0.001$) found between the pre test and post test scores in all the areas i.e., Knowledge, Comprehension, Application, Analysis and Synthesis.

Further, the overall 't' level in all the areas were 4.97 and 32.87 in the control and the interventional groups respectively, which shows a highly significant difference between the pre test and post test scores of interventional group ($P<0.001$). This proves that PBL method improves the thinking skills widely in all the domains.

These findings were consistent with the results of a study done by Gallagher S A, Stepien WJ and Rosenthal H[167] who conducted an experiment using an interdisciplinary PBL course called Science, Society and Future (SSF) on gifted high-school students with a comparison group of high-school students. They found that

PBL students showed a significant increase in the use of the problem-finding step from pre test to post-test, which was a critical problem-solving technique. In contrast, in the post-test, the comparison group tended to skip the problem-finding step and move directly from the fact-finding step to the implementation step. The result suggested that PBL is effective in fostering students' development of appropriate problem-solving processes and skills.

5.3.9.Comparison of pre test and post test levels of critical thinking skills and problem solving ability of nursing students between the groups

In comparison between the control group; pre test and interventional group; post test-2 in all the areas of critical thinking skills and problem solving ability of nursing students, the calculated overall 't' value was 22.49, which was higher than the table value and the 'P' value was highly significant at 0.001 level. It can be inferred that the higher scores gained in the interventional group in all the areas were due to the PBL method of teaching applied.

Further, there was a significant difference between post test -2 of control group and post test -2 of interventional group in the level of critical thinking skills and problem solving ability. The obtained overall 't' value 12.17, was higher than the table value, which is highly significant at 0.001 level of significance. Interestingly, it was evident that in the interventional group, the post test-2 scores were higher than the post test-1 scores, which proves that PBL promotes long term retention. It can be concluded that the interventional group, who underwent PBL process scored higher in critical thinking skills and problem solving ability than the control group, who were taught in lecture method. Hence, it was revealed that the highly significant result was by true difference, not by chance.

Supporting to this finding, in a study done by Dochy F, Segers M, van den Bossche P and Gijbels D[181] PBL students consistently outperformed traditional students on long-term retention assessments. In reviewing the studies that investigated the effects of PBL over time, Norman and Schmidt[45] found some interesting results in several studies. The study by Martenson D, Eriksson H, and Ingelman-Sundberg M[182] showed that no difference was found in the short-term retention of the content between PBL students and traditional students; however, the PBL students' long-term retention rate (average 25 points out of 40) was 60% higher than that of traditional students (average 16 points out of 40) 2 to 4-1/2 years after the course was completed. Also, the PBL students tended to remember more about principles, whereas the traditional students retained more rote-memorization types of knowledge. Tans and associates[183] found that PBL students' recall was up to five times greater on the concepts studied than traditional students 6 months after the course was completed.

Rideout E, England-Oxford V, Brown B and Fothergill-Bourbonnais F,[147] carried out a comparison study between a conventional teaching program and a PBL course. There were statistically significant differences between the two groups, with PBL receiving higher ratings in regard to the role of the facilitators, program outcomes, student assessment, level of independence and overall satisfaction rates.

5.3.10.Comparison of the differences on the level of critical thinking skills and problem solving ability of nursing students between the control and the interventional groups at different points of time

One Way Repeated Measures ANOVA was used to compare the differences on the level of critical thinking skills and problem solving ability of nursing students between the control and the interventional groups at different points of time.

The study result revealed that a statistically significant difference was found in both the control group ($P < 0.001$) and the interventional group ($P < 0.001$). "F" value was highly significant in Interventional group compared to control group. Thus, it can be interpreted that the intervention (PBL method) was found to be most effective than the traditional method of teaching (Lecture).

Tiwari A, Lai P, So M and Yuen K[70] compared the effects of PBL and traditional learning approach on students' critical thinking ability for the undergraduate nursing programme in the University of Hong Kong. A longitudinal study was conducted, which involved a total of 40 students in the experimental group, who had undergone two semesters (one year) of PBL treatment. This study involved 39 students in the control group that were taught using traditional lecturing method. The data collected at four points of interval throughout three years of the course. The California Critical Thinking Dispositional Inventory (CCTDI) was used to measure students' critical thinking ability. Significant differences were found in the critical thinking disposition development between the two groups of students. Problem Based Learning students had significantly higher critical thinking disposition scores on completion of PBL compared with lecture students. They also continued to have higher scores, albeit to a lesser degree, than the lecture students for 2 years afterwards. Interestingly, students perceived that PBL tutorial sessions had contributed to their critical thinking development.

The stated hypothesis (H1) is supported in the light of the above findings of the present study. That is, there was a significant increase in the level of critical thinking skills and problem solving ability of nursing students who learnt through PBL process than the students who were taught using traditional lecture method.

Hypothesis 2 (H_2)

There is a significant difference in the level of perceived benefits on the influence of teaching method on critical thinking skills and problem solving ability of nursing students between the control group and the interventional group.

5.3.11. Overall level of perceived benefits of the teaching method

In the interventional group, all the subjects 130(100%) had favorable perception, whereas only 18(14%) had favorable and 112(86%) had unfavorable perception in the control group. This finding proves that the students who underwent PBL process had a favorable attitude towards PBL method of learning. Further, an overall 36% of difference in mean scores was observed between the groups with a mean percentage of 52% and 88%, in control group and the interventional group respectively, which shows a positive perception in the interventional group towards PBL.

This finding is supported by a study done by Ali Hassanpour Dehkordil and Saeed Heydarnejad[162] who found a significant difference between PBL and traditional lecture groups. In this study, the scores from evaluations of attitude and behavior of students compared to the traditional and PBL methods showed that the scores of the latter were higher than the former. A positive learning attitude was observed in the PBL group. Similar results were found with the previous studies that PBL students had significantly higher scores in the learning attitude than those of traditional lecture students.[160,170]

Similarly, the results of other studies showed that PBL caused the level of attitude and behavior of students to be enhanced.[171,172] In Azar's study[83] the active learning methods i.e.,. PBL, led to an increase in the behavior of students.

5.3.12. Item wise comparison on the perceived benefits of the teaching method

Regarding the perceived benefits of the teaching method almost majority of the subjects in interventional group had disclosed positive response for all the statements, except two respondents who had disagreed to the statements "being stimulated to think critically" and "It fostered the ability of dealing with confidence".

In the control group, only few had given positive response to the statements asked, which shows that the students were not enjoying their learning by pure lecture method of teaching.

Therefore, it is evident that the PBL method of teaching had enhanced their learning skills. Moreover, it is proved that the students enjoyed the PBL learning process which was disclosed from their response.

5.3.13. Comparison of the level of perceived benefits on the teaching method between control and the interventional groups

The result of the unpaired 't' test for the level of perceived benefits on the method of teaching revealed that there was a statistically highly significant difference existed between the control and the interventional groups (t=53.76, P=0.000). It was observed that the interventional group had more favorable response towards PBL process of learning, whereas the lecture group revealed unfavorable response towards lecture method of teaching. So, it is evident that the PBL method makes the students' learning enjoyable.

Similarly, in a study conducted by Tiwari et al,[70] analysis of the qualitative interview data revealed differences in the students' perceptions of their learning experiences, with the PBL students reporting active participation during the learning process and lecture students reporting passive listening. The PBL students found the experience enjoyable, inspiring and self-fulfilling; however, the opposite was expressed by the lecture students, who were quite negative about their learning experience. In terms of the students' views about what may have influenced the development of their thinking, the PBL students attributed much of it to the PBL tutorials. The lecture students did not feel that thinking was encouraged in lectures.

This result is supported by the study done by Martyn P Kingsbury and Joanne S Lymn,[184] who found in their study that the overall students' response to this PBL was overwhelmingly positive with 82% positively agreeing that they were interested in the subject matter. Furthermore, there was a significant positive correlation between student' enjoyment of' this clustered PBL format and various measures of tutor 'effectiveness.'

As mentioned in hypothesis (H_2), it was found that there was a significant difference in the level of perceived benefits on the influence of teaching method on critical thinking skills and problem solving ability of nursing students between the lecture group and the PBL group. It can be interpreted that the true difference was not by chance between groups. Hence the research hypothesis (H_2) is accepted. This finding suggests the implementation of PBL method of teaching, since the perceived benefits of the students who underwent PBL process were higher compared to the lecture method.

5.4. Relationship between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits of the teaching method in control and the interventional groups.

Hypothesis 3 (H_3)

There is a significant relationship between the critical thinking skills and problem solving ability of nursing students and their perceived benefits on the influence of teaching method.

5.4.1. Correlation between the level of critical thinking skills and problem solving ability and their perceived benefits among nursing students in control group and the interventional group

The finding of the present study revealed that there was a positive correlation found in the control group between critical thinking skills and problem solving ability and their perceived benefits at $p < 0.001$ level of significance. It could be interpreted that as the critical thinking skills and problem solving ability decrease, the perceived benefits also decrease further. Whereas, in the interventional group, it was observed that there was no correlation found between the two variables (critical thinking skills and problem solving ability; post test-1 and their perceived benefits) as 'r' value was near to '0'. Further, there was possibly no relationship between critical thinking skills and problem solving ability (post test- 2) and their perceived benefits.

These findings are consistent with the findings of Hala Gabr[185], in which some students reported disadvantages of PBL such as the preparation of learning materials and educational resources takes a lot of time, it need more time for learning, more place, conflict may arise between students which result in inability to work as a team. Such results may be attributed to that PBL led to an overload of work, and

because of the personal difference among nursing students they did not put equal effort into the assignments, and group work takes up too much of their time. Yuan et al,[158] mentioned that it is understandable that the transition from a traditional learning method to PBL caused feelings of insecurity and anxiety, confusion, a lack of a sense of purpose, and concern about reduced efficiency in learning.

In PBL, the students become the initiators of their own learning, the inquirers and problem solvers during the learning process, and they are no longer passive information receivers. The students not only are required to redefine their roles in the learning process but must also retune their learning habits. Woods[178] speculated that uncertainty about their grades was one possibility accounting for students' uneasiness about a new instructional method, resulting in some resistance to change and making the initial transition from traditional curriculum to PBL curriculum more difficult.

Schmidt H G, Machiels-Bongaerts M, Hermans H and Ten Cate TJ[163] reported that students need at least 6 months to adapt to this new instructional method. They found that the students' anxiety mainly resulted from their uncertainty about their roles and responsibilities in the course and how they would be evaluated. The difficulty of assuming a more active role with more responsibility in the learning process.

There was no correlation found between the between the critical thinking skills and problem solving ability of nursing students and their perceived benefits in the interventional group. Hence, the research hypothesis(H_3) is rejected at $P < 0.001$ level.

5.4.2. Relationship between critical thinking skills and problem solving ability of nursing students and their selected demographic variables

Multiple regression was done to find out the relationship between one dependent variable and more than one independent variables of nursing students both in the control and interventional groups.

In post test-2 of control group, R^2 was 0. 35, which can be interpreted that PBL accounts for 35% of the variance in criterion variable. Further, a statistically significant negative relationship was observed in critical thinking skills and problem solving ability of nursing students with 'courses offered in college' (β= -2.03, p=0.02), and 'No. of years Institution was started'(β= -2.49, p=0.000).

In post test-2 of interventional group, a statistically significant positive relationship was found for 'Education of father'(β=0.71, P=0.04) and 'No. of years Institution was started'(β=1.22, P=0.001) and a significant negative relationship was found for 'Religion'(β= -0.95, P=0.02) and 'Courses offered in college'(β= -2.90, P=0.000).

5.4.3. Relationship between the level of perceived benefits of teaching method and their selected demographic variables

In the post test of control group, a significant positive relationship was observed for 'Education of father' (β=5.19, P=0.01) and for % of marks in +2 (β= 5.38, P=0.02), whereas no significant relationship was found between dependent variable and selected demographic variables.

5.5. Association between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits of the teaching method with selected demographic variables

Hypothesis 4 (H_4)

There is a significant association between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits with selected demographic variables.

5.5.1. Association between the level of critical thinking skills and problem solving ability of nursing students and their selected demographic variables

In pre test of control group significant association was found between critical thinking skills and problem solving ability of nursing students with Occupation of father ($p < 0.01$), Medium of language during school ($p < 0.05$), % of marks in 1st Year B.Sc(N) ($p < 0.05$), Courses offered in college($p < 0.001$), Clinical trained obtained ($p < 0.01$) and No. of years institution was started ($p < 0.001$). In post test-2 of control group significant association was found with Occupation of father ,Residence, Medium of language during school ,Type of Board Studied in schooling, Aptitude to join in nursing, Courses offered in college , Courses offered in college, Clinical trained obtained and No. of years institution was started .

In interventional group of pre test, a significant association was found with Education of mother, Education of father, Income, Residence, Medium of language during school, Type of Board Studied in schooling, Courses offered in college, No. of years institution was started. Whereas, the result of post test-2 showed significant association with only one demographic variable i.e., “courses offered in the college”.

5.5.2. Association between the level of perceived benefits of the teaching method with selected demographic variables

In post test of control group, the result showed significant association with "courses offered in the college" and "No. of years institution was started", whereas, no association was found between the perceived benefits on the influence of teaching method in the post test of interventional group with their selected demographic variables.

As there is a significant relationship between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits with selected demographic variables found in this present study, the stated hypothesis (H4) is accepted.

CHAPTER – VI

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Fostering critical thinking skill in nursing students has become one of the most imperative tasks for nursing education. Problem-based learning affords an environment conducive to teaching and learning critical thinking skills.

The present study was a quasi experimental study undertaken to evaluate the effectiveness of Problem-Based Learning **(PBL)** on the critical thinking skills and problem solving ability among nursing students in selected Nursing Institutions at Coimbatore.

A quasi experimental study with control group pre test and post test design has been adopted for this study. The sample size was around 260, out of which 130 were allotted to the interventional group (PBL) and the remaining 130 to the control group (Lecture). Purposive Sampling Technique was used for this study. A questionnaire to assess critical thinking skills and problem solving ability of nursing students was developed consisting of Multiple Choice Questions on diabetes mellitus in the areas of knowledge, comprehension, application, analysis and synthesis. A Teaching Module on PBL methodology was developed and used for the interventional group.

6.1. AIM OF THE STUDY

To investigate the efficacy of PBL approach on nursing students in enhancing their critical thinking skills and problem solving ability with that of lecture method.

6.2. OBJECTIVES

1. To assess the pre test level of critical thinking skills and problem solving ability of nursing students among the control and the interventional groups.

2. To assess the post test level of critical thinking skills and problem solving ability of nursing students among the control and the interventional groups.
3. To determine the effectiveness of PBL on critical thinking skills and problem solving ability of nursing students.
4. To assess the students' perception on the influence of PBL and Lecture method on their critical thinking skills and problem solving ability in both control and the interventional groups.
5. To associate the level of critical thinking skills and problem solving ability of both the groups with selected demographic variables.
6. To associate the students' perception on the influence of PBL and Lecture method on critical thinking skills and problem solving ability in the control and the interventional groups with selected demographic variables.

6.3. HYPOTHESES

1. H_1- There is a significant difference in the level of critical thinking skills and problem solving ability of nursing students between the control group and the interventional group.
2. H_2- There is a significant difference in the level of perceived benefits on the influence of teaching method on critical thinking skills and problem solving ability of nursing students between the control group and the interventional group.
3. H_3- There is a significant relationship between the critical thinking skills and problem solving ability of nursing students and their perceived benefits on the influence of teaching method.

4. H_4- There is a significant association between the level of critical thinking skills and problem solving ability of nursing students and their perceived benefits with selected demographic variables.

6.4. SIGNIFICANT FINDINGS OF THE STUDY

6.4.1. Overall level of critical thinking skills and problem solving ability of nursing students

There was a significant increase in the overall the level of critical thinking skills and problem solving ability in the interventional group than in control group. Further, compared to the post test-1 and post test-2 levels of critical thinking skills and problem solving ability of nursing students between the control and the interventional groups , it was noted that in the interventional group, the post test-2 level (44%) was higher than the post test -1 level (35%) for excellent skill. Whereas in control group, a drastic reduction was found for excellent skill during the post test-2 (51%) period than post test-1(14%).

6.4.2.Overall level of perceived benefits of the teaching method

In the interventional group, all the subjects 130(100%) had favourable perception, whereas only 18(14%) had favorable and 112(86%) had unfavourable perception in the control group. Further, an overall 36% of difference in mean scores was observed between the groups with a mean percentage of 52% and 88%,in control group and interventional group respectively, which shows a positive perception in the interventional group towards PBL.

6.4.3.Area wise scores on critical thinking skills and problem solving ability

The overall mean difference was 40% in interventional group and 10% in control group.

6.4.4.Item wise scores on critical thinking skills and problem solving ability

The subjects in the interventional group gained higher range of scores in all the items of Knowledge, Comprehension, Application, Analysis and Synthesis compared to control group.

6.4.5. Item wise comparison on the perceived benefits of the teaching method

Regarding the perceived benefits of the teaching method almost majority of the subjects in interventional group had disclosed positive responses for all the statements.In the control group, only few had given positive responses to the statements asked about pure lecture method of teaching.

6.4.6.Comparison of pre test and post test levels of critical thinking skills and problem solving ability of nursing students within both the groups.

The overall 't' level in all the areas were 4.97 and 32.87 in the control and the interventional groups respectively, which shows a highly significant difference between the pre test and post test scores of interventional group ($P<0.001$).

6.4.7.Comparison of pre test and post test levels of critical thinking skills and problem solving ability of nursing students between the groups.

In comparison between the control group; pre test and interventional group; post test-2 in all the areas of critical thinking skills and problem solving abilities of nursing students, the calculated overall 't' value was 22.49, which was higher than the table value and the 'P' value was highly significant at 0.001 level.

Further, there was a significant difference between post test -2 of control group and post test -2 of interventional group in the level of critical thinking skills and problem solving ability. The obtained overall 't' value 12.17, was higher than the table value, which is highly significant at 0.001 level of significance.

6.4.8.Comparison of the differences on the level of critical thinking skills and problem solving ability of nursing students between the control and the interventional groups at different points of time.

A statistically significant difference was found in both the control group ($P < 0.001$) and the interventional group ($P < 0.001$). "F" value was highly significant in Interventional group compared to control group.

6.4.9. Comparison of the level of perceived benefits on the teaching method between control and the interventional groups

Unpaired 't' test for the level of perceived benefits on the method of teaching in the control and the interventional groups was found to be highly significant. ($t=53.76$, $P < 0.001$).

6.4.10. Correlation between the level of critical thinking skills and problem solving ability and their perceived benefits among nursing students in control group and interventional group.

A positive correlation was found in the control group between critical thinking skills and problem solving ability and their perceived benefits at $p < 0.001$ level of significance. But, there was possibly no relationship between critical thinking skills and problem solving ability and their perceived benefits.

6.5. CONCLUSION

Teaching critical thinking skills is recognized as a fundamental objective of programs in which clinically focused care providers are educated. Presently, no one approach has been identified as the best method for preparing providers for the array of situations they may encounter in clinical practice. However, it is acknowledged by educators that more effort must be put forth to produce better-prepared practitioners who can manage the complexity encountered in caring for our society. The current study has provided additional empirical evidence supporting the use of problem-based learning to enhance critical thinking skills and problem solving ability of the nursing students. By enhancing critical thinking skills and problem solving ability through problem-based learning, nurses can be better prepared to evaluate and solve the problems faced in clinical practice. In the light of the findings of this study, there is a positive effect on the influence of PBL in enhancing critical thinking skills and problem solving ability among nursing students. It offers several advantages over traditional lecture methods. It is based on principles of adult learning theory, including motivating the students, encouraging them to set their own learning objectives, and giving them a role in decisions that affect their own learning. So, it was concluded that PBL is a potentially powerful and essential approach to promote quality in nursing practice, which is dependent upon the educational preparation of nurses to think critically and solve problems.

6.6. LIMITATIONS

- Although the use of this clustered PBL methodology appeared to be successful it should be noted that this study was conducted at Nursing Colleges from a single city.

- The sample size was relatively small and so the results of this study cannot be generalized to the total population of nursing college students.
- The design adopted was a quasi experimental rather than truly experimental, in which purposive sampling was used to collect data.
- The advantages of various aspects of PBL were not assessed.
- Further research is clearly needed to explore the generalizability of these findings.
- Instructor training should be provided to successfully integrate course content may be another limitation of this study.

6.7. IMPACT OF THE STUDY

The world of nursing has been changing daily specially in the last two decades. In today's fast paced, technologically advanced world, the challenge for nursing faculty is to teach students critical thinking (CT) skills and the ability to practice competently in a variety of situations. The rapidly changing nature of the health care system presents nurses with varied complex practice issues with no clear solutions. These health care problems require nursing students and nurses to have CT skills.

Critical thinking is the first needed skill for nurse students. It is the advance process of cognitive domain for decision making upon caring patients. The affective disposition of a critical thinker includes being inquisitive, systematic, judicious, truth seeking, analytical, open-minded, and confident in reasoning.

Problem – Based Learning is a student-centered instructional strategy in which students collaboratively solve problems and reflect on their experiences. It is a learning that results from the process of working towards the understanding or

resolution of a problem. As a curriculum, it consists of carefully designed and scripted problem scenario that demand a range of skills from the learner. These skills include: self-directed learning, critical thinking, team participation and acquisition of critical knowledge. Thus the investigator introduced Problem Based Learning (PBL) inorder to enhance critical thinking skills and problem solving abilities among nursing students. PBL will help the nursing students to apply developed critical thinking skills in clinical practice.

6.8. IMPLICATIONS OF THIS STUDY

6.8.1. Implications for Nursing Practice

As discussed in this study, fostering critical thinking skills in nursing students has become one of the most imperative tasks for nursing practice. The rapidly changing nature of the health care system presents nurses with varied complex practice issues with no clear solutions. These health care problems require nursing students and nurses to have critical thinking skills and problem solving ability. . In order to solve unique and complex problems nurses need to be organized and utilize information innovatively. This is an empowering activity It has been emphasized through this study finding that problem-based learning is an effective method to enhance critical thinking skills and problem solving ability, which are essential for nurses to find solutions to the clinical problems

6.8.2. Implications for Nursing Education

Fostering critical thinking ability in nursing students has become one of the most imperative tasks for nursing education. The practical application during clinical practice of nurses depends much upon the educational preparation they had. Educators have to equip nursing students with skills that promote their critical thinking skills to

solve complex issues. The development of critical thinking skills requires students to engage in discussions to become active participants in their own learning. PBL is an active learning, which will result in significant improvement of critical thinking skills and problem solving ability that are required to bridge the gap between the education and nursing practice. Once combined with active learning strategies, teaching becomes a process where the learner takes an energetic role in education. PBL is usually enjoyable, motivational and effective, and retention of knowledge is perceived to be increased. Nursing educational programs should follow steps that systematically develop self-directed learning and critical thinking skills. Nursing programs should include the teaching strategies that promote self-directed learning, which ultimately improves critical thinking skills and problem- solving ability. It should also ensure the application of all its competencies. Nursing curricula should include PBL course as an effective means of enhancing critical thinking skills and problem solving ability. Moreover, the integration of PBL into nursing education as an effective educational methodology allows nurses to achieve best practice outcomes based on real-life clinical problems.

6.8.3. Implications for Nursing Administration

In service education and continuing education should be arranged for practice nurses to implement clinical practice guidelines using PBL. The healthcare organizations should actively support and promote PBL methodology that will assist and support nurses in their clinical education and professional development. Nursing educational administrators must play an active role in designing PBL workshops emphasizing the concept and the importance of PBL as the teaching strategy for improving self-directed learning and critical thinking skills. Nursing educational

administrators should take steps to plan " instructional development program" for the aim of enhancing teaching abilities of novice nursing teachers.

6.8.4. Implications for Nursing Research

Although many foreign studies prove a tendency towards improved critical thinking by students taught with PBL, more substantive data are needed in Indian context to support the broader adoption of PBL as a reliable method for teaching critical thinking. Study results would be more meaningful if the construct of critical thinking could be further unified thereby making the results of studies translatable from one situation to the next. Additional research is needed to determine the utility of PBL in various aspects of teaching.

6.9. RECOMMENDATIONS

1. The study can be replicated in a larger sample size.
2. A similar study can be conducted in other parts of Tamil Nadu.
3. Longitudinal studies can be done to provide a profile of students' development of approaches to learning over time in order to assess the enduring effect of PBL.
4. PBL should be introduced into nursing curriculum in order to promote critical thinking skills and problem solving ability among nursing students.
5. Similar studies can be conducted to assess the critical thinking skills and problem- solving ability of practicing nurses.
6. Studies supporting other aspects of PBL could be conducted.

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APPENDIX – A

CONTENT VALIDITY CERTIFICATE

This is to certify that I ----------

----------have gone through the tool submitted by **Shyla Kamalakumari.R,** Ph.D scholar doing her research under The Tamilnadu Dr. M.G.R Medical University, Chennai.

"A study to evaluate the efficiency of **PROBLEM-BASED LEARNING (PBL)** over Lecture method in terms of enhancing critical thinking skills and problem solving ability among nursing students in selected Nursing Institutions of Tamil Nadu".

I have gone through the tool for construct, content and criterion validity. I certify that this tool can be used for above mentioned study.

Signature, Designation & Seal of the expert

LETTER SEEKING PERMISSION FOR TOOL VALIDITY

From

Mrs.Shyla Kamalakumari.R, M.Sc(N),

Principal,
Sree Abirami College of Nursing,
Coimbatore.

To

Respected Madam /Sir,

Sub: Expert opinion for tool validity

I, Shyla Kamalakumari.R, doing Ph.D in Nursing at C.S.I Jeyaraj Annapackiam College of Nursing, Madurai, which is affiliated to The Tamil Nadu Dr. M.G.R Medical University, Chennai seek your expert validation on my study topic ***"A study on the efficiency of Problem Based Learning (PBL) over Lecture method in terms of enhancing critical thinking skills and problem solving ability among Nursing students in selected Nursing Institutions of Tamil Nadu".***

I am herewith sending a copy of the tool along with the criteria check list prepared by me for its content validation.

Hence, I request you to kindly examine the tool item wise and give your valuable opinion and suggestions for improvement of this tool. I would appreciate if this tool will be returned to me after verification with suggestions within a week's time, so as to enable me proceed with my pilot study.

Please forward the tool and the signed content validity certificate to the address mentioned on the stamped cover sent along with this letter.

Thanking you in anticipation,

Yours sincerely,

Shyla Kamalakumari.R

APPENDIX – B

LETTER SEEKING PERMISSION FOR DATA COLLECTION

From,

Mrs.Shyla Kamalakumari. R, M.Sc(N),
Principal,
Sree Abirami College of Nursing,
Coimbatore.

To

Respected Sir/Madam,

Sub: Seeking permission to do Ph. D data collection- reg.

I, Shyla Kamalakumari.R, doing Ph.D in Nursing at C.S.I Jeyaraj Annapackiam College of Nursing, Madurai, which is affiliated to The Tamil Nadu Dr. M.G.R Medical University, Chennai have undertaken the topic for thesis as "**A study on the efficiency of Problem Based Learning (PBL) over Lecture method in terms of enhancing critical thinking skills and problem solving ability among Nursing students in selected Nursing Institutions of Tamil Nadu"**.

My study topic requires II year B.Sc(N) students as study samples. Therefore, I request your good self to grant me permission to collect data in your esteemed institution as per your convenience. Expecting your favourable reply.

Thanking you,

Yours Sincerely,

Shyla Kamalakumari.R

APPENDIX – C

ETHICAL COMMITTEE CLEARANCE CERTIFICATE

Minutes of the ethical committee meeting held on 16.11.2009 in C.S.I. Jeyaraj Annapackiam College of Nursing, Madurai. The research title**, "Efficiency of Problem-Based Learning (PBL) over Lecture method in terms of enhancing critical thinking skills and problem solving ability among Nursing students in selected Nursing Institutions of Tamil Nadu"** was approved by the committee and **Shyla Kamalakumari.R** is permitted to do the research under the Guidance of **Prof. Dr. A. Charles Stephen Rajasingh, M.S.,M.Ch.,** and Co-Guidance of **Prof. Dr.C. Jothi Sophia, M.Sc(N).,Ph.D.,** for the research work is provisionally registered from 1.1.2009 for four years as a part time candidate for research leading to the award of Doctor of Philosophy in Nursing in the broad field of community Health Nursing to the Tamil Nadu Dr. M.G.R. Medical University, Chennai.

1.Chairperson Prof.Dr.Charles Stephen Rajasingh, M.S., M.Ch., Medical Superintendent, Christian Mission Hospital, Madurai.	**6. Member Secretary** Prof.Dr.C.Jothi shopia, M.Sc.(N)., Ph.D., Principal, C.S.I.Jeyaraj Annapackiam College of Nursing, Madurai.
2.Co-Chairperson Prof.Dr.K.Rajalakshmi, M.Sc.(N)., Ph.D., Research Coordinator, C.S.I.Jeyaraj Annapackiam College of Nursing, Madurai.	**7.Member-Clinician** Prof.Dr.Jeyasingh, M.D., D.V., Ph.D., Head of Department (STD), Christian Mission Hospital, Madurai.
3.Medical Scientist Prof.Dr.V.N.Rajasekaran, M.D., Ph.D., Medical Director, Meenakshi Mission Hospital, Madurai.	**8.Legal Expert** Mr.Fernandez Rathinaraja, M.A., B.L., Legal Advisor, DM & R, Madurai.
4.Philosopher Prof.Dr.Gabriel, M.Sc., M.Ed., M.Phil., Ph.D., Director, C.S.I.School of Education, Madurai.	**9. Social Scientist** Mr.R,Ravikumar, M.A., B.Ed., M.Phil., Principal, Bethsan Special School, Madurai.
5.Member Secretary Curriculum Development, The Tamil Nadu Dr.M.G.R.Medical University, Chennai.	**10. Community Worker** Mrs.Gandhimathi, M.A., Community worker-Grade-III, Thiruparankundrum, Madurai.

Signature of the Chairperson

APPENDIX – D

LIST OF EXPERTS

S. No	Name of the Expert	Qualification	Field
1	Prof. Dr. Raja Lakshmi	M.Sc(N)., Ph.D.,	Pediatric Nursing
2	Prof. Dr. Madhavi	M.Sc(N)., Ph.D.,	Medical Surgical Nursing.
3	Prof. Dr. Angella Gnanadurai	M.Sc(N)., Ph.D.,	Medical Surgical Nursing.
4	Prof. Dr. Karoline Rajkumar	M.Sc(N)., Ph.D.,	Medical Surgical Nursing.
5	Prof. Dr. EstherJohn	M.Sc(N)., Ph.D.,	Obstetrics and Gynecological Nursing
6	Prof. Dr. Shanthi Appavu,	M.Sc(N)., Ph.D.,	Medical Surgical Nursing.
7	Prof. Dr.Manivannan	M.Sc(N)., Ph.D.,	Community Health Nursing
8	Dr.Meenakumari	M.B.B.S., M.D.,	Adult and Pediatric Diabetologist
9	Dr. Kannan	Ph.D.,	Sociology
10	Dr.Ravi sankar	Ph.D .,	Statistics
11	Dr. Antony	Ph.D.,	Education
12	Mr. Mani Velsamy	M.Sc., M.Phil.,	Bio - Statistician

APPENDIX - E

1	2

Part I

DEMOGRAPHIC VARIABLES

Circle the option in coding sheet which applies to you : Eg:

1) Name_____

2) Age_____

3) Sex _____

4) Class_____

5) Mail ID_____

6) Religion

1. Hindu
2. Christian
3. Muslim
4. Others

7) Parents Education

1. Non literate
2. Primary
3. Secondary
4. Collegiate

8) Occupation of parents:

1.Daily wages/ Farmer
2.Non Executive eg.,Typist, Clerk
3.Executive eg., Manager
4.Business/ Self employed
5.Professional eg., Doctor, Teacher
6.Skilled eg.,Tailor, Painter
7.No work

9) Income of the family / Month :

1. 1000 – 3000
2. 3001 – 6000
3. 6001 – 9000
4. 9001& Above

10) Place of residence:

1.Urban
2. Rural
3. Semi urban

11) Medium of language during schooling

1. Tamil
2. English
3. Malayalam
4. Any other-Specify

12) Type of board studied in schooling:

1.State
2.Matriculation
3.Central
4.Any other- Specify

13) Percentage of marks obtained in +2

1. < 40%
2. 41- 60%
3. 61-80%
4. >81%

14) Marks obtained in I year B.Sc (N)

1. < 40%
2. 41- 60%
3. 61-80%
4. >81%

15) Aptitude to join nursing:

1. Self interest
2. Parents
3. Friends
4. Relatives
5. Any other-Specify

16) Name of the college_____

17) Sector of the college

1. Private
2. Government
3. Deemed

18) Courses offered in the college

1. UG Only
2. UG & Diploma
3. UG & PG

19) Clinical training obtained through

1. Parent Hospital
2. Affiliated Hospital
3. Both

20) Number of years since institution was started

1. 1-3 yrs
2. 4-6 yrs
3. 7-9 yrs
4. 10 & Above

PART II

QUESTIONNAIRE TO ASSESS CRITICAL THINKING SKILLS AND PROBLEM SOLVING ABILITY **Time Duration: 45 Mts**

Note: Circle your answer for each question in section A&B. Also write rationale for your answers in sections C & D

SECTION A : KNOWLEDGE

A1. Insulin is secreted from pancreas by

1) Alpha cells
2) Beta cell
3) Gamma cells
4) Somatastatin

A 2. Insulin's action on the cells are the following except

1) Transport and metabolizes glucose for energy
2) Releases the stored dietary fat from adipose tissue
3) Stimulates storage of glucose in the liver and muscle
4) Signals the liver to stop the release of glucose

A 3. Type I diabetic mellitus is

1) Non- insulin dependent Diabetes mellitus
2) Insulin dependent Diabetes mellitus
3) Juvenile Diabetes mellitus
4) Gestational Diabetes mellitus

A 4.Type I Diabetes Mellitus develops in people who have the tendency found in Antigen

1) HCG
2) CEA
3) HLA
4) AFP

A 5. Diabetes Mellitus is a group of

1) Hormonal disorder
2) Metabolic disorder
3) Fibrinolytic disorder
4) Coagulant disorder

A 6.One of the following options depicts the characteristics of type I diabetes mellitus

1) There is insulin secretion, but the body's demands are increased
2) There is no insulin secretion, but the body's demands are increased
3) There is insulin secretion, but the body's demands are decreased
4) There is no insulin secretion, but the body's demands are decreased

A7. Type I diabetes mellitus is the result of

1) Auto immune Beta- cell destruction leading to absolute insulin deficiency
2) Auto immune alpha- cell destruction leading to absolute insulin deficiency
3) Auto immune gamma- cell destruction leading to absolute insulin deficiency
4) Auto immune somotostatin- cell destruction leading to absolute insulin deficiency

A8.The expansion of the term IFG

1) Insulated fasting glucose
2) Impaired fatty glycogen
3) Insulated fatty glucose
4) Impaired fasting glucose

SECTION B: COMPREHENSION

B1. Insulin waning is

1) a progressive rise in blood glucose level from bed time to morning
2) a progressive reduction in the blood glucose level from bed time to morning
3) a progressive rise in the blood glucose level from morning to bed time
4) a progressive reduction in the blood glucose level from morning to bed time

B 2. One of the following laboratory tests indicate the compliance of a diabetic client with insulin therapy

1) 2- hours post prandial blood glucose
2) Fasting blood glucose
3) Glycosylated hemoglobin
4) Oral glucose tolerance test

B 3.The following tests are used to diagnose diabetic ketoacidosis

1) PH and Sr. Bicarbonate
2) PH and Sr. potassium
3) PH and blood glucose
4) PH and Sr.magnesium

B 4. Jet injector is a device

1) that uses a small, prefilled insulin cartridge that is loaded into a pen like holder
2) that delivers insulin through the skin under pressure in an extremely fine stream.
3) that is externally worn and contains a syringe attached to a long, thin, narrow lumen tube with a needle
4) that is implanted in the peritoneal cavity, where insulin can be absorbed in a more physiological manner.

B 5. What is glycemic index?

1) How quickly a sugar can raise blood glucose
2) How quickly a food can raise blood glucose
3) How quickly a fat can raise blood glucose
4) How quickly a fruit alone can raise blood glucose

B 6.Acute complications of diabetes mellitus are the following, except

1) Diabetic Nephropathy
2) Diabetic Ketoacidosis
3) Hypoglycemia
4) Hyperglycemic Hyperosmolar Nonketotic Syndrome.

B7. The following are the signs and symptoms that indicate hyperglycemia in a client with diabetes mellitus, except

1) Metabolic acidosis
2) Increased urination
3) Cold clammy skin
4) Deep rapid respiration

B8. Which health education should a nurse insist for a patient in hyperglycemia?

1) Drink plenty of water
2) Have a good rest
3) Take her prescribed insulin
4) See her doctor right away

SECTION C: APPLICATION (Answer each question with rationale)

C1. A client is admitted to a hospital with a diagnosis of DKA. The initial blood glucose level was 950mg/dl. A continuous IV infusion of regular insulin is initiated along with IV regulation with normal saline. The serum glucose level is now 240 mg/dl. Which of the following would the nurse next prepare to administer?

1) Intravenous fluids containing 5% dextrose
2) NPH insulin subcutaneous
3) An ampule of 5% dextrose
4) Phenytoin (dilantin) for the prevention of seizure.

C2. A Nurse is preparing a teaching plan for a client with diabetes mellitus regarding proper foot care. Which instruction is included in the plan?

1) Soak feet in hot water
2) Apply a moisturizing lotion to dry feet but not between the toes.
3) Always have a podiatrist cut your toe nails; never cut them yourself.
4) Avoid using a mild soap on the feet

C3. The hospitalized client with diabetes mellitus received NPH insulin in the morning. The nurse monitors the client for hypoglycemia, knowing that the peak action occurs

1) 1-2 hours after administration
2) 6-14 hours after administration
3) 14-18 hours after administration
4) 18-24 hours after administration

C4. A client with diabetes mellitus is self administering NPH insulin from a vial that is kept at room temperature. The client asks the nurse about the length of time an unrefrigerated vial of insulin will maintain it's potency. The most appropriate response to the client is which of the following?

1) 2 weeks
2) 1 month
3) 2 Months
4) 6 Months

C5. A client newly diagnosed with diabetes mellitus has been stabilized with insulin injections daily. A nurse prepares a discharge teaching plan regarding the insulin. The teaching plan should reinforce which of the following concepts?

1) Increase the amount of insulin before unusual exercise.
2) Ketones in the urine signify a need for less insulin.
3) Always keep insulin vials refrigerated.
4) Systematically rotate insulin injection sites.

C6. A nurse is assisting a client with diabetes mellitus who is recovering from DKA develops a plan to prevent a recurrence. Which of the following is most important to include in the plan of care?

1) Eat six small meals per day
2) Receive appropriate follow up health care
3) Monitor blood glucose levels frequently
4) Test urine for ketone levels

C7. A client is brought to the emergency room in an unresponsive state, and a diagnosis of Hyperglycemic Hyperosmolar Non Ketotic Syndrome is made. The nurse would prepare immediately to initiate which of the following anticipated physician's orders?

1) 100 units of NPH insulin
2) Endotracheal intubation
3) Intravenous replacement of sodium bicarbonate
4) Intravenous infusion of normal saline.

C8. An external insulin pump is prescribed for a client with the DM. The client asks the nurse about the functioning of the pump. The nurse bases the response on the information that the pump

1) gives a small continuous dose of regular insulin subcutaneously, and the client can self administer a bolus with an additional dosage from the pump before each meal
2) is timed to release programmed doses of regular or NPH insulin in to the blood stream at specific intervals
3) is surgically attached to the pancreas and infuses regular insulin into the pancreas, which in turn releases the insulin in to the blood stream.
4) continuously infuses small amounts of NPH insulin in to the blood stream while regularly monitoring blood glucose levels.

SECTION D: ANALYSIS (Answer each question with rationale)

D1. A client with a diagnosis of DKA is being treated in an emergency room. Which finding would a nurse expect to note as confirming this diagnosis?

1) Increase blood glucose and decrease plasma carbonate
2) Decrease urine output
3) Increase respiration and an increase in PH
4) Comatose state

D2. A home health nurse visits a client with a diagnosis of type one diabetes mellitus. The client relates a history of vomiting and diarrhea and tells the nurse that no food or medication has been consumed for 36 hours. Which additional statement by the client indicates a need for further teaching?

1) I need to stop my insulin.
2) I need to increase my fluid intake.
3) I need to call the physician because of these symptoms.
4) I need to monitor my blood glucose every 3-4 hours.

D3. A nurse performs a physical assessment on a client with type II DM. Findings include a fasting blood glucose of 120mg/dl, temperature 101ºF, pulse of 88/mt, respiration of 22/mt, and blood pressure 140/84mmHg. Which finding would be of most concern to the nurse?

1) Pulse
2) Blood pressure
3) Respiration
4) Temperature

D4. A nurse notes that a client with type I DM has lipodystrophy on both upper thighs. The nurse would appropriately inquire if the client

1) cleanses the skin with alcohol before each injection
2) rotates site for injection
3) aspirates the blood before injection in to subcutaneous tissue
4) administers the insulin at a 45 degree angle

D5. A nurse teaches a client with diabetes mellitus about differentiating between hypoglycemia and ketoacidosis. The client demonstrates that understanding of the teaching by stating that glucose will be taken if which of the following symptoms developed?

1) Fruity breath order
2) Shakiness
3) Blurred vision
4) Polyurea

D6. A client with type I diabetes mellitus calls to the nurse to report recurrent episodes of hypoglycemia with exercising. Which statement by the client indicates an inadequate understanding of the peak action of NPH insulin and exercise?

1) The best time for me to exercise is every afternoon
2) The best time for me to exercise is after I eat
3) The best time for me to exercise is after breakfast
4) The best time for me to exercise is after my morning snack

D7. A nurse is teaching a client how to mix regular insulin and NPH insulin in the same syringe. Which of the following actions, if performed by the client, indicates the need for further teaching

1) Injects air into NPH insulin vial first
2) Injects an amount of air equal to the desired dose of insulin into the vial
3) Withdraws the NPH insulin first.
4) Withdraws the regular insulin first.

D8. A client with type II diabetes mellitus has a blood glucose greater than 600mg/dl and is complaining of polydypsia, polyuria, weight loss, and weakness. A nurse reviews the physician's documentation and would expect to note which of the following diagnosis?

1) Diabetic Keto Acidosis(DKA)
2) Hypoglycemia
3) Hyperglycemic Hyperosmolar Non Ketotic Syndrome(HHNS)
4) Pheochromocytoma

SECTION E: SYNTHESIS

A patient with type I diabetes mellitus has been admitted with the diagnosis of DKA. Choose the correct response and fit according to the problem solving steps given below

1) Medical history, Laboratory data and imbalanced dietary pattern
2) Normal physiological status
3) Vomiting, diarrhea, altered consciousness and palpitation
4) Rehydration, insulin therapy and electrolyte balance
5) Normalize blood glucose level, Gain in fluid and electrolyte balance and dietary balance
6) DKA
7) Dehydration, alteration in fluid and electrolyte imbalance, Increased blood glucose
8) Correction of sr. potassium level, blood glucose, fluid imbalance, sr. bicarbonate

E1. Encounter the problem ----------
E2. Specify the problem ----------
E3. Collect relevant data ----------
E4. Analyze data to specify the problem ----------
E5. Determine plan of action ----------
E6. Prioritize ----------
E7. Execute action plan ----------
E8. Evaluate ----------

ANSWER KEY

Knowledge:

1) 2
2) 2
3) 2
4) 3
5) 2
6) 2
7) 1
8) 4

Comprehension:

1) 1
2) 3 (Hb A1 C) is the best indication of diabetic control. It reflects blood glucose level for the past 3-4 months.
3) 1 (Low Sr.Bicarbonate(0to 15 meq/l) Low PH 6.8 to 7.3)
4) 2
5) 2
6) 1
7) 3
8) 3

Application:

1) **1;** Rational: during management of DKA, when the blood glucose level falls to 250 to 300 mg/dl, the infusion rate is reduced and 5% dextrose is added to maintain a blood glucose level of about 250mg/dl or until the client recovers from the ketosis. NPH insulin not used to treat DKA. Fifty percent dextrose is used to treat hypoglycemia. Phenytoin(Dilantin) is not a usual treatment measure for DKA.
2) **2 ;** Rationale: The client is instructed to use a moisturizing lotion on the feet and to avoid applying the lotion between the toes. The client should be instructed not to soak the feet and should avoid hot water to prevent burns. The client may cut the toe nails straight across and even with the toe itself and would consult a podiatrist if the toe nails were thick or hard to cut or if vision was poor. The client should be instructed to wash the feet daily with a mild soap.

3) **2 ;** Rationale: NPH insulin is intermediate acting insulin. the onset of action for NPH insulin is 1-2 hrs and it peaks in 6-14 hrs. and it's duration of action is 24 hrs.
4) **2 ;** Rationale: An insulin vial in current use can be kept at room temperature for up to 1 month without significant loss of activity. Direct sun light and heat must be avoided.
5) **4 ;** Rationale: Insulin dosages should not be adjusted and should not be increased before unusual exercise. If acetone is found in the urine, it possibly may indicate the need for additional insulin. To minimize the discomfort associated with insulin injections, insulin should be administered at room temperature. Injection sites should be rotated systematically from one area to another.
6) **3 ;** Rationale: Client education following DKA should emphasize the need for home glucose monitoring 2-4 times per day. Instructing the client to notify the health care provider when illness occurs also is important. The presence of urine ketones indicate that DKA has occurred already. The client should eat well-balanced meals with snacks as prescribed.
7) **4 ;** Rationale: The primary goal of treatment in HHNS is to rehydrate the client to restore fluid volume and to correct electrolyte deficiency. IV fluid replacement is similar to that administered in DKA and begins with IV infusion of Normal saline. Regular, not NPH insulin would be administered. The use of sodium bicarbonate to correct acidosis is avoided because it can precipitate a further drop in Sr. Potassium levels. Intubation and mechanical ventilation are not required to treat HHNS.
8) **1 ;** Rationale: An insulin pump provides a small continuous dose of regular insulin subcutaneously throughout the day and night, and the client can self administer a bolus with additional dosage from the pump before each meal as needed. Regular insulin is used in an insulin pump. An external pump is not attached surgically to the pancreas.

Analysis:

1) **1 ;** Rationale: In DKA the arterial PH is < 7.35, Plasma bicarbonate < 15 mEq/l. The blood glucose level higher than 250mg/dl and ketones are present in the blood and urine. The client would be experiencing polyuria and kussmals respiration would be present. A comatose state may occur if DKA is not treated. But coma would not confirm the diagnosis.

2) **1 ;** Rationale: When a client with diabetes mellitus is unable to eat normally because of illness, the client still should take the prescribed insulin or oral medication. The client should consume additional fluids and should notify the physician. The client should monitor the blood glucose level every 3-4 hours.
3) **4 ;** Rationale: An elevated temperature may indicate infection. Infection is the leading cause of HHNS or DKA. The other findings noted in the question are within normal limits.
4) **2 ;** Rationale: Lipodystrophy (hypertrophy of subcutaneous tissue at injection site) occurs in client with diabetes mellitus when injection sites are used for a prolonged period of the time. Thus clients are instructed to adhere to plan of rotating injection site to avoid tissue changes. Cleansing with alcohol, aspiration and angle of insulin administration do not produce this complication.
5) **2 ;** Rationale: Shakiness is the sign of hypoglycemia and would indicate the need for food or glucose. A fruity breath odour, blurred vision & polyuria are signs of hyperglycemia.
6) **1 ;** Rationale: A hypoglycemic reaction may occur in response increased exercise. Client should avoid exercise during the peak time of insulin. NPH insulin peaks at 6 to 14 hours therefore afternoon exercise will occur during the peak of the medication. Option b, c, d do not address peak action times.
7) **3 ;** Rationale: When preparing a mixture of regular insulin with another insulin preparation, draw the regular insulin into the syringe first. The sequence will avoid contaminating the vial of regular insulin with insulin of another type. Options 1,2 &4 identify the correct actions for preparing NPH and regular insulin.
8) **3 ;** Rationale: HHNS occurs in clients with type 2 diabetes mellitus. The onset of polyuria, polydipsia, dehydration, mental status alterations, weight loss and weakness. Option 1,2 &4 are incorrect interpretation of the client's symptoms.

Synthesis:

Encounter the problem	3
Specify the problem	6
Collect relevant data	1
Analyze data to specify the problem	7
Determine plan of action	4
Prioritize	8
Execute action plan	5
Evaluate	2

Part III	**PERCEIVED BENEFITS QUESTIONNAIRE OF TEACHING METHOD**					
Note: Use (✓) mark for your choice						
S. No	**Comments**	***Strongly agree***	***Agree***	***Uncertain***	***Disagree***	***Strongly disagree***
1	I was motivated to work on the assignment					
2	I did not have less learning opportunities for searching for information					
3	I was not discouraged to do my own learning					
4	I was probed to think of more possibilities for solving problems					
5	I was not helpless to find the best way to solve problems					
6	I was able to Look at concepts or ideas from many different angles					
7	I learned to analyze situation in different ways					
8	My thinking has improved in different ways					
9	I was stimulated to think critically					
10	My thinking area was not restricted.					
11	I was not demotivated to get new perspectives					
12	I could think systematically					
13	I was not restricted to share the opinions with others					
14	My oral and writtten communication skills are developed					
15	I was not discouraged to express my own opinions in the group					
16	Communicating effectively with others was not affected					
17	I was more involved with my classmates					
18	I was able to collaborate with others effectively					
19	I did not find it difficult to work as a team effectively					

20	I was motivated to have effective interaction with peers					
21	I was enabled to teach each other					
22	I was facilitated in getting the feedback.					
23	It fostered my oral and written communication skills					
24	It fostered the ability of dealing with confidence					
25	The facilitated group sessions did not affect myself directed learning					
26	The unit was not hard to understand the content					
27	It enabled me to focus on my learning needs					
28	I was not in a tensed atmosphere for problem solving					
29	I felt warm during working as a team					
30	I had greater responsibilities for myself and the group					
31	I could know each other well					
32	I enjoyed debating issues and new ideas					
33	I could respect others opinion					
34	I could know much from text books					
35	The clinical programme was not time consuming					
36	It was not hard to catch the key points and understand deeply					
37	I could feel relaxed					
38	I did not experience greater work load					
39	I had sufficient time to complete tasks					
40	It was not waste of time explaining the material to others					

LESSON PLAN ON DIABETES MELLITUS

Subject : Medical Surgical Nursing (Adult including Geriatrics)-I

Unit-VII : Endocrine System

Time : PBL- Group interaction: 9 hrs

Topic : Diabetes Mellitus

Level of students : II year B.Sc.N.,

Method of teaching : Problem Based Learning

CENTRAL OBJECTIVES

At the end of the class the students will be able to:

- gain in depth understanding on diabetes mellitus through PBL process
- comprehend, apply, analyze and synthesize
- develop a positive attitude in caring a patient with diabetes mellitus
- develop critical thinking skills and problem solving abilities
- apply problem based learning for solving clinical problems
- apply critical thinking and problem solving skills in clinical context

SPECIFIC OBJECTIVES

At the end of the class the students will be able to:

- explain the etiology and pathophysiology of diabetes mellitus

- enumerate the clinical manifestations of diabetes mellitus
- enlist the diagnostic studies of diabetes mellitus
- differentiate between type1and type2 diabetes mellitus
- differentiate between hypoglycemia and hyperglycemia
- differentiate between DKA and HHNS
- analyze possible steps in the management of diabetes mellitus
- enlist the types of insulin, their actions and modes of administration
- explain about the complications of diabetes mellitus
- apply critical thinking skills and problem solving abilities to manage complications of diabetes mellitus
- apply problem solving steps in care of patients with diabetes mellitus

Time	Learning Objectives	Content	Teaching Learning Activities	Evaluation
5 mts	Introducing the topic	**INTRODUCTION TO THE TOPIC:** You are in ICU as the in-charge nurse. A patient is brought in with multiple fractures. Another young patient suffers cardiac arrest. You have to act swiftly and intelligibly balancing both. You need to prioritize your work. You are confused with how to go about. We, as nurses face such situations very commonly and you may feel helpless at times. If nurses are to deal effectively with complex change, increased demands and greater accountability, they must become skilled in higher level thinking and reasoning abilities. The rapidly changing nature of the health care system presents nurses with varied complex practice issues with no clear solutions. These health care problems require nursing students and nurses to have critical thinking (CT) skills.The development of CT skills requires students to engage in discussions to become active participants in their own learning .Nurses have found that there is a gap between theory and practice. They are usually unable to do medical performances. Education with an active learning will result in significant increase between the education and medical practice. Unfortunately, traditional undergraduate exercise science courses using lecture based instruction are often content driven, emphasizing abstract concepts over concrete examples and application. Little attention is given to learning problem solving, collaboration, and lifelong learning skills. Information–heavy presentation within a lecture likely results in students cramming to simply memorize information in order to pass examinations. Such instructional methods may not result in long-term knowledge retention. Once combined with active learning strategies, teaching becomes a process where the learner takes an energetic role in education. Active learning is usually enjoyable, motivational and effective, and retention of knowledge is perceived to be increased. An innovative learning method called Problem Based Learning will be introduced for learning diabetes mellitus.	The teacher introduces problem based learning	

2 mts	Describe Critical thinking	**CRITICAL THINKING** Critical thinking is defined as purposeful,self regulatory judgment, an interactive, reflective, reasoning process of making a judgment about what to Believe or do. Critical Thinking is a learned behavior which is crucial for decision making	Explaining Critical thinking	What is critical thinking?
2 mts	Describe Problem Solving	**PROBLEM SOLVING** The Problem Solving is the practical application of critical thinking skill. Problem Solving is a systematic process leading to the achievement of outcomes	Describing Problem Solving	What is problem solving?
3 mts	Explain the importance of critical thinking in nursing	**IMPORTANCE OF CRITICAL THINKING IN NURSING** Critical thinking is a learned behavior which is crucial for decision making. In order to solve a unique and complex problem, nurses need to be organized and utilize information innovatively thus empowering the nursing activity. Critical thinking is an essential learning tool in professional education. Critical thinking in nursing is an essential component of professional accountability and quality nursing care. Practitioners in nursing who are critical thinkers value and adhere to intellectual standards. Critical thinking is important in different aspects of nursing such as knowing, diagnosing, and bridging the gap between theory and practice.	Explaining and discussing the importance of critical thinking in nursing	Why critical thinking is important in nursing?

25 mts	Define PBL	**WHAT IS PBL?** The principal idea behind PBL is that the starting point for learning should be a problem, a query, or a puzzle that the learner wishes to solve. It is a process of acquiring understanding, knowledge, skills and attitudes in the context of an unfamiliar situation, and applying such learning to that situation. Problem-based learning originated in the late 1960s at McMaster University in Ontario, Canada. Howard Barrows, the founder of this educational methodology, developed the self-directed model to improve education in the school of medicine. It was developed to improve medical education by moving from a subject and lecture-based curriculum to an interdisciplinary one guided by 'real-life' problems." Its effectiveness has been well documented in medical education research. Along with self-directed learning, the development of critical thinking and problem solving skills is the main goal of PBL. Problem-based learning affords an environment conducive to teaching and learning critical thinking skills. **Problem Based Learning:** Problem based learning (PBL) is an active learning instructional method that uses “real world” problems to facilitate instruction. Students work through problems in a small collaborative group in and outside of class emphasizing the application of knowledge and the development of higher order thinking. **PBL Problem Module** PBL problem module will consist of the PBL orientation session, group sessions, out-of-class self-directed study, a group presentation session, and a reflection session. These sessions will not contain any lectures and the instructor will serve only as a guide to assist you in your learning.PBL module will follow the group problem solving steps.	Explaining about PBL through power point presentation Explaining the problem module of PBL	What is PBL? What do you mean by PBL problem module?

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Group Function
This class will function as one group working independently during and outside of class. The collective resources and effort of the group will be used to problem solve. In order for the group to function well, the group will discuss and agree upon a set of guidelines or ground rules. Consequences will be defined as well.

Comparison – CASE Method and PBL:
<table>
<tr><th>CASE METHOD</th><th>PBL</th></tr>
<tr><td>Uses CASE material or problem sceneries as a vehicle for analysis and / or decision making</td><td>Same</td></tr>
<tr><td>Knowledge precedes the problem</td><td>The problem comes first</td></tr>
<tr><td>Often a step-by-step analysis by the teacher models the critical thinking process, followed by student discussion.</td><td>The problem is posed so that the students discover that they need to acquire some new knowledge before they can understand or solve the problems.</td></tr>
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<td>Explaining and discussing the differences between Case method and PBL.</td>
<td>How do you function as a group in PBL?</td>
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3 mts	Explain the need for using PBL	**NEED FOR USING PBL** To encourage learning at the higher levels of the cognitive domain of bloom's taxonomy. To promote development of lifelong learning skills. To address nursing leaders & scholars concern that many students / graduate lack……. ➢ Problem solving skills ➢ Critical thinking skills	Explaining and clearing doubts regarding use of PBL.	Why do we use PBL?
7 mts	Explain the defining characteristics of PBL	**CHARACTERISTICS OF PBL** An essential characteristic of the PBL approach is the concept of self-directed learning. Along with self-directed learning, the development of critical thinking and problem solving skills is the main goal of PBL. **PBL is experiential** Students experience application & acquisition of knowledge while solving a real or realistic problem. **PBL is inductive** Knowledge is gained through the process of problem solving. Research indicate that " deeper" learning takes place when information is introduced within a meaningful context. Acquiring knowledge in the context in which it is meant to be used facilitates recall and application of concepts and skills learned. **PBL builds – on and challenges prior learning** If the problem scenario is relevant to students, they will attempt to apply prior learning to synthesize a solution. By focusing on their learning, students can test assumption, prior learning stratergies, and facts. Students may discover misconception in their prior learning.	Explaining and discussing the defining characteristics of PBL	What are the defining characteristics of PBL?

3 mts	Describe the Role of Instructor in PBL	**PBL is collaborative** Students experience others' thought processes & analytical skills as they work to solve the problem. Students develop critical thinking skills. **Formulate questions** To support collaborative learning. To challenge others. To help others verbalize prior learning . To stimulate new learning **INSTRUCTOR'S ROLE IN PBL** ▪ Instructor models metacognitive questioning to transfer the ownership of the question . ▪ What was going through your mind as you formulated that question. ▪ What are you thinking that has prompted that question. ▪ Instructor models reflective restatement to reframe clarify & link question. Eg., Can you help us see which part you don't agree with From what I hear in your question, you feel / think……. Can we explore how your question links with what X just said? Instructor models cognitive socialization by establishing norms and meditative conflicts. That was a good observation about that misconception. Let's ask X to explain how she/he might apply his/her prior knowledge to the situation." I understand your point. Let's explore what the others in the group think.	Explaining the role of Instructor with examples of clarification statements used by the Instructor	What are the roles of Instructor in PBL? What are the role differences of instructors between PBL and lecture methods of teaching?

15 mts	Explain how to implement PBL in classroom	**HOW IS PBL IMPLEMENTED IN THE CLASS ROOM?** Form teams of 8-10 students. Each team chooses a chairperson and scribe. **THE PBL "SEVEN STEP"** **Session1** • Clarify concepts • Define the problem • Analyze the problem- Brainstorm • Organize facts and knowledge • Formulate learning objectives **Intersession** • Self- study **Session2** • Discuss During the process of self study, each group will meet daily to discuss about the progress made in their study. The Chairperson of the group is supposed to plan the schedule for each day for discussion. The scribe will record the discussion carried out each day based on their groups' learning objectives. The record will be used by the group for the final day discussion. **PROBLEM SCENARIO**	Explaining about the implementation of PBL in classroom with the seven steps of PBL	What are the seven steps of PBL
10 mts	Illustrate a Problem Scenario	You are in the outpatient clinic. Your nursing instructor asks you to be involved in the care of Mrs. Mary , a 50 year old woman. You enter the room and her husband Mr. Tom is attending her. You enquire about Mrs. Mary's condition and he states that Mrs. Mary has complaints of vomiting, diarrhoea, palpitation , headache and altered consciousness since previous night after attending a party where she had eaten some cakes, pastry and icecreams. He also informs that she is a known diabetic	Narrating a problem Scenario on Diabetes Mellitus using power point and handouts	How will you solve the given problem using the steps of PBL

		for the past 20 years and takes insulin 30 units twice a day. Further, he informs that as she was having vomiting & diarrhoea, she did not take food & due to which she has stopped to take her regular doses of insulin. On examination, you find her skin is very cold and clammy and her breath is fruity odoured. You are also noticing lipodystrophy over her abdomen and she is dehydrated. Her BP is 80/50 mmHg.Pulse is weak and rapid.Urine testing shows presence of ketones.Results of her blood investigation shows that her PH level is 6.7mg/dl, glucose level 640mg/dl, Hbg A1c 7.8%. ECG is taken and the finding is evident for hypokalemia. Diagnose and treat the patient.		
15 mts	Clarify concepts	**Clarify concepts.** • Chairperson asks if there are any terms or concepts to be clarified • Enables all participants to start from a common starting point by… • Recognizing concepts lacking clarity • Asking for or giving an explanation • Scribe records terms and/ or concepts to be clarified • Members clarity • Instructor intercedes only if necessary. Concepts……Vomiting, diarrhoea, palpitation, headache, altered consciousness, Diabetic -20 years,Insulin-30 units twice a day,Cold and clammy skin,Fruity odoured breath, Lipodystrophy, PH level, Blood glucose, HbgA1C, ECG, Hypokalemia, DKA, Glycemic Index.	Discuss and clarify concepts based on the given scenario	What are the terms or concepts to be clarified?
13 mts	Define the given problem	**Define the problem** • Distill the given scenario into a concrete problem statement. • Translate the essence of the task into a defined problem. Establish boundaries for knowledge that is to be gained in the process.	Students discuss about the given scenario and define the problem to be solved.	How will you define the given problem?

30 mts	Analyse the given problem	**Analyse the problem** • Chairperson keeps discussion on topic and encourages everyone to participate… • Members reflect on prior learning and formulate question; scribe records… • Question to be investigated • Pertinent information • Explanation • Avoid discounting proposed explanation	Students analyse the given scenario, discuss and formulate questions to be investigated	How will you analyse the given problem by formulating questions?
28 mts	Explain on organizing Information	**Organize information** • Members group the listed question information, and explanation in to like categories for further studies. • Scribe denotes categories with color or numeric codes	Students organize the information for further studies	How will you organize the information?
30 mts	Formulate learning objectives	Formulate learning objectives • Members determine what knowledge is lacking . • Members formulate unambiguous question to address deficiencies in knowledge Learning Objectives……eg., • What are the characteristic findings of DM? • Types of DM. • Signs and symptoms of DM. • Compare and contrast; Type I and Type II DM, hypoglycemia, hyperglycemia and DKA, Acute and Chronic complications of DM. Investigations-values.(normal and altered) • Insulin administration(action, time of peak action, method of administration, and dosage) • Insulin Complications and Prevention of Complications	Students identify their own learning needs and formulate learning objectives	What are the learning objectives formulated?

		• Nursing Management for Mrs.Mary • Prepare a treatment plan for Mrs.Mary • Formulate a diet plan		
30 mts	Summarize the learning issues to the whole group	After formulating learning objectives, groups summarize their case and learning issues for the whole group	Students summarize the case and learning issues for the whole group	
2 mts	Summarize the topic	**SUMMARY** So far, it was discussed about PBL, its uses and how far it enhances critical thinking skills and problem solving ability and how to apply PBL practically. You are also given a problem scenario on diabetes mellitus, which need to be solved using PBL.	Teacher summarizes the topic using Black Board and power point.	
2 mts		**CONCLUSION** PBL is an active learning strategy which will help you to solve clinical problems with enhanced CT skills. Teacher informs the groups to search for more information on diabetes mellitus through applying PBL and to present their learned issues on the fifth day during discussion.	Teacher concludes the topic	
2-4 days	Apply PBL process in self study	**SESSION-2** Self study • Schedule study time Set goals and time line	Schedule study time based on set goals by referring study resources. Students	

		• Select and study resources Text book, journal, www, etc… • Study resources Study based on the learning objectives. Establish links between previous and new knowledge • Prepare a report Make notes and diagrams; cite resources **SESSION-3**	prepare a report with adequate information	
3 hrs 15 mts	Explain the answered learning objectives	Discussion • Each group presents their identified learning objectives and answers questions from the whole group. • Chairperson moderates the discussion • Members present information to answer learning objectives • Members present supporting diagram and examples. • Members discuss any conflicting or unclear information. • Members critically reflect on what was studied. • Members determine depth and relationship of knowledge	Instructor moderates the discussion by stressing integration of information. Students discuss answers for the learning objectives using supportive diagrams and examples.	Discuss the learnt learning issues.
12 mts	Summarize the topic	**SUMMARY** We discussed about etiology, pathophysiology, clinical manifestations, diagnostic studies, management and complications of type1and type2 diabetes mellitus in detail. Further many relevant practical issues were discussed. The problem scenario on diabetes mellitus was solved successfully applying the problem solving steps.	Teacher summarizes the topic using black Board	

3 mts	Conclude the topic	**ASSIGNMENT:** Apply PBL method of learning in other clinical problems **CONCLUSION** Hope, you would have learnt diabetes mellitus in an interesting manner as you had an active learning through PBL. Diabetes Mellitus was learned through PBL in a very effective manner. Since PBL is a new method of learning, it can be applied to learn all the topics in an interesting manner with improved critical thinking and problem solving skills .	The teacher concludes the topic	

POWERPOINT PRESENTATION

PROBLEM BASED LEARNING TO DEVELOP CRITICAL THINKING SKILLS AND PROBLEM SOLVING ABILITY

What Is PBL?

The principal idea behind PBL is that the starting point for learning should be a problem, a query, or a puzzle that the learner wishes to solve."

PBL is...

"...a process of acquiring understanding, knowledge, skills and attitudes in the context of an unfamiliar situation, and applying such learning to that situation."

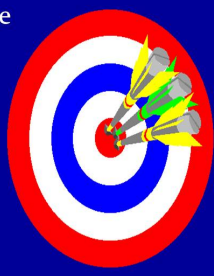
What is critical thinking?

Critical thinking is defined as purposeful, self regulatory judgment, an interactive, reflective, reasoning process of making a judgment about what to Believe or do.

Critical Thinking is a learned behavior which is crucial for decision making.

What is Problem Solving?

The Problem Solving is the practical application of critical thinking skill. Problem Solving is a systematic process leading to the achievement of outcomes.



Importance of critical thinking skills in Nursing

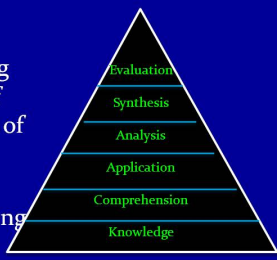
- Critical thinking is a learned behavior which is crucial for decision making.
- In order to solve a unique and complex problem,nurses need to be organized and utilize information innovatively thus empowering the nursing activity.
- Critical thinking is an essential learning tool in professional education.

Contnd.....

- Critical thinking in nursing is an essential component of professional accountability and quality nursing care.
- Practitioners in nursing who are critical thinkers value and adhere to intellectual standards.
- Critical thinking is important in different aspects of nursing such as knowing,diagnosing,and bridging the gap between theory and practice.

Why use PBL?

- To encourage learning at the higher levels of the cognitive domain of bloom's taxonomy.
- To promote development of lifelong learning skills.



Why use PBL?

To address nursing leaders & scholars concern that many students / graduate lack.....

- Problem solving skills .
- Critical thinking skills .

THE DEFINING CHARACTERISTICS OF PBL

PBL IS EXPERIENTIAL

- Students experience application & acquisition of knowledge while solving a real or realistic problem.

PBL IS INDUCTIVE

- Knowledge is gained through the process of problem solving.
- Research indicate that " deeper" learning takes place when information is introduced within a meaningful context.
- Acquiring knowledge in the context in which it is meant to be used facilitates recall and application of concepts and skills learned.

PBL BUILDS – ON AND CHALLENGES PRIOR LEARNING

- If the problem scenario is relevant to students, they will attempt to apply prior learning to synthesize a solution.
- By focusing on their learning, students can test assumption, prior learning stratergies, and facts.
- Students may discover misconception in their prior learning.

PBL IS COLLABRATIVE

- Students experience others' thought processes & analytical skills as they work to solve the problem.
- Students develop critical thinking skills.

FORMULATE QUESTIONS

- To support collaborative learning.
- To challenge others.
- To help others verbalize prior learning .
- To stimulate new learning.

INSTRUCTOR'S ROLE IN PBL

- Instructor models meta-cognitive questioning to transfer the ownership of the question .
- What was going through your mind as you formulated that question.
- What are you thinking that has prompted that question.
- Instructor models reflective restatement to reframe clarify & link question.

CONTD……

Eg

- Can you help us see which part you don't agree with
- From what I hear in your question, you feel / think.....
- Can we explore how your question links with what X just said?

- Instructor models cognitive socialization by establishing norms and meditative conflicts.
- That was a good observation about that misconception. Let's ask X to explain how she/he might apply his/her prior knowledge to the situation."
- I understand your point. Let's explore what the others in the group think."

HOW IS PBL IMPLEMENTED IN THE CLASS ROOM?

- Form teams of 8-10 students.
- Each team chooses a chairperson and scribe for each session.

THE PBL "SEVEN STEP"

- **SESSION1**
- Clarify concepts
- Define the problem
- Analyze the problem- Brainstorm
- Organize facts and knowledge
- Formulate learning objectives
- **INTERSESSION**
- Self- study
- **SESSION2**
- Discuss

PROBLEM SCENARIO

PROBLEM SCENARIO

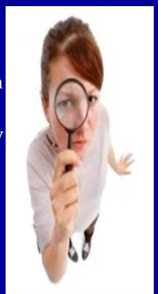
- You are in the outpatient clinic. Your nursing instructor asks you to be involved in the care of Mrs. Mary , a 50 year old woman. You enter the room and her husband Mr. Tom is attending her. You enquire about Mrs. Mary's condition and he states that Mrs. Mary has complaints of vomiting, diarrhoea, palpitation , headache and altered consciousness since previous night after attending a party where she had eaten some cakes, pastry and icecreams. He also informs that she is a known diabetic for the past 20 years and takes insulin 30 units twice a day. Further, he informs that as she was having vomiting & diarrhoea, she did not take food & due to which she has stopped to take her regular doses of insulin.

CONTD...

- On examination, you find her skin is very cold and clammy and her breath is fruity odoured. You are also noticing lipodystrophy over her abdomen and she is dehydrated. Her BP is 80/50 mmHg. Pulse is weak and rapid. Urine testing shows presence of ketones. Results of her blood investigation shows that her PH level is 6.7mg/dl, glucose level 640mg/dl, Hbg A1c 7.8%. ECG is taken and the finding is evident for hypokalemia. Diagnose and treat the patient.

CLARIFY CONCEPTS

- Chairperson asks if there are any terms or concepts to be clarified
- Enables all participants to start from a common starting point by...
- Recognizing concepts lacking clarity
- Asking for or giving an explanation
- Scribe records terms and/ or concepts to be clarified
- Members clarity
- Instructor intercedes only if necessary.



Concepts.....

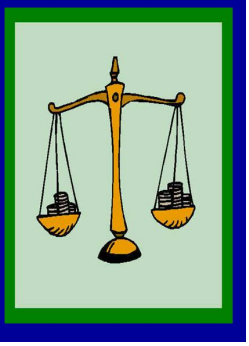
- Vomiting, diarrhoea,
- palpitation, headache,
- altered consciousness
- Diabetic -20 years
- Insulin-30 units twice a day
- Cold and clammy skin
- Fruity odoured breath
- Lipodystrophy
- PH level
- Blood Glucose
- HbgA1C
- ECG
- Hypokalemia
- DKA
- Glycemic Index

DEFINE THE PROBLEM

- Distill the given scenario into a concrete problem statement.
- Translate the essence of the task into a defined problem.
- Establish boundaries for knowledge that is to be gained in the process.

ANALYSE THE PROBLEM

- Chairperson keeps discussion on topic and encourages everyone to participate...
- Members reflect on prior learning and formulate question; scribe records...
- Question to be investigated
- Pertinent information
- Explanation
- Avoid discounting proposed explanation



Analyse the problem.....

- What are the physiological values altered in this patient?[PH ,glucose HbgıAc levels in blood,and ECG finding for hypokalemia]
- Compare the normal values with the altered values .
- Compare and contrast the findings.

ORGANIZE INFORMATION

- Members group the listed question information, and explanation in to like categories for further studies.
- Scribe denotes categories with color or numeric codes

FORMULATE LEARNING OBJECTIVES

- Members determine what knowledge is lacking .
- Members formulate unambiguous question to address deficiencies in knowledge

Learning Objectives. Egs.,

- What are the characteristic findings of DM?
- Types of DM.
- Signs and symptoms of DM.

COMPARE AND CONTRAST;
Type I and Type II

- hypoglycemia, hyperglycemia and DKA.
- Acute and Chronic complications of DM.
- Investigations-values.(normal and altered)

Learning Objectives - cond.....

- Insulin administration(action, time of peak action, method of administration, and dosage)
- Insulin Complications & Prevention of Complications
- Nursing Management for Mrs.Mary
- Prepare a treatment plan for Mrs.Mary
- Formulate a diet plan

After formulating learning objectives,

GROUPS SUMMARISE THEIR CASE AND LEARNING ISSUES FOR THE WHOLE GROUP

SELF STUDY

- Schedule study time

  Set goals and time line
- Select and study resources

  Text book, journal, www, etc...
- Study resources

  Study based on the learning objectives.

  Establish links between previous and new knowledge
- Prepare a report

  Make notes and diagrams; cite resources

DISCUSSION

- Chairperson moderate the discussion
- Members present information to answer learning objectives
- Members present supporting diagram and examples.
- Members discuss any conflicting or unclear information.
- Members critically reflect on what was studied.
- Members determine depth and relationship of knowledge

APPENDIX - F

VALIDATION OF THE TOOL

Please give your opinion for the tool constructed by the investigator. Please give your valuable opinion.

PART-I DEMOGRAPHIC VARIABLES

Item No:	Appropriate (Yes / No)	Not Appropriate	Need Modification	Suggestion	Remarks
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					

Any other suggestion:

PART-II

QUESTIONNAIRE TO ASSESS CRITICAL THINKING SKILLS AND PROBLEM SOLVING ABILITY

Item No:	Appropriate	Not Appropriate	Need Modification	Suggestion	Remarks
A. Knowledge					
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
B. Comprehension					
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C. Application					
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D. Analysis					
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E. Synthesis					
1.					
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7.					
8.					

Any other suggestion:

PART III PERCEIVED BENEFITS QUESTIONNRIE

Item No:	Appropriate	Not Appropriate	Need Modification	Suggestion	Remarks
1					
2					
3					
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Any other suggestion: