

Effectiveness of Problem Based Learning In Mathematics

R.D.Padmavathy

Research Scholar
School of Education
Pondicherry University

Mareesh .K

Assistant Professor
CK College of Education
Cuddalore.

Paper Received on: 16/01/2013

Paper Reviewed on: 19 /01/2013

Paper Accepted on: 22/01/2013

Abstract

The investigator makes an attempt to test the effectiveness of problem based learning (instructional method) in teaching the concepts of mathematics education at middle school level. Randomized control group pre test and post test experimental design was followed for the study. The sample consists of equal number (30) samples for both groups. The data were collected using appropriate tools and it was analyzed using mean, standard deviation and 't' test. Findings of the study revealed that problem based learning had effect in teaching mathematics and improve students understanding, ability to use concepts in real life.

Keywords: *Problem Based Learning, Mathematics*

Introduction:

The world we live where change is accelerating and where the need for mathematics as a way of representing, communicating and predicating events is increasing. In the century the important requirement is what we learn must be utilized in daily life to cope with dynamic competition. To face the situation we (teachers) want to produce critical thinking capabilities among the learners. Though there are many methods to teach mathematics in the world the only method being adopted by mathematics teacher is lecture method (instruction). Poor learning outcome is due to poor instructional strategy .This is an important problem in teaching mathematics, it creates difficulties, poor achievement and poor attitude towards mathematics among the learners. This was supported by Ogunbiyi (2004)¹ in his study it has been quoted "in most part of the world it has been discovered that lecture method or traditional expository method is being used by the mathematics teachers".

Antonoplos(1985)² and Stevenson (1987)³ in their studies showed the understanding the importance of mathematics , **superiority of Japanese** students in mathematics when compared with their counterparts from Sweden, Australia, England and the united states . Stevenson also explained that the Japanese teachers are enthusiastic in their classroom practices. They engage the attention of the pupils in discussion and debate on mathematics. The children were encouraged to make meanings and connections through discussion and

giving various meanings on the same idea or concept to be learnt (Stigler, Lee and Stevenson, 1987; Antonopoulos 1985). The length of hour put into mathematics teaching and learning was highest when compared with those other countries. The commitment has also justified their cultural belief in hard work for success in mathematics rather than innate ability (Abimbade, 2012)⁴.

To engage the attention of the learners our teachers must adopt some different method to teach mathematics which provide platform to learners to think, active, brainstorm and learning have come to the fore in discussions of classroom or transferable learning and gives motivation. The only economical method which provides all the above said is problem based learning (PBL) method. This article first describes different philosophy and methods of teaching mathematics and problem based learning (PBL) and goal of PBL and the advantages, secondly it provides evidence that PBL is effective for teaching mathematics by conducting experiment.

DIFFERENT PHILOSOPHY AND METHODS OF TEACHING MATHEMATICS

- **Idealistic** prescribed lecture, discussion, conversation, dialogue, question answer, argumentation etc.
 - **Realistic** emphasize scientific and objective method and emphasize heuristic, experimental, self experience, research and correlation method.
 - **Naturalistic and Pragmatists** emphasize learning by doing, learning by experience and learning by playing, observation, play way, Montessori, Dalton plan Arun Kumar Kulshretha, (2003)
 - **Fredrick (1995)**⁵ originator of kinder garden, placed emphasis on play, games, motor, expression, songs, language symbols, self activities and participation in the natural environment.
 - **Johann Heinrich Pestalozzi**⁶ (Father of Elementary Education) placed emphasis on the use of variety of activities in immediate environment for learning through observation, sense impression and investigation.
 - Plato's made use of dialectic and intuitive reasoning.
 - **Vittorino De Feltre**⁷ (Father of Secondary Education) placed great attention on individual difference and practical education.
 - **Herbert** (1986)⁸ introduced a new psychology of learning identified five formal stages preparation, presentation, comparison and abstraction, generalization and application.
 - Kilpatrick gave birth to project method.
- and the other different methods are** Enhanced mastery learning, advanced organizer, problem solving, demonstration, individualized teaching, laboratory method, Inductive –deductive, analytic –synthetic method, discovery method, lecture method, concept mapping, co-operative teaching, question and discussion, mental image, project method etc.

NEED FOR THE STUDY:

Students of today are challenged, they learn to learn on their own, available resources, understand more ideas, develop skills in many academic areas, and enjoy the course to a greater extent. What they need from us (teacher) is to act as facilitator and help them to identify what they know and need to learn and apply to solve the problem. Though there are many methods to teach mathematics, one of important method which facilitates metacognition and reasoning is Problem-based learning method. So the investigator felt the need to find whether there is any relative effectiveness of Problem-based learning and conventional method of teaching Mathematics.

PROBLEM BASED LEARNING IN MATHEMATICS

Problem-based learning began at McMaster University Medical School over 25 years ago. It has since been implemented in various undergraduate and graduate programs around the world. Additionally, elementary and secondary schools have adopted PBL. The PBL approach is now being used in few community colleges also. Problem-Based Learning (PBL) describes a learning environment where problems drive the learning. That is, learning begins with a problem to be solved, and the problem is posed in such a way that students need to gain new knowledge before they can solve the problem. Rather than seeking a single correct answer, students interpret the problem, gather needed information, identify possible solutions, evaluate options, and present conclusions. Proponents of mathematical problem solving insist that students become good problem solvers by learning mathematical knowledge heuristically. Students' successful experiences in managing their own knowledge also help them solve mathematical problems well (Shoenfeld, 1985; Boaler, 1998)⁹. Problem-based learning is a classroom strategy that organizes mathematics instruction around problem solving activities and affords students more opportunities to think critically, present their own creative ideas, and communicate with peers mathematically (Krulik&Rudnick,1999; Lewellen&Mikusa,1999; Erickson,1999; Carpenter et al., 1993; Hiebertetal.,1996; Hiebertetal.,1997)¹⁰.

THE STEPS OF PROBLEM BASED LEARNING

- 1) Explain unknown wording, statements and concepts
- 2) Define the problem(s)
- 3) Brainstorm – analyze/try to explain the problem(s)
- 4) Formulate Learning Issues and Define Action To Be Taken
- 5) Self Directed Learning.
- 6) Subsequent Group Meetings: Report and evaluate on self-directed learning. Refine learning issues and define further action.
- 7) Report Phase. Resolution of problem. Evaluation of process.

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 (Barrows and Kelson, 1995)¹¹. It is designed to help students

- 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. (Hmelo-Silver,2004)

OBJECTIVES OF THE STUDY

The objective of the study is to find out the relative effectiveness of Problem Based Learning and Conventional Method of teaching mathematics.

HYPOTHESIS OF THE STUDY

1. There is no significant difference between the Problem Based Learning (PBL Experimental) group and Conventional (Control) group in the pre test.
2. There is no significant difference between the pre test and post test scores of Conventional (Control) group.
3. There exists a significant difference between the pre test and post test scores of Problem Based Learning (PBL Experimental) group.
4. There exists a significant difference between the Problem Based Learning (PBL Experimental) group and Conventional (Control) group in the post test.
5. There is no difference between boys and girl students in the group taught by PBL method

METHODOLOGY

The group pretest and post –test experimental design was followed.

VARIABLES OF THE STUDY

- Independent variable – problem based learning method
- Dependent variable - achievement of school children in post test.

POPULATION OF THE STUDY

In this design two groups are measured not only after being exposed to treatment of some sort but also before treatment. The experimentation was conducted to VIII standard students. The students were selected on the basis of their achievement in the pre-test. The students were divided into 2 groups viz Conventional & Problem Based Learning using the groups is matched for mean and standard deviation. Thus both group consisted of 30 students each.

INSTRUMENTATION

The instrument used for data collection was self constructed achievement test to measure the achievement levels of the student with duration of 45 minutes. It consists of 12 items in three types (fill in the blanks, five short questions and two detail questions).

ANALYSIS AND INTERPRETATION OF DATA

The following table shows the data on pre-test and post-test performance of the control group and experimental group and also the significant difference in the achievement scores of the students of various groups in detail

Table 1: Achievement Scores (Pre-Post Test) of Conventional and PBL Method

Groups	N	Pre Test		Post Test		Post Test (Boys)		Post Test (Girls)		“t” value
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Control Group (Conventional)	30	14.53	2.9	15.46	2.41	15.26	2.44	15.81	2.44	1.43 Not Significant at 0.05 level
Experimental Group-(PBL)	30	14.86	2.5	17.33	2.27	17.05	2.60	17.69	1.79	5.20 significant at 0.05 level
“t” value		0.49	Not Significant at 0.05 level	3.40	significant at 0.05 level					

To interpret the raw scores the data were analyzed using the descriptive and differential analysis

H₀ 1: The groups are matched for mean and standard deviation. The calculated t-value is 0.49 less than the table value 1.99 at 0.05 and the null hypothesis is accepted ,this reveals that the there is no significant difference between Problem Based Learning(PBL) experimental group and the conventional control group achievement in their pre-test.

H₀ 2: The mean and standard deviation of conventional group pre test is 14.53 and 2.9 and the mean and standard deviation of conventional group post test is 15.46 and 2.41. The calculated t-value is 1.43 which is less than the table value 1.99 at 0.05 and the null hypothesis is accepted ,this reveals that the there is no significant difference between conventional (control) group pre test and the conventional (control) group post test. There is no significant gain in the post test achievement of students in the conventional control group after teaching through conventional method.

H₁ 3: The mean and standard deviation of Problem Based Learning (PBL) experimental group pre test is 14.86 and 2.5 and the mean and standard deviation of post test is 17.33 and

2.27. The calculated t-value is found to be 5.20 which are greater than the table value 1.99 at 0.05 and the research hypothesis is accepted. Therefore there exist a difference between pre test and the post test scores of experimental group. This shows students in the experimental group significantly scored high in achievement test when compared to pre test.

H₁ 4: The mean and standard deviation of conventional group is 15.46 and 2.41 in the post test and the mean and standard deviation of Problem Based Learning (PBL) experimental group post test is 17.33 and 2.27. The calculated t-value is found to be 3.4 which are greater than the table value 1.99 at 0.05 and the research hypothesis is accepted. Therefore there exists a difference between conventional group and experimental group in their post test. This show a student who receives one month problem based learning has done well in achievement test than students in control group.

H₀ 5: The mean and standard deviation of Problem Based Learning (PBL- experimental)group post test score of boys are is 17.05 and 2.60 and the mean and standard deviation of Problem Based Learning (PBL-experimental) group post test scores of girls is 17.69 and 1.79. Thus we can conclude that the boys and girls were equally got benefited by problem based learning method.

CONCLUSION

The major finding of the study reveals that PBL method of teaching is more effective for teaching mathematics. By adopting PBL method in teaching mathematics teacher can create a number of creative thinkers, critical decision makers, problem solvers which is very much needed for the competitive world. And also Problem based learning instructional strategy had a effect on content knowledge which provides greater opportunities for the learners to learn a content with more involvement and increase the students active participation, motivation and interest among the learners. This leads the learners to have a positive attitude towards mathematics and help them to increase their achievement to a large extent and which will lead to long term memory. It gave a new and desirable kind of experience for the students.

REFERENCES:

- Arun Kumar Kulshretha,(2003) ,*Teaching of Mathematics*, Lall Book Depot, Meerut .
- Abimbade, A and Afolabi, S.S.(2012), *A Study of Pedagogical Approach of Mathematics Teaching In Southwestern States Of Nigeria*. International Journal of Asian Social Science vol 2,no 8,pp 1182-1192. (Johann Heinrich Pestalozzi andVitterine De Feltre)
- Antonoplos, D.P.(1985),*Students characteristics learning and curriculum in Japan*.Washington DC, Office of Educational Research and Improvement (ed.)
- Barrows, H.,and Kelson, A. C. (1995), *Problem-Based Learning in Secondary Education andthe Problem-Based Learning Institute* (Monograph 1), Problem-Based Learning Institute, Springfield, IL.
- Boaler, J. (1998),*Open and closed mathematics: student experiences and understandings*. "Journal for Research on Mathematics Education," 29 (1). 41-62.Carpenter, T., Ansell, E. Franke, M, Fennema, E., & Weisbeck, L.

- (1993). Models of problem solving: A study of kindergarten children's problem solving processes. "Journal for Research in Mathematics Education," 24 (5). 428-441.
- Erickson, D. K. (1999), *A problem-based approach to mathematics instruction*,
 - "Mathematics Teacher," 92 (6). 516-521
 - Fredrick , J. (1995), *Psychology ,Science and Understanding* , McGraw-Hill Companies.
 - Herbert , W.(1986),*Psychology ,The Hybrid Science*,5th ed, Chicago.
 - Schoenfeld, A. H. (1985),*Mathematical problem solving*, New York: Academic Press
 - Hiebert, J. Carpenter, T. P., Fennema, E., Fuson, K., Human, P., Murray, H., Olivier, A., & Wearne, D. (1997), *Making mathematics problematic: A rejoinder to Prawat and Smith*. "Educational Researcher," 26 (2). 24-26.
 - Hmelo-Silver, E. (2004), *Problem-Based Learning: What and How Do Students Learn?*, Educational Psychology Review, Vol. 16, No. 3. pp235-266. 1040-726X/04/0900-0235/0 C ° 2004 ,Plenum Publishing Corporation.
 - Kilpatrick, W. H. (1918). *The project method*. Teach. Coll. Rec. 19: 319–335.
 - Krulik, S., & Rudnick, J. A. (1999), *Innovative tasks to improve critical- and creative-thinking skills*. In I. V. Stiff (Ed.), "Developing mathematical reasoning in grades K-12." Reston. VA: National Council of Teachers of Mathematics. (pp.138-145).
 - Lewellen, H., & Mikusa, M. G. (February 1999),*Now here is that authority on mathematics reform, Dr. Constructivist!* "The Mathematics Teacher," 92 (2). 158-163.
 - Tamilnadu State Board Syllabus Mathematics book from 6 to +2.
 - Ogunbiyi, O. (2004), *New Challenges in the methodologies of teaching:A case for inservice programme for school teachers*.*Teachers mandate on education and social development inNigeria*,D.F.Elaturoti and A.Babarinde Eds., Nigeria.Stirling-Horden Publishers, pp 152-157.
 - Stevenson,M.C.(1987), *The Asian Advantage: The case of mathematics*, American educator. Vol 11,No 4, pp 26-31.