

Rupantaran : A Multidisciplinary Journal  
Vol. III : 43-50, March, 2020  
ISSN : 2091-0061  
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## Pedagogical Practice in Teaching - Learning Mathematics in Secondary in School Level

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### Abstract

*This article reflects about the effective and concrete learning of mathematics with the help of self-devised innovative activities, worksheets, project experiments and teaching aids. The present research shows if maximum participation of students is ensured -either in the mathematics laboratory activities or class room interactive questioning sessions like that of quiz- is really joyful learning of the subject. `Learning by doing` is very effective methodology in teaching learning process as the experience gained meticulously (Krockover, 1997). It remains permanently fixed in the minds of the children. Thus, innovative teaching aids and projects of mathematic laboratory plays a vital role in the conceptualization process. Some researchers emphasize on the children's experience of school education that must be linked with the life outside the school. It brings joyful experience in the learning. Keeping this in mind, several opportunities are provided to students to construct their systematic knowledge by engaging them in activities, experiment, field visits, discussion with peers and teachers, group works, brainstorming sessions, collecting information from different sources, inquiring, listening, thinking and so on. The students are encouraged and allowed to share and explain their ideas and ask, pose and frame questions. Appropriate innovative tools and techniques are applied depending on the situation and requirement.*

**Key words:** innovation, pedagogy, heuristic, meticulously, storming

### Introduction

Teaching of mathematics in the class is not only concerned with the computational knowledge of the subject but it is also concerned with the selection of the mathematical or scientific contents and communication leading to its understanding and application.

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Therefore, while teaching, one should use the teaching methods, strategies and pedagogic resources that are much more fruitful in gaining adequate responses from the students than we have ever had in the past we know that the teaching and learning of mathematics is a complex activity and many factors determine the success of this activity(Lamichane-2010). The nature and quality of instructional materials, the presentation of contents, the pedagogic skills of the teacher, the learning environment, and the motivation of the students are all important and must be kept in view in any effort to ensure quality in teaching-learning mathematics (Canny, 1984). In this context, the present study is focused on innovations and innovative practices in teaching mathematics using appropriate teaching methods, strategies and pedagogic resources to make happiness learning. The objectives encompass to develop the mathematical skills like speed, accuracy, neatness, brevity, estimation, etc. among the student, to develop their logical thinking, reasoning power, analytical thinking and critical thinking, to develop their power of decision-making, to develop the techniques of problem solving, to develop their scientific attitude i.e. to estimate, find and verify results, to develop their ability to analyze, draw inferences and generalize from the collected data and evidences, to develop their heuristic attitude and discover solutions proofs with their own independent efforts, and to develop their mathematical or scientific perspective and outlook for observing the realm of nature and society.

### **Innovative practices need for in teaching mathematics**

In the foregoing aims of teaching mathematics the researchers realize that more focused should be laid on the classroom to the higher level of objectives underlying the mathematics subject, like critical thinking, analytical thinking, logical reasoning, decision-making, problem solving Shrestha,S.B.(1990) Such objectives are difficult to be achieved only through verbal and mechanical methods that are usually used in the class of mathematics. As one of the verbal methods of instruction: Give all importance to speech and texts, to the book and to the teacher who used to be simply satisfied with giving the mathematical or scientific rules to pupils and having them memorize it, e.g. the rule of signs and formulas in algebra, students memorize this and remember it. Another verbal method involves explanation (Ducharme& Ducharme,1999). Teachers who use these methods assume that the mental structure of the child is the same as the adult`s. This method leads to series of explanations and students at the initial steps of logical explanations trying to understand and grasp but slowly the gap is created between the explanations transmitted by teacher and received by students which lead to the poor understanding on the part of students and they develop a fear of the subject.

Some research works point out that `in the teaching of mathematics emphasis should be more on the understanding of basic principles than on the mechanical teaching of mathematical computation`

## **Innovations in teaching mathematics**

Innovations in teaching mathematics or science can be diversified in the terms of methods, pedagogic resources, Mastery Learning Strategy used in teaching learning process.

### **Mastery learning strategy**

Teaching strategy is a generalized plan for a lesson and includes a specific structure to be followed. B.S. Bloom has developed Mastery learning strategy (Dutta,1999). It consists of different steps: division of content into units, formulation of objectives related to each unit, teaching and instruction organized for realizing objectives of each unit.

## **Methods and Materials**

A style of the preparation of content in classroom, the innovative methods that the present study used to make teaching-learning process effective in mathematics.

## **Results and Discussions**

### **Inductive-deductive method**

Inductive method is to move from specific examples to general and deductive method is to move from general to specific examples. In the classroom, usually the instructions directly start with the abstract concepts and are being taught in a way that does not bring understanding on the part of majority of the students. Formulas, theorems, examples, results are derived, proved and used. The researcher starts with specific examples and concrete things and then move to generalization and abstract. The researcher shows how generalizations can be derived and it holds true through specific examples. This method helps students for better understanding; students do not have to study the things and will have long lasting effect (Copeland, 1970).

### **Example:**

Pythagoras theorem - In a right-angle triangle ABC at right angle at B,  $AB^2 + BC^2 = AC^2$  (considering right angle triangles of different measurement leading to generalization and then establishing it through the theoretical proof).

### **Analytic-synthetic method**

Analytic is breaking down and moving from unknown to known and synthetic is putting together known bits of information and moving from known from unknown. These methods were basically used in proving the results and solving sums. In textbooks, mostly synthetic method is used to prove something unknown we start with certain knowing thing, but that leaves doubt in mind of students why we have started with that step and using this particular known thing (Sharma, 1997).In order to explain and relate each step logically, combination can be used. which is shown in following table.

**Table 1** : Synthetic and Analytical method

Synthetic method	Analytical method
$b/a=d/c$ $\therefore b/a-2a=d/c-2a$ (why ?) $\therefore d(a-2ab)=b(c-2ad)$ Here, the doubt raised in student's mind is being solved with the help of analytical method.	$d(a-2ab)=b(c-2ad)$ $\therefore (a-2ab)/b=(c-2ad)/d$ $\therefore b/a-2a=d/c-2a$ $\therefore b/a=d/c$

### Problem-solving method

This method aimed at presenting the knowledge to be learnt in the form of a problem. It started with a problematic situation and consists of continuous meaningful well-integrated activity. Choosing a problem and giving it to students and engaging them without spending time in going over the things. As they struggled with the problem to get solution, meanwhile it helped them in developing divergent thinking (Patra, Bairagi).

#### Example:

There is a problem of finding the amount of water in a given container instead of deriving the formula of volume (cylinder-filled with water).

### Play-way method

Use of the activities that include a sort of fun or play and give joy to the students in the classroom teaching was selected. As the students did not realize regarding their learning but in a way, they were gaining knowledge through the participating in different activities. This way helps them to develop interest in mathematics, motivates them to learn more and reduces the abstract nature of the subject to some extent inherently (Bhatia,1992).

#### Example:

Mathematical game and puzzles

### Laboratory method

Teaching in the classroom through the way of `learning by doing` and `learning by observation` and proceeding from concrete to abstract was practiced. All students did not just listen to the information given but did something practically also. They learnt through hands on experience leading them to discover mathematical facts (Renton, 1973). After discovering something by their own efforts, the day started taking pride in this achievement; providing them happiness in return along with mental satisfaction and encouragements toward further achievements.

**Example:**

Making and observing models, paper folding, and paper cutting construction work in geometry.

**Pedagogic resources**

The use of the pedagogic resources in teaching practice to integrate in a method for the transaction of a particular content and draw up on to advance the students.

**Teaching aids**

It is conformed of the view that teaching aids are the materials used for effective teaching and enhancing the learning of students. It can be anything ready-made or made by the teacher or made by students. Different teaching aids are used in teaching mathematics like chart, manipulative, programmed learning materials (PLM), computers etc. (Ducharme,1999).

- a) Chart -Used in class to display formula, symbols, mathematical and geometrical figures and for making students familiar to the symbol and for memorization of basic formula. Further, it is used to bring to the students two- dimension geometry and the graphical representation in a better way (*Wuyep, Solomon Z*)
- b) Manipulative- Manipulative are such objects or materials that involve mathematics concepts, appealing to several senses, that can be touched and moved around by the students (not demonstration of materials by the teacher). Each student need material to manipulate independently. With students actively involved in manipulating materials, interest in mathematics or science will be stimulated. Canny (1984) has shown that mathematics instruction and students' mathematics or scientific understanding will be more effective like three- dimension figures in geometry.
- c) Programmed Learning Materials (PLM): these are the self-learning materials in which learner can be proceeded at his own place. It has the characteristics of all sequential steps, learners' response, self-pacing, immediate feedback, reinforcement and self-evaluation which is helpful in acquisition of concepts like fractions, number system etc. and can be used as a remedy for slow learners for a specific contain (D. ASPY-1994).
- d) Computers and television: Computer can be used for multimedia presentation for the concepts that require visualization and imagination. Computer can also be used for providing computer Assisted information (CAI). It is similar to PLM i.e. it is a computerized PLM (Bhatia, 1992). Television can be used to show some good mathematics or science education show.

## Activities

Activities here include all such work wherein students play an active role, have to interact with different resources and generate knowledge (Shrestha-1990). It includes quiz competition, projects, role play, seminars, discussion, mathematics club, science clubs, assignment, field trips, etc. As shown in the table.

**Table 2 :** List of Activities

Name of the activities	Examples/situations where activity can be used
Quiz competition	Logic, properties of numbers, Mathematical rule and results
Projects	Contribution by different mathematicians
Role play	Arithmetical concepts like profit and loss, simple and compound interest
Seminars	Application of mathematics or science in other disciplines.
Discussion	Properties of `zero`, difference between rational and irrational numbers, relating different concepts in mathematics or science
Mathematics clubs	Application of the concept studied, preparing models, paper folding (Origami)
Assignment	Self-study, extension of knowledge
Field trip	Experiencing the functional use of mathematics in bank, insurance company.

In any curriculum, content and presentation of contents are two most important inseparable components. It is difficult to say anything definitely about which method and pedagogic resource is going to be most effective for presentation of a particular type of content. Selection of method pedagogic resource depends on many factors like type of content, objectives to be achieved, level of student, entry behavior, and availability of resources. Also, acceptance of innovative methods and positive attitude of teachers towards it, is an important factor for the selection of method and pedagogic resource (Copeland,1970). The things included under innovations are existed in the book, also there are researches which show that some innovations are carried out in the classroom and have shown the positive effect on teaching learning process but their practical usage and implementation in classroom is not seen to the expected level.

### Some suggestion for innovations in teaching mathematics

- For effective transaction of the curriculum and achievement of curricular objectives appropriate method and pedagogic resources should be used in providing learning experience to the students.

- A number of factors need to be considered while making use of a particular method and pedagogic resource: Learner's capabilities, availability of resources, entry behavior, school environment, objectives to be achieved, the nature of the contents and the teachers' own perception and mastery.
- Decide on and plan in advance the innovative idea that the teachers would be incorporating to transact a particular concept so that loss of instructional time is prevented or minimized.
- The immediate environment of the learner both natural and human should be used when and where possible for making learning concrete and meaningful.
- Involve the students in the process of learning by making them beyond the process of listing to that of thinking, reasoning and doing.
- In order to promote self-study skill use of library and resource center needs to be encouraged.

## Conclusion

The study shows that effective and concrete learning of mathematics by the use of innovative activities, proper receiving regular feedback for teaching and learning should be the components of teaching-learning process. On the basis these components, the mathematics or science teacher can make his/her class more effective as well as joyful. Furthermore, continuous and comprehensive evaluation has to be ensured as it plays an important role for the required modification in teaching-learning process. Properly instruct and guide the students for carrying out different activities precautionary measures should be taken so that the student is not misguided and it should be necessary. The study of mathematical journals and modern books of professional interest and in-service training should be provided for improving teaching of mathematics or science.

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