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Effectiveness of PBL Programme on Achievement in Mathematics Application Skill

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Abstract

The present study is experimental nature. The objectives of the study as: (1) To construct PBL Programme of Mathematics in Primary School, (2) To study the effectiveness of PBL Programme on Achievement of Mathematical Application Skill in Primary School boys and (3) To study the effectiveness of PBL Programme on Achievement of Mathematical Application Skill in Primary School girls. The students studying in Gujarati medium primary schools in Gujarat was considered as population of the study. The investigator were selected eighth standard students of two primary schools in Mota-vadala as sample in which one boys and one girls. The two groups of boys were formed for experiment. Twenty students were selected for experimental group as well as control group. Similarly separate two groups of girls will also select for the same treatment. Hence 40+40=80 sample students were selected for experimental purpose. Experimental type research Programme was used. The investigator selected True-experimental design namely "Randomized two group post-test only experimental design". In the present study the investigator constructed standardized Achievement test of Mathematics was used. To find out significant of difference between scores on Achievement test of Mathematics of two groups, statistical technique t-test was used. For that M and SD of Achievement of Mathematical Application Skill scores on post-test (Achievement test of Mathematics) of both groups were calculated. The study revealed that (1) The boys of PBLP-group is more effective than CP-group after Problem Based Learning Programme with reference to Achievement of Mathematical Application Skill and (2) The girls of PBLP-group is more effective than CP-group after Problem Based Learning Programme with reference to Achievement of Mathematical Application Skill

Key words: Problem Based Learning Programme, Mathematical Application Skill

Introduction

Problem-based learning (PBL) is an instructional method that challenges students to "learn to learn," working cooperatively in groups to seek solutions to real world problems. These problems are used to engage students' curiosity and initiate learning the subject matter. PBL prepares students to think critically and analytically, and to find and use appropriate learning resources (Duch, 1995).PBL is “an active learning method that starts from a specific problem. It is unclear whether PBL enhances knowledge and skills of students, and whether it increases student motivation and satisfaction. The effectiveness of PBL in terms of increasing student knowledge and skills has been extensively studied in the academic literature for higher education students (particularly in medicinal education programs). Whereas some of the studies reported positive effects of PBL on student test scores, other studies found that PBL-teaching offers no considerable advantages to students in terms of higher gain in knowledge and/or skills. With respect to the effect of PBL on student satisfaction, results show that students in a problem-based learning track are overall more satisfied with their teaching than students in the conventional track. So an important question remains regarding the mathematics education of high ability students: What strategies can be used to challenge these students and foster achievement? Research indicates that students with mathematical-giftedness achieve the most academic gain when presented with curriculum that contains higher order thinking probes; inquiry-based instruction; scaffolding and small group activity; prompts that require problem-solving and reasoning; elaboration; and real-world applications (Erickson, 1999; Gavin et al., 2009; Rotigel & Fello, 2004; VanTassel-Baska, 2013). One such pedagogical technique that combines many of these attributes is problem-based learning (PBL).Recent studies on Effectiveness of PBL Programme on Achievement of Mathematical Application Skill.

Literature Review

Problem based learning encourages students to think and solve problems in a limited amount of time (Cotton, 2011) and provides authentic experiences that foster active learning, support knowledge construction, and naturally integrate school learning and real life (Torp & Sage, 2002). Problem based learning, as an instructional model is receiving increased attention from educational practitioners. The model has developed rapidly in medical school programs since 1980. It is characterized by students’ working in small groups to increase knowledge and develop understanding by identifying learning objectives, engaging in self-directed work, and participating in discussions (Barrows & Tamblyn, 1980). It has become a popular mode of delivery in medicine, nursing, and engineering, but far less so in physics. Only in the last decade or so has the teaching of physics through PBL begun to take root (Raine & Collett, 2003). Compared with many pedagogical approaches problem-based learning has emerged relatively recently, being popularized by Barrows and Tamblyn (1980) following their research into the reasoning abilities of medical students at McMaster Medical School in Canada. Barrows and Tamblyn’s study and the approach adopted at McMaster marked a clear move away from problem-solving learning in which individual students answer a series of questions from

information supplied by a lecturer. Rather, this new method they proposed involved learning in ways that used problem scenarios to encourage students to engage themselves in the learning process, a method to become known as problem-based learning. In this early version of problem-based learning certain key characteristics were essential. Students in small teams1 would explore a problem situation and through this exploration were expected to examine the gaps in their own knowledge and skills in order to decide what information they needed to acquire in order to resolve or manage the situation with which they were presented. Aim of PBL is to apply critical thinking, problem solving skills, and content knowledge to real-world problems and issues (Levin, 2001) and to develop self-directed, reflective, lifelong learners who can integrate knowledge, think critically, and work collaboratively with others (Barrows, 1996). The advantage of PBL is that students become more aware of how they can put the knowledge that they are acquiring to use (Hallinger & Lu, 2011). During the past few years, physics education research has primarily focused on students' understanding of conceptual physics and the misconceptions that hinder the learning process (Campbell, 2008). The traditional approach to concept teaching consists of the following steps; giving the student the word that expresses the concept, specifying the definition of the concept and identifying and distinguishing qualities needed to understand the definition, to ensure that students find examples related and unrelated to the concepts. This traditional approach is not effective enough in the learning of concepts (Çepni et al., 1997). This is because it is not enough that a student can only identify and memorize the concepts in order to understand concepts and the relationship between these concepts. Instead of this, proper learning environments should be created for students where they can study and invent their scientific knowledge as scientists. Thus the student, without the need to memorize knowledge, will gain the ability to conceptualize learning. One of the approaches targeting learning through own experience and discovering knowledge is Problem Based Learning - PBL- (Taşkesenligil, Şenocak & Sözbilir, 2008). PBL is informed in sessions within which there are small collaborative groups comprised of 6 or 8 students with guidance from a tutor .They deal with scenarios involving several problems (Akınoğlu & Tandoğan, 2007) that are authentic, complex, ill-structured problems to help students make connections between theory and real-world application, as well as develop their ability to handle the complexity of real world (Hung, 2013).

Objectives of the study

Objectives of the study were:

1. To construct PBL Programme of Mathematics in Primary School.
2. To study the effectiveness of PBL Programme on Achievement of Mathematical Application Skill in Primary School boys.
3. To study the effectiveness of PBL Programme on Achievement of Mathematical Application Skill in Primary School girls.

Variables involved in the study

Two types of variables were involved the study: (1) Independent variable and (2) Dependent variable.

Independent Variable. The independent variable of present study was instructional Programme. Two level of Instructional Programme: (1) PBL Programme and (2) Conventional Programme (CP).

Dependent Variable. The dependent variables of present study were Scores of Achievement of Mathematical Application Skill.

Operational definitions of terms

Operational definitions of terms as:

Problem Based Learning (PBL). The tenets of PBL are based in constructivist and sociocultural theories; students construct knowledge through a social context. The peer group and the teacher serve as scaffolds in order to facilitate the activation of prior knowledge and higher-order thinking (Gavin et al., 2009; Henningsen & Stein, 1997). In addition, there are two cognitive theory hypotheses as to why PBL is effective – the activation-elaboration hypothesis and the situational interest hypothesis. In the activation-elaboration hypothesis, PBL serves to activate prior knowledge and identify gaps in what the student already knows.

PBL Programme. The PBL Programme consists of ten main phases which are:

Phase-1: Review of objectives
Phase-2: Presentation of the "ill-structured" problem or scenario
Phase-3: Assigning roles
Phase-4: Developing a problem statement from the students' analysis of what they do and do not know
Phase-5: Listing possible actions, recommendations, or solutions
Phase-6: Preparing for self-directed learning
Phase-7: Listing information, resources, processes, etc. needed to solve the problem
Phase-8: Accessing, evaluating, learning, and utilizing information
Phase-9: Presenting and supporting the learning and re-addressing the problem
Phase-10: Assessment

Achievement of Mathematical Application Skill. The scores achieved by the learner on the Achievement test of Mathematics prepared by the investigator.

Hypotheses of the study

With reference to objective the null hypotheses were framed as:

H_{01} There was no significant difference between the average scores on Achievement of Mathematical Application Skill test in PBLP-group and CP-group of Primary School boys.

H_{02} There was no significant difference between the average scores on Achievement of Mathematical Application Skill test in PBLP-group and CP-group of Primary School girls.

Population & sample

The students studying in Gujarati medium Primary schools in Gujarat was considered as population of the study. The investigator were selected eighth standard students of two primary schools in Mota-vadala as sample in which one boys and one girls. The two groups of boys were formed for experiment. Twenty students were selected for experimental group as well as control

group. Similarly separate two groups of girls will also select for the same treatment. Hence 40+40=80 sample students were selected for experimental purpose.

Research design

The investigator selected True-experimental design namely "Randomized two groups post-test only" experimental design.

Time Period of the Experiment

Two groups in which PBL Programme (PBLP) was conducted in PBLP group as experimental group and other CP group as control group. The experiment was conducted in second term of the academic year 2016-2017. The experiment was continued for fifteen days. Thirty minutes time duration of each period.

Tool of the study

In the present study the investigator in order to trace out students Achievement of Mathematical Application Skill by standardized Achievement test of Mathematics was prepared. The minimum score can be zero and maximum score can be 30.Time duration of Achievement test of Mathematics was 30 minutes.

Formation of Groups

The sample schools were selected by purposeful sampling technique. The students were identified from primary school students (boys and girls) of Mota-vadala with the help of selected technique. The two groups of boys and girls from selected Mota-vadala were formed for experiment. Twenty boys and girls were selected for experiment in each group (experiment group) and twenty boys and girls were selected for consensual in each group (Control group).

Data collection

Achievement of Mathematical Application Skill test was administered after the experiment. The student's scores on the Achievement test of Mathematics were recorded.

Statistical technique used of analysis of the data

The data were analyzed by statistical technique mean and SD and testing the null hypotheses by t-test.

Results and discussion

Results and discussion of the present study were as:

Effectiveness of PBL Programme on Achievement of Mathematical Application Skill in Primary School boys

The results of Mean, SD and t-value of after Problem Based Learning Programme in PBLP-group and CP-group of Primary school students' boys on Achievement of Mathematical Application Skill are presented in Table-1.

Table-1

Mean, SD and t-Value after Problem Based Learning Programme in PBLP-Group and CP-Group boys on Achievement Test of Mathematics

Students	Group	N	Mean	SD	df	t-value	p
Boys	PBLP	20	50.10	8.43	38	20.18	p<0.01
	CP	20	20.21	7.21			

The Table-1 presents a significant difference between ABLP-group and CP-group boys. The PBLP -group boys were found having significantly better Problem Based Learning Programme as compared to their CP-group boys (t=20.18, df=38, p <0.01).Thus the null hypothesis H_{01} "There was no significant difference between the average scores on Achievement test of Mathematics in PBLP-group and CP-group of Primary School boys" was rejected. It means the boys of PBLP-group should show more effective than those the boys of CP-group.

Effectiveness of PBL Programme on Achievement of Mathematical Application Skill in Primary School girls

The results of Mean, SD and t-value of after Problem Based Learning Programme in PBLP-group and CP-group of Primary school students' girls on Achievement of Mathematical Application Skill are presented in Table-2.

Table-2

Mean, SD and t-Value after Problem Based Learning Programme in PBLP-Group and CP-Group girls on Achievement Test of Mathematics

Students	Group	N	Mean	SD	df	t-value	p
Girls	ABLP	20	59.98	8.98	38	25.10	p<0.01
	CP	20	22.31	6.68			

The Table-2 presents a significant difference between ABLP-group and CP-group girls. The ABLP-group girls were found having significantly better Problem Based Learning Programme as compared to their CP-group girls (t=25.10, df=38, p<0.01).Thus the null hypothesis H_{02} "There was no significant difference between the average scores on Achievement test of Mathematics in ABLP-group and CP-group of Primary School girls" was rejected. It means the girls of ABLP-group should show more effective than those the girls of CP-group.

Conclusions

Conclusions were as under:

1. The boys of ABLP-group is more effective than CP-group after Problem Based Learning Programme with reference to Achievement of Mathematical Application Skill.
2. The girls of ABLP-group is more effective than CP-group after Problem Based Learning Programme with reference to Achievement of Mathematical Application Skill.

Research implication

Research implications were as under:

1. The result of the study has proved that the Problem Based Learning Programme on ABLP-group is more effective than the CP-group. So the teacher should use Problem Based Learning Programme in classroom.
2. Appropriate training for teachers to use Problem Based Learning Programme to teach Mathematics would enhance the active learning.
3. Keeping the result of study in mind the NCTE, CTE, GCERT and DIET should take up the work to teacher by Achievement of Mathematical Application Skill.
4. Preparation of a teacher's guide accompanying the Mathematics textbooks containing the executive steps and activities of the instructional model would help them to adopt such model.
5. Teachers of middle schools and high schools can be given orientation as how to teach Achievement of Mathematical Application Skill.

References

Ali, R., Hukamdad, Akhter, A., & Khan, A., 2010. Effect of using problem solving method in teaching mathematics on the Achievement of Mathematical Application Skill students. *Asian Social Science, 6*, 67-72. Retrieved from: www.ccsenet.org/ass

Becerra-Labra, C., Gras-Martí, A., & Torregrosa, M. J., 2012, Effects of a Problem-based Structure of Physics Contents on Conceptual Learning and the Ability to Solve Problems. *International Journal of Science Education, 34*(8), 1235-1253. doi:10.1080/09500693.2011.619210

Boud, D. & Feletti, G. (Ed.), 2001, *The challenge of problem-based learning* (2nd ed.). London: Kogan Page.

Boyce, L. N., VanTassel-Baska, J., Burruss, J. D., Sher, B. T. & Johnson, D. T., 1997, A problem-based curriculum: Parallel learning opportunities for students and teachers. *Journal for the Education of the Gifted*, 20 (4), 363-379.

Clarke, D., Breed, M., & Fraser, S., 2004, The consequences of a problem-based mathematics curriculum. *The Mathematics Educator, 14*, 7-16.

Diggs, L.L., 1997, Students' attitude toward and achievement in science in a problem based learning educational experience. PhD dissertation, University of Missouri-Columbia, Columbia, MO.

Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D., 2003, Effects of problem-based learning: a meta-analysis. *Learning and Instruction, 13*, 533-568. doi: 10.1016/S0959-4752(02)00025-7

Duch, B. J., Groh, S. E., & Allen, D. E. (Eds.). 2001, *The power of problem-based learning.* Sterling, VA: Stylus Publications.

Duck, K. D., 2014, *The Effects of Problem-Based Learning on Interest in Mathematics for Elementary Students Across Time* (Unpublished graduate thesis). Western Kentucky University, Bowling Green, KY.

Erickson, D. K.. 1999, A problem-based approach to mathematics instruction. *The Mathematics Teacher*, *92*, 516-521.

Gallagher, S. A., & Stepien, W. J., 1996, Content acquisition in problem-based learning, depth versus breadth in American studies. *Journal of Education and Gifted, 19*(3), 257–275.

Gavin, M. K., Casa, T. M., Adelson, J. L., Carroll, S. R., & Sheffield, L. J., 2009, The impact of advanced curriculum on the achievement of mathematically promising elementary students. *Gifted Child Quarterly, 53*, 188-202. doi:10.1177/0016986209334964

Henningsen, M., & Stein, M. K., (1997, Mathematical tasks and student cognition: Classroom-based factors that support and inhibit high-level mathematical thinking and reasoning. *Journal for Research in Mathematics Education, 28*, 524-549.

Hmelo, C. E. & Ferrari, M., 1997, The problem-based learning tutorial: Cultivating higher order thinking skills. *Journal for the Education of the Gifted*, 20 (4), 401-422.

Hmelo-Silver, E., 2004, Problem-Based Learning, What and How Do Students Learn? *Educational Psychology Review, 6*(3).

Inman, T. F., 2011, *The Effects of Problem-Based Learning in Math and Science on High Potential Elementary School Students* (Unpublished doctoral dissertation). Western Kentucky University, Bowling Green, KY.

Oon Seng, T., Little, P., Hee, S. Y., & Conway, J., 2000, *Problem-based learning: Educational innovation across disciplines.* Hong Kong: Temasek Centre for Problem-Based Learning.

Roh. K. H., 2003, Problem-based learning in mathematics. Eric Digest 482725. ERIC Clearing House for Science, Mathematics, and Environmental Education, 1-7. Retrieved from: www.ericdigest.org/2004-3/math.html

Rotigel, J. V., & Fello S., 2004, Mathematically gifted students: How can we meet their needs? *Gifted Child Today, 27*, 46-51, 65. doi: 10.4219/gct-2004-150.

Savin-Baden, M., 2000, *Problem-based learning in higher education: Untold stories.* Buckingham: Open University Press.

Schmidt, H. G., Loyens, S. M., van Gog, T., & Paas, F., 2007, Problem-based learning is compatible with human cognitive architecture: Commentary on Kirschner, Sweller, and Clark (2006). *Educational Psychologist, 42*, 91-97.

Schmidt, H. G., Rotgans, J. I., & Yew, E. H. J., 2011, The process of problem-based learning: What works and why. *Medical Education, 45*, 792-806. doi: 10.1111/j.1365-2923.2011.04035.x

Selcuk, G. S., 2010, The effects of problem-based learning on pre-service teachers' achievement, approaches and attitudes towards learning physics. *International Journal of the Physical Sciences, 5(*6), 711-723.

Selcuk, G. S., Çaliskan, S., & Şahin, M., 2013, A Comparison of Achievement in Problem-Based, Strategic and Traditional Learning Classes in Physics, *International Journal on New Trends in Education and Their Implications, 4*(1).

Stepien, W. J., & Pyke, S. L., 1997, Designing problem-based learning units. *Journal for the Education of the Gifted*, 20 (4), 380-400.

Strobel, J., & van Barneveld, A., 2009, When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. *Interdisciplinary Journal of Problem-Based Learning, 3*, 44-58. doi: 10.7771/1541-5015.1046

Sungur, S., 2006, Effects of Problem-Based Learning and Traditional Instruction on Self-Regulated Learning*, Journal of educational, 99*(5).

VanTassel-Baska, J., 2013, Curriculum issues: Curriculum, instruction, and assessment for the gifted: A problem-based learning scenario. *Gifted Child Today, 36*, 71-75. doi: 10.1177/1076217512465289