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ENHANCING PROBLEM-SOLVING SKILLS OF STUDENTS THROUGH ACTIVITY BASED SCIENCE TEACHING: AN EXPERIMENTAL STUDY

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Abstract

The classroom learning should be such which may develop the required skills and fulfil the needs of the 21st century learners. Our education policies are aimed at achieving these need-based objectives of the society, favors the development of skills which are essential for the future, though they are not effectively implemented in our classroom. UNESCO has also identified the essential skills which are required in the 21st century. Problem solving skill is one among them which has become not only important but also has grown more and more imperative for our society. This study tried to fill the gap between what is needed and what is happening in the development of such an important skill. For this an intervention program was developed that was Problem Solving skill embedded task-basedclassroom activities. The aim of the study was to show the effect of an intervention program that includes classroom-task based activities on the development of problem solving skill among elementary class students. This study reveals how to develop problem solving skill with the help of activity-based science learning. The study was conducted on 70 students (35 experimental group & 35 control group) belonging to 8th grade studying in an English medium public school in Ghaziabad district. The study was conducted in the year 2018-19. It was a quasi-experimental design with non-equivalent groups and pretest- posttest design, where two intact sections were taken as a control group and experimental group. The experimental group was taught through the intervention program and the control group was taught through the traditional teaching method. After analyzing the data, it was found that activity-based science learning positively effects in developing problem-solving skill among students of elementary class. It was also found that gender doesn't create any differences in the development of problem-solving skills.

Keywords: *Problem solving skill, Activity based learning*

Introduction

20th century dealt with the literacy alone and producing working labours. But the 21st century needs cannot be fulfilled by literacy alone. There must be an entry of vital life skills in the education policy. All the education policies reflect the needs of the society.UNESCO has also identified the essential skills which are required in the 21st century citizens. These skills help in developing their thinking skills and change their attitude. In other words, it broadens the aspects of the views of the new generation. It is aptly said by world's greatest

scientist, Albert Einstein that *"Education is not the learning of facts, but the training of the mind to think."*

We are very much concerned about our child's education and we train our children in a way to prepare them for the competitive world out there. Our idea of change is right but the way to implement those changes is not, because we still judge a child by his/her memorizing power and how better he memorizes than the other. Our Judgement based on their power of rote learning is going to spoil the future of the child. The world is changing rapidly, where knowledge creation is tremendous and very fast and so is the change in society. The '3 R's (reading, writing and arithmetic) alone can't help our students and cannot build their career. Einstein also pointed out that "we cannot solve problems using the same kind of thinking we used when we created them." We need to develop and learn new ways of solving the emerging problems and issues.

UNESCO science report towards 2030 also emphasizes the demand of requisite skills for the 21st century.TheNational Education Association (NEA) in their manual, given stress on the importance of the "Four C's (critical thinking, creativity, communication and collaboration)" and gives strategies to bring it into the classrooms.

In recent times, there was a huge impact of scientific and technological developments on the lives of even the common man. These scientific and technical development compel to change the style of traditional teaching in schools. In the past few years school education has also seen changes in their system. Though the government of India has made so many significant changes in the educational system, yet the teachers in Indian schools, however, remains ignorant of these changes and not taking any effort and are practicing the same old teacher-centered approach.

A person having an attitude and ability of critical thinking and problem solving, uses the habit of interpretation, analysis, evaluation, inference drawing and evaluating the given information or evidence which results into the unbiased decision or judgement (Kowalczyk, Hackworth & Smith, 2012).

If we talk about the purpose of science education, our 1986 Indian National Policy on Education already recommends the development of enquiry skill, problem solving skill, decision making skills and ability to ask questions. National curriculum framework 2005 has also emphasizes the cultivation of critical thinking skills in the present scenario (NCF 2005).

Problem solving skill

Mary Kay Utech has rightly remarked, *"It's not a Problem that we have a Problem. It's a Problem if we don't deal with the problem."* The problem is a problem till we cannot understand it and it exists until we solve it. The problem remains until the solution is found. The approach of problem solving in our lives is of utmost importance because we must face problems in our daily life which makes us desperate and frustrated if we do not get their solution. However, after learning the problem solving skills, it not only changes the way of seeing our problem but also bring changes in the views of living life.

Problem solving is a journey which includes step- by- step planned strategy, to reach the destination. It is a purposeful mental process that involves discovering, analyzing, using reasons or logics and finding solutions that best resolve the issue. While solving any problem one must be systematic and logical in his approach. Problem solving approach is a process where one uses his previous knowledge and skills according to his own understanding in unfamiliar situations. Krulik and Rudnick (1980, p.4), also favour this; they said "one must synthesize his learnt knowledge and use it to a different and new circumstances".

Bransford in 1993 suggested 5 steps for problem solving skills known as 'IDEAL' where: "**I-identifying** the problem, **D-defining** the problem and determining relevant information, **E**- explore alternative solutions by brainstorming and for examining the problem, different points of view was used, **A**-act on the strategies to find the solution, and **L**-look back to evaluate the results.

Another approach called 'PACE' was suggested by Campel in 1995 in order to solve problems, step- by- step. Where, **P** stands for problem identifying, **A**- alternative solutions, **C**-consequences, **E**- evaluating and selecting the most appropriate solution.

The above explanations suggest that problem solving is a step-by-step planned strategy to reach the desired destination. A good problem solver has the following abilities"

- Ability to diagnose/identify the root cause of the problem
- Art of generating multiple solutions in the form of hypothesis
- Capable to make accurate planning and develops the habit of moving in a step-by-step process
- Development of positive attitude towards the problem or situation
- Centre of contemplation of students thought focused on the solution rather than the problem ("Don't find fault... find a remedy".-Henry Ford)

- Acceptance of challenges and ready to find out the solution
- Evaluate the multiple options and select the best one
- Building confidence among students. Look forward to every moment and very much sure or confident that there is a solution to every problem.
- Taking decisions firmly and ready to accept the consequences of the result
- Ability of acceptance of failure and learn from mistakes.
- Keep on striving continuously until you reach the best possible solution according to the given situation.

Other than the qualities described above, a problem solver also has a good control on self, become an expert in time management, increase in sociability, focused, think multidimensional, construct new knowledge, generate good options, decisions are well planned and well executed and develop deeper perspective. Some problems are complex and need analysis in order to avoid irrational decisions (based on emotions). Here in Problem solving, critical thinking is merged within and helps to bring out fruitful decisions, based on evidence that can be justifiable.

Activity based science learning

Activity based science learning is a term which is used to denote such task oriented strategies in teaching-learning process that engages the students in active learning. Activity based learning turns the students:

- From passive learner to active recipient
- To think deeply
- To analyse the situation
- Evaluate the information on the basis of evidences and experiences which in turn reflected into a fruitful result
- Independent and responsible thinker

Students have a better attitude and utmost interest towards the activity based approach than the traditional approach (lecture cum discussion method). John Mac Peckwas the first who recommended the conception of an integrated approach in his book "*critical thinking and education*" (1981). He said that critical thinking should never be taught alone as a distinct subject. Peter A. Facione also emphasized on the use of strategies in teaching for building intellectual character rather than developing only cognitive skills (Peter A. Facione, 2000). Sivan et al. (2000) find out that there is a contribution of active learning in the development

of qualities like problem solving and critical thinking skill and also to become self-managed learner. Activities gave students a sense of being in control of their own learning. It develops corporation, rewarding, gives personal attention to the learning and social problems of the students. So the activity based approach can fulfill the gap in teaching and learning process by improving the quality of instruction. Bain(2004, p.88) favours the use of strategies (like class discussions, projects or papers) to develop the ability to express and defend ones point of views in the learning environment.

Objective of the study

1. To study the effectiveness of 'activity-based science learning' on problem solving skill among students of elementary class.
2. To study the effectiveness of 'activity-based science learning' on problem solving skill among students of elementary class with respect to gender.

Hypothesis

1.**$H0_1$**There is no significant difference in the mean levels of problem solving skill between the students belonging to experimental group and the control group at pre-test level for the total sample**.**

2.**$H0_2$**There is no significant difference in the mean levels of problem solving skill between the students belonging to experimental group and the control group at post-test level for the total sample.

3.**$H0_3$**There is no significant difference in the mean levels of problem solving skill between the students belonging to experimental group and the control group at post-test level with respect to gender.

4.**$H0_4$** There is no significant difference between the mean levels of problem-solving skill of the experimental group and the control group for the total sample with the adjusted means at post-test level.

Variables

There were two variables in this study. One was an independent variable (I.V.) and the other was dependent variables (D.V.).

Independent variable (I.V.)

The independent variable was Intervention program ('activity based teaching-learning' lesson plan) developed by the researcher.

Dependent Variable (D. V.)

The dependent variable wasProblem Solving Skill of elementary class students (class VIII students in this experiment).

This study investigated and find out the effect of independent variable (Activity Based Science learning) on the dependent variables (Problem solving skill of Elementary class Students).

Population

Population for the present study constitutes the students studying in class 8th of all types of Public Schools regulated under CBSE board in Ghaziabad district. Area of research was basically from upper primary school, confined to 8th class.

Sample of the study

Keeping in mind the objectives of the study, sampling was done at two stages. At first stage one school was selected purposively and as per the convenience of the researcher. In the second stage, random sampling technique was adopted to draw two intact sections of 8th class for the study. The students in these two sections were not equated under any ability. For the study, total sample was of seventy (70 students), 35 students in each section.

From the above randomly selected two sections, one section was randomly assigned to experimental group and another one as a control group.

Operational definitions of key terms:

Activity: Here the term activity means those task-based strategies in teaching-learning process, which develop the power to think and understand. In Activity-based module, activity actually refers to the question-based situations which engage children in thinking process. Activity of self-questioning promotes higher thinking. Heward (2013),also support the self-questioning by considering it as a type of self-management strategy which helps in bringing change in behaviour, helpful in completing the task effectively and gaining more understanding etc. Activities based on the problem solving skill include different types of thought provoking statements, questions in the form of puzzle, fill-up, matching, guessing questions, scenarios, discussion, etc. These activities were part of a course and could be given in between the teaching-learning process.

Problem solving skill: Problem solving is helpful in developing student's reasoning skills. Problem solving is a process of planned activities which eliminate a problem or unpleasant situation to a desired goal. It involves identifying and defining a problem, generating

alternative solutions, selecting the best one and implements it. Finally evaluate the solution whether that works or not, if it does not work then revisit the step of generating alternative solutions and select the other solution and proceed further.

Tools used for the research and data collection

For conducting the study and collecting the data, following tools were used:

1. Intervention Programme "Activity based module"- developed by the researcher.
2. "Problem solving skill test" to measure the skill of problem solving among the students - developed by the researcher.

Method of data collection

The pre- test was administered one by one on both the groups i.e. Problem solving skill test, administered on both groups (experimental group and control group). After that, both groups were taught by the researcher herself. Control group were taught through traditional (lecture cum discussion) method and experimental group were taught the same lessons through the intervention program that was developed by the researcher. The time duration for teaching a period of 45 minutes per day and was the same for both the groups.

After 26 working days of intervention, post-test were administered on both the groups. The whole process was extended up to 30 days, including the number of days of teaching-learning process along with the days in which tests were conducted.

Data analysis

Data analysis of this study was done according to the Research objectives and design of the study. This includes descriptive statistics and inferential statistical tests**.** The design of the study was Quasi experimental and pre-test and post-test with non-equivalentgroup design. Statistical tests used for analyzing the data were t-test (independent sample test) and analysis of covariance (ANCOVA) for the total sample. The data were analysed and interpreted according to the following hypothesis:

$H0_1$ There is no significant difference in the mean levels of problem solving skill between the students belonging to experimental group and the control group at pre-test level for the total sample**.**

Comparison of mean scores of Experimental group and Control group on Problem-Solving Skill test at pre-test level shown in table 1.

Table 1: Pretest scores of the experimental group and control group on problem solving skill test

Group	N	Mean	Standard Deviation	Standard Error Mean	df	Mean Difference	Sign. (2-tailed)
Experimental	**35**	**17.6571**	**5.50370**	**0.93030**	**68**	**1.68571**	**0.176**
Control	**35**	**15.9714**	**4.78654**	**0.80907**			

Table 1 depicts that though there was difference in the mean scores on pre-test of the experimental group and control group and also the mean of experimental group was a little higher than the control group in their problem solving skills, yet there was no significant difference at 0.05 level of significance. Hence null hypothesis was accepted here. It means there was no significance difference in the Problem solving skill between students of experimental group and control group in their pre-test scores.

$H0_2$ There is no significant difference in the mean levels of problem solving skill between the students belonging to experimental group and the control group at post-test level for the total sample.

It was found that there was a significant difference between the mean level of problem solving skill of experimental group and control group at post-test level.

Table 2: Post-test scores of the experimental group and control group on problem solving skill test.

Group	N	Mean	Standard Deviation	Standard Error Mean	df	Mean Difference	Sign. (2-tailed)
Experimental	**35**	**20.8856**	**5.23611**	**0.88506**			
					68	**3.2285**	**0.002**
Control	**35**	**17.5999**	**3.22621**	**0.54533**			

Table 2 reflects that there was an effect of the intervention program on developing the problem solving skill of students of experimental group. Hence, the null hypothesis was rejected.

$H0_3$ There is no significant difference in the mean levels of problem solving skill between the students belonging to experimental group and the control group at post-test level with respect to gender.

Table 3: Post-test scores of the experimental group and control group on problem solving skill test with respect to gender

Gender	Groups	Mean	Std. Deviation	N	F	df1	df2	sig.
Male	**Experimental**	**18.8824**	**4.96088**	**17**	**1.365**	**3**	**66**	**0.261**
	Control	**17.1500**	**5.47025**	**20**				
	Total	**18.4865**	**5.18342**	**37**				
Female	**Experimental**	**20.1889**	**6.02093**	**18**				
	Control	**17.7333**	**3.86313**	**15**				
	Total	**18.9818**	**5.25270**	**33**				
Total	**Experimental**	**20.8856**	**5.50370**	**35**				
	Control	**17.5999**	**4.78654**	**35**				
	Total	**19.2143**	**5.18999**	**70**				

Table 3 indicates that though there were significant differences in the mean value of control group and experimental group in problem solving skill at post-test level but it was found that there was no significant difference in the mean value of problem solving skill with respect to gender. It means there was no effect of Intervention program on the development of Problem Solving skill of students with respect to gender.

H0$_4$There is no significant difference between the mean levels of problem-solving skill of the experimental group and the control group for the total sample with the adjusted means at post-test level.

For comparison of scores on Problem solving skill test between the two groups (control and experimental) by taking pre-test scores as a covariate at the post-test level, it was necessary to control it statistically in order to nullify the impact of pre-test scores on final scores. ANCOVA reduces the error and increases the statistical power.

Here ANCOVA was applied and covariate column filled with pre-test scores of both the groups for computing this. The result comes out as shown in table 4.

Table 4: ANCOVA analysis of mean scores of Problem solving skill between the experimental group and control group with the adjusted means at Post-test level

Groups	**N**	**Source**	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Experimental & Control	70	Corrected Model	736.623[a]	2	368.311	21.994	0.000
		Intercept	123.632	1	123.632	7.383	0.008
		Pre-test_PSS	686.894	1	686.894	41.019	0.000
		Groups	7.813	1	7.813	11.605	0.000
		Error	1121.963	67	16.746		
		Total	21649.000	70			
		Corrected Total	1858.586	69			

a. R Squared=0.396 (Adjusted R Squared = 0.378)

The above table (table 4) indicates that the experimental group and control group are statistically significantly different, having adjusted for the covariate. In order to control statistically or nullifying the impact of pre-test scores on final scores, ANCOVA was applied. On applying ANCOVA, it was found that the value of significance for the groups was 0.000. This means there was a significant difference between the mean levels of problem solving

skill of the experimental group and the control group for the total sample with registered means at posttest level. This shows that there is a significant effect of intervention program in developing problem solving skill of experimental group. Hence, the null hypothesis was rejected.

Findings of the study

The findings of the study are as follows:

- This study revealed that both the groups, before the intervention program were significantly similar in the mean value of problem solving skill.
- After the intervention program, this study also revealed that though the problem solving skill of control group and experimental group were increased but the problem solving skill of experimental group students were much higher than the control group students. It means there is a positive effect of intervention program in developing problem solving skill among experimental group students.
- This study also revealed that there is no significant difference between genders in developing problem-solving skills. It means both (male and female) have equal opportunity to develop problem solving skill. It means there were no effects of intervention program on the development of problem solving skill with respect to gender.
- The study also gives the result of real impact of intervention program in developing problem solving skill by computing the analysis of data through ANCOVA. A comparison of scores of Problem solving skill test between the two groups (control group and experimental group) by taking pre-test scores as a covariate at the post-test level and found that the value of significance for the groups was 0.000. This means there was a significant difference between the mean levels of problem solving skill of the experimental group and the control group for the total sample with adjusted means at posttest level. This shows that there was a significant effect of intervention program in developing problem solving skill of experimental group.

Conclusion

From the findings of the study, it can be concluded that there was a significant impact of intervention program on developing problem solving skill of students belonging to elementary level. It also enhances the academic achievement of the students of experimental

groups. Development of problem solving, critical thinking skill and academic achievement with the effect of Intervention program seems to be successful. This study also revealed that both genders either male or female have the equal opportunity in developing problem solving and critical thinking skill and also equal opportunity in enhancing their academic achievement.

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Internet resource

http.www.indiabix.com/logical_reasoning/statement_arguement

http://edweb.sdsu.edu/clrit/learningtree/PBL/PBLadvantages.html

http://www.ift.org/knowledge-centre/

http://www.ncde.appstate.edu/publications/jde/

https://www.insightassessment.com