Effect of Problem Based Learning (PBL) with Metacognitive Scaffolding on Problem Solving Ability among Higher Secondary Students in Relation Metacognitive Ability

Jinto M
Research Scholar,
St.Ann's College of Education,Mangalore.

Vijaya Kumari S.N,
Associate Professor,
St.Ann's College of Education, Mangalore.

Abstract: *Underlying the significance of innovative approach in the teaching learning process the study deals with the Effect Problem Based Learning (PBL) with Metacognitive Scaffolding on Problem Solving Ability in Relation to Metacognitive Ability among Higher Secondary Students. It is an experimental study with pre-test post-test control group design. The experimental treatment was teaching Sociology using PBL with Metacognitive Scaffolding instructional material which was developed by the authors. Problem Solving Ability was measured by administering the Standardized Problem Solving Ability Test developed by LM Dubey. Data were analysed by applying 't' test and ANOVA. The findings of the study revealed that PBL with Metacognitive Scaffolding is significantly effective in enhancing the Problem Solving Ability among Higher Secondary Students. The study also revealed that PBL with Metacognitive Scaffolding is significantly effective in enhancing Problem Solving Ability in relation to different Metacognitive Ability levels. Based on the findings recommendations are made to incorporate PBL in Higher Secondary Education and in the Teacher Education Pedagogy as a regular practice.*

Key Words: *Problem Based Learning, Metacognitive Scaffolding, Metacognitive Ability, Problem Solving Ability, Higher Secondary Students.*

Introduction

Problems are reality of life and life in society poses problems to everyone irrespective of young or old. Thus the very purpose of education should be to prepare the learners for life, to face the challenges and problems of daily life. To be successful in life one must be adequately equipped with reasoning and reflecting power to solve the puzzles of life. The recent trends and studies show that integrating a better method in teaching learning process

can enhance the achievement and cognitive skills of the learners. The very purpose of education is to enhance the innate potentials, reasoning ability and problem solving ability of the learners.

Problem based learning is a method by which learners can be taught to develop their multiple cognitive skills and Problem Solving Abilities. PBL is a new teaching approach which focuses on the learner. It is a learner-centered approach in contrast to the teacher-centered traditional method. PBL approach can be used to enhance the cognitive and metacognitive skills of the learners.

Problem solving ability enables the child to find appropriate solutions to the problems that confront him / her. Problem means anything a matter or a person that is difficult to deal with, to solve or to overcome. A problem occurs when an activity is hindered by an obstacle that cannot be removed by using the readily available habits. Problem solving is a planned attack upon a difficulty or perplexity for the purpose of finding a solution.

Dewey explains problem solving as, "Whenever no matter how slight and common place in character perplexes and challenges the mind so that it makes a belief at all uncertain there is a genuine problem. The problem fixes the end of thought and the end controls the process of thinking." Problem solving involves reflective thinking which according to Dewey is "active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and further conclusions to which it tends, constitute reflective thinking." Risk, T.M. defines Problem solving as "planned attack upon a difficulty or perplexity for the purpose of finding a satisfactory solution." James Ross, defines "problem solving is an educational device whereby the teacher and the pupils attempt in a conscious, planned, purposeful manner to arrive at an explanation or solution to some educationally significant difficulty."

Woodworth and Marquis (1948), defines Problem behaviour occurs in novel or difficult situations in which a situation is not obtainable by the habitual methods of applying concepts and principles derived from past experience in every similar situations. According to Skinner (1968), problem solving is a process of overcoming difficulties that appear to interfere with the attainment of a goal. It is a procedure of making adjustment in spite of inferences. Problem solving ability is the capacity of the individual to come out of a puzzle or to remove the obstacle in attaining certain goals.

At Higher Secondary level students are capable of abstract thinking and reasoning. They are capable of cognitive activities and higher order thinking. They are able to foresee the future problems that come on their learning situations and daily life and analyse it in the most possible way to arrive at the solutions. They can be effective problem solvers when trained in PBL and their performance in all areas can be enriched. Today we need to train the pupil not only to solve problems in the class room but also the complex problem of social life.

Problem Based Learning (PBL)

Problem Based Learning (PBL) is a student-centered pedagogy in which students learn about a subject through the experience of problem solving. Students learn both thinking strategies and domain knowledge. The PBL format originated from the medical school of thought, and is now used in other areas as well. The goals of PBL are to help the students to develop flexible knowledge, effective problem solving skills, self-directed learning, effective collaboration skills and intrinsic motivation. Problem based learning is a style of active learning.

PBL approach is a flexible learning process that enables students to decide and prioritize their own learning agenda. It gives students ample opportunities to draw on their own experiential knowledge and allows them to reflect on the very process of their own thinking and problem solving. This can make them goal oriented and motivated to the learning process. In PBL learner is allowed to make mistake and learn from it. Group interaction enables students to see the perspectives on a problem.

PBL provides a forum to develop the collective skills of the learners. It is fundamentally an instructional method, characterized by the use of real world problems as the context for students to learn critical thinking and problem solving skills and acquire knowledge of the matter being taught. PBL describes a learning environment where problems drive the learning. It begins with a problem to be solved, where the problem is posed in such a way that the students need to gain new knowledge before they can solve the problem. Therefore, the students are asked to try out different solutions than sticking towards a particular solution. This gives them an opportunity to explore, to research, and to gather information and various possibilities towards the solution of a problem. In problem based learning students are confronted with an academic problem that has meaning for them. Problem Based Learning is a pupil-centered instructional strategy in which students jointly solve problems and reflect on their experiences. PBL is a new teaching approach which focuses on the learner. PBL approach will enhance the reasoning abilities, cognitive abilities, metacognitive skills of the learners.

Metacognitive Ability

The term 'Metacognition' is associated with John Flavell (1979). "Metacognition" is often simply defined as "thinking about thinking." What is basic to the concept of Metacognition is the notion of thinking about one's own thoughts. Those thoughts can be of what one knows (i.e., metacognitive knowledge), what one is currently doing (i.e., metacognitive skill) or what one's current cognitive or affective state is (i.e., metacognitive experience).

Metacognitive Ability is higher order thinking which is essential for meaningful learning. Metacognitive ability is the knowledge concerning one's own cognitive process and product. Activities such as planning how to

approach a given learning task, monitoring comprehension, and evaluating progress toward the completion of a task are metacognitive in nature. Metacognition plays a crucial role in successful learning so it is important to study metacognitive activity and development to determine how students can be taught to better utilize their cognitive resources through metacognitive control (VijayaKumari and Jinto, 2014).

According to Flavell (1979, 1987), Metacognition consists of both metacognitive knowledge and metacognitive experiences or regulation. Metacognitive knowledge refers to acquired knowledge about cognitive processes, knowledge that can be used to control cognitive processes. Metacognitive experiences involve the use of metacognitive strategies or metacognitive regulation (Brown, 1987). Metacognitive strategies are sequential processes that one uses to control cognitive activities, and to ensure that a cognitive goal (e.g., understanding a text) is achieved. These processes help to regulate and oversee learning, and consist of planning and monitoring cognitive activities, as well as checking the outcomes of those activities.

Metacognitively aware students plan their work properly, know how to manage the information available, monitor their own progress and evaluate them periodically, correct their mistakes in time and are always aware of their knowledge. This awareness leads to meaningful learning in Sociology.

Metacognitive Scaffolding

Metacognition literally means cognition about cognition or knowledge about knowing and learning. It is an awareness of one's thinking. Metacognition is controlled and is purposeful thoughtfulness. In fact when we think about our own thinking we are not far from having an absolute picture of how we think. There is always uncertainty about how our minds work but the active search for increased understanding is adaptive. Metacognition relies on a fair amount of abstract thinking, the skill engaged are often highly representational and internalized. Once students possess the necessary strategies, they must become active on remediation efforts and monitor their own Behaviour.

Metacognitive Scaffolding is a technique in which the teacher provides instructional support as students learn to do the task and then gradually shifts responsibility to the students. It is an approach that prepares the learner to be independent and self-reliant. Scaffolding is the process of helping children "... achieve more than they can on their own by skilfully structuring the environment to make it easier for them." (Hetherigton and Parke, (1986), p.293.). Scaffold is used as temporary structural support during building construction, so also scaffolding instruction serves as a support for students to develop new skills and abilities (Englert, Raphael, Anderson, Antony, & Stevens, 1991). Scaffolding can be the support provided in the course of learning, teacher guidance, instructional strategies, teacher help, teacher evaluation, probing questions, instructional aides etc.

The purpose of learning in higher secondary is to develop the abilities of reasoning and independent thinking. A change in teaching learning method and process is the need of the hour. Today we need a method that makes the learner the centre of the learning process.

Relevance of the Study

A problem is an opportunity for improvement. Problem solving is the frame work of pattern within which creative thinking and reasoning take place. Problem solving skills do not come naturally rather they are consciously learnt and nurtured. It is the ability to think and reason on given levels of complexity. Problem solving is a mental process that involves discovering, analyzing and solving problems (Saini, 2013).

PBL can enhance students' performance and learning skills (Candice et al.). PBL can improve student thinking Metacognition (Gerald F.Smith). PBL can enhance critical thinking and academic performance (Chiou Fen Lin et al.). PBL aides in enhancing positive learning outcomes (Donna Kann Pun Wong and Debbie Oi Bing Lam). PBL can enhance students' problem solving ability, creativity and self-regulation (Sonmi Jo and Ja Ok Ku). PBL helps the students in enhancing metacognitive and problem solving skills, personal relationship skills and become self-directed learners (Janice V.Kimmons and Phyllis R. Spruiell).Therefore, problem based learning approach with Metacognitive Scaffolding strategies become inevitable and essential in the classroom teaching and learning process.

PBL promotes student competencies in self-directed, collaborative learning and tackling novel situations (Manwal, Ng et al. 2014). PBL improves learning skills and achievement in learning (Priyanka Mahendru and D.V. Mahindru, 2011). Studies relating to PBL endorse the notion that PBL can enhance academic performance and many other cognitive and metacognitive skills of the learners.

Students who received Metacognitive Scaffolding are enhanced in metacognitive knowledge and Metacognitive ability (Molenaar Inge et al. 2011). Metacognitive scaffolding can enhance enquiry skills (Ido et al. 2012). Scaffolding can enhance knowledge acquisition and Metacognitive awareness of the learners (Raes, Annelieset al.,2012). Scaffolding intervention can enhance metacognitive skills and cognitive abilities of the learners.

Research studies reveal that there is a significant relationship between PBL with Metacognitive Scaffolding and cognitive skills. The studies also reveal that the PBL with Metacognitive Scaffolding is effective in enhancing multiple skills and higher order thinking of the learners. Employing Problem Based Learning with Metacognitive Scaffolding in teaching learning process can enrich learning and multiple skills of the learners. Problem based learning and Metacognitive Scaffolding is systematic and meaningful approach to enhance Problem solving ability.

PBL with Metacognitive Scaffolding is an instructional strategy which enables the learner to be independent and self-motivated. It offers ample opportunity for the learner to explore and experiment various methods in the process of learning. It enables the learners to explore various possibilities to arrive at the correct learning. PBL with metacognitive Scaffolding is an instructional strategy that will unfold the layers of true learning and teacher pupil interaction. Here the learner is facilitated to learn, employing all his or her faculties of reasoning, problem solving abilities and incorporating many other skills.

So undertaking an experiment and study to test the efficacy of PBL with Metacognitive Scaffolding would prove highly effective to enhance problem solving ability and various capabilities of the students of Standard Twelve. Employing this approach would enable the learners to improve their academic performance and higher order thinking.

Statement of the Problem

Effect of Problem Based Learning with Metacognitive Scaffolding on Problem Solving Ability among Higher Secondary Students in Relation to Metacognitive Ability.

Objectives of the Study

- ❖ To study the Effect of Problem Based Learning with Metacognitive Scaffolding on Problem Solving Ability among Higher Secondary Students.
- ❖ To study the effect of Problem based Learning with Metacognitive Scaffolding on Problem Solving Ability among Higher Secondary Students in Relation to Metacognitive Ability.

Hypotheses of the study

- ❖ There is a significant difference on Problem Solving Ability among Higher Secondary Students taught through Problem based Learning with Metacognitive Scaffolding.
- ❖ There is a significant difference on Problem Solving Ability among Higher Secondary Students taught through Problem based Learning with Metacognitive Scaffolding in Relation to Metacognitive Ability.

Independent Variable

- ❖ Independent variable is the treatment given. Treatment is teaching Sociology using PBL with Metacognitive Scaffolding.

Dependent Variable

Problem Solving Ability of the Higher Secondary Students refers to the scores obtained by the students of Standard Twelve on the standardized Problem Solving Ability Test Constructed by L.N. Dubey.

Population of the Study

❖ The population consisted of all the Standard Twelve Students studying in state syllabus of Mananthavady Taluk, Waynad district only.

Sample of the Study

❖ The sample consisted of randomly selected sixty students of Standard Twelve Students studying in state syllabus of Mananthavady Taluk, Waynad district.

Tools used in the study

❖ Instructional Material in Sociology using PBL with Metacognitive Scaffolding on selected topic from Standard Twelve Sociology text book.
❖ Standardized Test 'Metacognitive Inventory' constructed by Dr.Punita Govil.
❖ Standardized Problem Solving Ability Test Constructed by L.N. Dubey.

Procedure of Data Collection

Pre-test Post-test single group design was followed in the study. The experimental procedure in which the study was conducted comprised three levels.

Phase I: Administration of Pre-tests

Metacognitive Inventory Standardized tool developed by Punita Govil was administered on the sample and students were classified according to their metacognitive ability levels as Above Average, Average and Below Average. Standardized Problem Solving Ability Test Constructed by L.N. Dubey was administered.

Phase II: Treatment

The experimental group was given instruction for 15 sessions of forty five minutes duration with the specially designed instructional Material based on PBL with Metacognitive Scaffolding prepared by authors.

Phase III: Administration of Post-tests

Standardized Problem Solving Ability Test Constructed by L.N. Dubey was administered

Statistical Techniques

The data obtained were analyzed and interpreted applying appropriate Statistical techniques.

Descriptive Statistics

Descriptive Statistics Descriptive Statistics mainly mean and standard deviation were employed to analyse the variables of the study.

Inferential Statistics

Inferential Statistics 't' test was used to test the significance of difference between the means of Pre-test and Post-test on effectiveness of PBL with Metacognitive Scaffolding on Problem Solving Ability and ANOVA was used to test the significance of difference in relation to Metacognitive Ability levels.

Findings and Educational Implications of the study.

Findings of the study reveal that the PBL with Metacognitive Scaffolding is ;

- ❖ Significantly effective in enhancing Problem Solving Ability among higher secondary students,
- ❖ Significantly effective in enhancing Problem Solving Ability in relation to Metacognitive Ability.
- ❖ Significantly effective for Students with Above Average Metacognitive Ability than Average and Below Average Metacognitive Ability among Higher Secondary Students.
- ❖ Equally effective for Students with Average and Below Average Metacognitive Ability among Higher Secondary Students.

Findings of the present study are consistent with the earlier studies which states that the instructional material enhanced creative problem solving abilities, K.Lalithamika (2003). The findings of the present study can be used to improve the present educational practices in the class room to make the teaching and learning process more effective and meaningful. PBL with metacognitive scaffolding is one of the best methods to enhance Problem Solving Ability and multiple skills of the learners.

The present study specifically reveals that PBL is significantly effective in enhancing Problem Solving Ability among Higher Secondary students. The study also revealed that PBL with metacognitive scaffolding is significantly effective in enhancing Problem Solving Ability in relation to different Metacognitive Ability Levels. Students with Above Average Metacognitive Ability to be identified to enhance their Problem Solving Ability to the optimum level. Irrespective of learners' Metacognitive ability PBL with Metacognitive Scaffolding can be incorporated into the curriculum. It could be an effective method and strategy to enhance

academic performance and problem solving ability among students of all levels. PBL with Metacognitive Scaffolding can be used as effective method to improve cognitive and metacognitive skills of the learners at all levels of teaching learning process.

References

- Ango, M.L. (2002). Mastery of science process skills and their effective use in the teaching of science: an educology of science education in the Nigerian context. *International Journal of Educology*, 11-30.

- Behra, B. (2009). Problem solving skills in mathematics learning. *Edutracks*, 34.

- Eggen, Paul &Kauchack, Don (1999).Educational Psychology. Merril, Upper Saddle River, New Jersey, Columbus, Ohio.

- Englert, C.S., Raphael, T.E., Anderson, L.M. Antony H.E & Stevens, D.D. (1991). Making Writing Strategies and Self-talk Visible. Cognitive Strategy Instruction in Writing. *American Educational Research Journal*, 28, p.337-373.

- Hetherington Mavis, E. & Ross Parke, D. (1986). Child Psychology: A Contemporary View Point (3rd Ed.). Singapore: McGraw Hill Book Company.

- Inge, Molenaar; van Boxtel, Carla A. M.; Sleegers, Peter J. C.(2011). Metacognitive Scaffolding in an Innovative Learning Arrangement a study.*Instructional Science: An International Journal of the Learning Sciences*, v39 n6 p785-803.

- James, Loney and Okpala, Comfort. O., (2010). *Journal of College Teaching & Learning*, v7 n11 p 47-49.

- Kevin Downing, (2010). Problem-based Learning and Metacognition, *Asian Journal on Education & Learning*, Vol. 1(2), p 75-96.

- Kaur, N. P. (2015). Comparative Study of Problem Solving Ability among Senior Secondary School Students. *New Frontiers in Education* , 42-46.

- Molenaar, I. e. (2011, December). *htt://eric.ed.gov*. Retrieved February 14, 2014, from www.eric.gove.com: www.eric.gov.com

- Raes, Annelies, et al.,(2012). Scaffolding Information Problem Solving in Web-Based Collaborative Inquiry Learning. *Computers & Education*, v59 n1 p82-94 Aug 2012.

- ShirishBalya and PriyaKhimnani**,** (2011). Metacognition of Science stream B.ed.student Teachers in Relation to their Academic Achievement at Graduation level. *Educational Quest*, Vol.No.2, pp.231-235.

❖ Saini, M. K. (2013). Problem Solving Abilities of the Senior Secondary Commerce Students in Relation to their Enterpreneurial Talent. *Learning Community* , 29-35.

❖ Vijaya Kumari S.N and Jinto M. Effectiveness of KWL Metacognitive Strategy on Achievement in Social Science and Metacognitive Ability in Relation to Cognitive Styles.Int. J. Educat. Res. Technol. Vol 5 [1] March 2014: 92-98

❖ Winn, J.(1992).The Promises and Challenges of Scaffold Instruction. Paper Presented at the Annual Meeting of the American Educational Research Associations, San Francisco.