ADV MATH SCI JOURNAL
Advances in Mathematics: Scientific Journal **9** (2020), no.8, 5455–5463
ISSN: 1857-8365 (printed); 1857-8438 (electronic)
https://doi.org/10.37418/amsj.9.8.16

MODERN PEDAGOGY IN TEACHING OF MATHEMATICS FOR UNDERGRADUATE AND POST GRADUATE STUDENTS

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ABSTRACT. Currently, science educational approaches have brought about a mismatch between what is educated to the students and what a student actually needs. As such, numerous institutions are moving towards problem-based learning as an answer to produce students who are inventive, can think critically, diagnostically and are able to solve problems. As Mathematics is one of the mainstays of Basic Sciences, one of the solutions is to evacuate the arithmetic fear that has been cribbing into the brains of the students. In this paper, we focus on the problems, objectives, needs and on the imaginative strategies of teaching and attracting students to this subject. Some pedagogic devices with which an educator ought to be prepared have been referenced. A short study of the quantity of students, of certain colleges in the state, picking this subject has been done and featured in this paper.

1. INTRODUCTION

Mathematics, being a vital subject and possessing a focal position since the antiquated period till date, has not been important to numerous students. The reason is for the most part on the grounds that there is desire yet it is difficult to achieve. Being highly abstract, it is concerned with ideas, which are interrelated, and with the control of images. Teaching of mathematics is not only concerned about the computational expertise of the subject but on the other

2010 *Mathematics Subject Classification.* 97C70.
Key words and phrases. Innovations, Mathematics, Undergraduate, Syllabus enrichment, Oral Presentation.

hand is concerned about the determination of the scientific substance and correspondence prompting its comprehension and application. So while teaching of mathematics one should utilize the showing techniques, methodologies and academic assets that are significantly more productive in increasing satisfactory reactions from the students. Teaching and learning mathematics involves complexities which can be survived if certain standards are pursued. The nature and quality of instructional material, the introduction of substance, the educational aptitudes of the educator, the learning condition, the inspiration of the students are exceptionally critical and must be kept in view in any push to guarantee quality in instructing learning of arithmetic. Mathematics has a task to carry out in various fields: developments in drug, computerized encryption, and correspondence innovation, demonstrating genuine wonders, anticipating calamities, association of ventures, business and transport to give some examples. At the core of arithmetic instruction lies undergrad science training. It is difficult to handle any of the issues related with science instruction, at any dimension without intercession at the undergrad level. All things considered, the harbingers of progress, if there are to be any, will be the teachers, policy makers, the creators and imparters of curriculum and pedagogy. And each one of them will have been shaped by their undergraduate (mathematics) education. Hence it is necessary that we examine the doctrines that govern undergraduate mathematics education in India.

1.1. **Objectives.**

In this paper, efforts to discuss innovations and innovative practices in teaching mathematics at the undergraduate level, under teaching methods, strategies and pedagogic resources have been made. The process of innovation is generally described as consisting of three essential steps, starting with the conception of an idea, which is then proposed and is finally adopted. Though many ideas have been conceived to bring about change in the teaching of Mathematics, it is yet to be proposed and adopted. So, the innovations discussed may not be new in terms of the idea but is new in terms of practice.

1.2. **Innovations in Teaching Mathematics.**

This can be diversified in terms of methods and Pedagogic resources used in teaching-learning process.

2. METHODS

Method is a style of presentation of content in classroom. The following are the innovative methods that can be used to make teaching-learning process of Mathematics effective.

2.1. **Inductive-Deductive Method.**

Inductive method is to move from specific examples to generalization and deductive method is to move from generalization to specific examples. In classrooms, usually instructions start with the abstract concepts which are beyond the understanding of the students. Formulas, theorems, examples, results are derived, proved and used. But teacher needs to start with specific examples and concrete things and then move to generalizations and abstract things. Then teacher again needs to show how generalization can be derived and it holds true through specific examples. This method helps students for better understanding; they don't have to cram the things and will have long lasting effect.

Example:

(i) Pythagoras Theorem - In a right-angled ABC, right angled at B, Δ (Considering right angle triangles of different measurements leading to generalization and then establishing it through the theoretical proof).

(ii) The sum of two sides of a triangle is greater than the third side. (Ask the student to take any triangle, measure the sides, add any two of them, the result will always be greater than the third. The teacher can then proceed with the general proof.)

2.2. **Analytico-Synthetic Method.**

Logical is separating and moving from obscure to known and Synthetic is assembling known bits of data and moving from known to obscure. These strategies are fundamentally utilized in demonstrating the outcomes and taking care of issues. In course readings, generally engineered technique is utilized, to demonstrate something obscure we begin with a specific known thing, yet that leaves questions in psyches of understudies about why we have begun with that progression and utilizing this specific known thing. So an instructor needs to consolidate both so as to clarify and relate each progression legitimately.

2.3. **Laboratory Method.**
With the advent of computers, many of the colleges are well equipped with computer laboratories. The availability of computing softwares can be utilized in complementing classroom mathematical teaching to promote students active engaging and learning; to exchange long and difficult numerical and algebraic manipulations by communication of supporting reasoning when answering mathematical questions; to make experimental activities easier to handle; to develop problem resolution skills dealing with more interesting and difficult problems in so far as numerical, algebraic graphical and programming resources are available; to encourage discussion of different solutions or strategies as one works with multiple representations of the same mathematical object or process; to motivate the development of paired notions like discrete/continuous and finite/infinite. The pedagogical work needed to construct and implement learning situations to actualize these potentialities constitutes a major challenge to teachers. Some mathematical problems can be solved through Computer programs such as Maple, Mathematica, MATLAB, SPSS, Group algorithm program (GAP), GeoGebra which are powerful software programs used to solve general-purpose mathematical problems. Problems in the areas of mathematics, science and engineering (and many more) can be investigated using in-built commands of these programs or by utilizing these programming languages to create one's own personalized programs. They can be used for solving problems in Calculus, Algebra, Coordinate Geometry, Solution of Differential Equations, Linear Programming, Statistics, plotting of points in two and three dimensions and also to create a three dimensional view of an object and many more. Hence, introduction of laboratory component, in mathematics teaching, at the under graduate level, may enhance a better understanding of the subject for all papers for which there is feasibility of working in a laboratory environment.

2.4. **Oral Presentation in Mathematics Learning.**
Anne B D'Arcy-Warmington (2008) mentioned that "it is important to consider the merits of oral presentations in mathematics service units as students" educational needs are diverse. Reaching parts of the brain that usual educational methods don't reach may be the answer to those poor students who do not

have a "mathematical brain". The theory of multiple intelligences and brain-based learning may be the tool that will aid these students to be more confident about their mathematical ability. Oral presentations provide all students with a chance to display their knowledge in fun and creative ways. The interest aroused when researching the topic may give rise to a new curiosity about mathematics. With the declining numbers of students wishing to study mathematics perhaps, an injection of creativity in service units may spark an interest in mathematics in these and other students". A study done by Lianghuo and Shu Mei (2007) showed that both teachers and students overall developed positive views about the benefits and usefulness of using oral presentation tasks into their daily mathematics teaching and learning. Oral presentation is an activity of sharing ideas and clarifying understanding verbally. Firstly, this method is regarded as an alternative mode of assessment for teachers to gather information about their students? learning of mathematics and hence make relevant instructional decisions. Secondly, it is also viewed as a tool for developing students" communication skills. One general purpose of oral presentation is to allow teacher to hear what students think about mathematics, and how they express it and their understanding of mathematics in their own words. Furthermore, teachers using oral presentation tasks must provide opportunity for students to think through questions and problems; express their ideas; demonstrate and explain what they have learnt; justify their own opinion; and reflect on their own understanding and on the ideas of others. Thus, in the existing syllabus, changes can be made so as to include oral presentation as a process of mathematics learning by allocating some grades/marks to every paper. This incorporation may induce a better understanding of the subject.

2.5. **Syllabus enrichment.**

Generally the Mathematics courses of both B. Sc programmes (with Honours / Non-medical) and M. Sc Mathematics are the same as indicated in the syllabus curriculum to be followed at the undergraduate level and postgraduate level in all affiliating universities from UGC; the two programmes differ in the nature of the stream, a student chooses from, in addition to mathematics, that is, whether from science or social sciences stream. The B. Sc (Honours / Non-medical) and M.Sc Mathematics curriculum of most of the universities include the following

as compulsory courses: Algebra (Classical and Linear Algebra) and Trigonometry Calculus (Differential and Integral Calculus, Advanced Calculus) Differential Equations (Ordinary Differential Equations and Partial Differential equations) Vector Analysis Analytic Geometry of two and three dimensions Analysis (Real and Complex analysis, Metric Spaces) Modern/Abstract Algebra Mechanics List of Optional papers Principles of Computer Science-Theory and Practical Differential Geometry, Discrete Mathematics, Mathematical Modeling, Applications of Mathematics in Finance and Insurance Special theory of Relativity Combinatorial Number Theory Computational Mathematics Laboratory Numerical Analysis Operational Research Astronomy Complex function Theory and Real Analysis, Cryptography, Object Oriented Programming With new ways of improvement in the teaching-learning process, the Syllabus may also be modified keeping pace with the all round development of the society. Some of the above mentioned optional papers in many of the colleges are options made by the teachers and college authorities and not by the students themselves and as a result the purpose of an optional paper at undergraduate gets defeated in many cases. Thus in order to eliminate such practices, some of the vital optional papers mentioned above can be included into core courses. The courses that can be incorporated into the core courses, to name a few, are topics from Computer Science (Data storage, Data Manipulations, Operating system and network, algorithm, Programming languages, Software Engineering, Data Structures), Discrete Mathematics (Propositional logic, Relations, Lattices, Boolean algebra, Graphs, Combinatorics) Mathematical Statistics (Probability theory, Descriptive Statistics , Statistical Methods (Sampling, Statistical Tests), Distributions, Sampling theory, Correlation and Regression and multivariate analysis) Differential Geometry (Curves, Surfaces, Manifolds, tensor Analysis) Cryptography (Classical and Modern techniques, Elliptic curves Cryptography) The inclusion of the above topics to the present syllabus can prove beneficial for the students in enhancing their employability. This is an exploratory research paper and the above recommended syllabus enrichment is not a technique, but rather a suggestive approach which when followed may prove beneficial for the students studying mathematics in enhancing their employability.

2.6. **Pedagogic Resources.**
These are resources that a teacher may integrate in a method for the transaction of a particular content and draw upon to advance the students learning. There are many pedagogical resources used in modern teaching such flipped class room teaching, online video through NPTEL, SWAYAM, Coursera, edX and many more online plateform.

2.7. **Programmed Learning Material (PLM).**
As internet usage by the students is increasing day by day, colleges can provide soft copies of important textbooks/learning materials and make them available to students through the colleges/ institutions websites. An interactive environment by the use of web 2.0 can also be created by every department of a college/Institution so as to encourage students-teachers interaction as a PLM through which a learner can proceed his self study at his own pace. It has the characteristics of all sequential steps, learners response, self-pacing, immediate feedback, reinforcement and self-evaluation. It is helpful in acquisition of concepts like fractions, number systems, etc. and can be used as a remedy for slow learners for a specific content. Tablet- This is essentially an interactive whiteboard (IWB) or EWB that enables the lecturer to write with a special pen on the screen of a tablet that is connected to a data projector. Any work done on the tablet is then simultaneously (real time) broadcast to the whole class. The tablet enables the lecturer to, inter alia, annotate notes, make comments and use colour schemes to highlight important points in a lecture. Activities here include works wherein students play active roles, interact with different resources and generate knowledge. Some activities are listed below.

Activity Situations related to Activity Quiz competition Mathematical rules, results, formulae, Properties of numbers Projects Contribution by Mathematicians Seminars Applications of Mathematics, talks on Ancient Mathematics etc. Discussion Concept of Pi , Golden ratio, Presence of Mathematics in real world viz, nature and music Mathematics Clubs Preparing models , Paper folding Assignments Solving problems, proving of theorems Field trips Visit to banks, Insurance companies Self study Library, internet, resource centers Scholarship exams Mathematics Olympiads, Mathematics Training and Talent Search (MTTS), Advanced Training in Mathematics etc, all funded by NBHM (National Board for Higher Mathematics).

Explorative Study a brief explorative study is done in connection with mathematics performances of the students in the state by using the data obtained. One cans the percentage of students failing in Mathematics in class X is increasing. Data reveals a marginal decline on the percentage of students failing in Mathematics for class XII in every year. However, it may not be authentic to draw a definite conclusion about this percentage as it again shows an increase in the following year. But an overall study reveals that more than 50% of the students are not able to stand to the subject and as a result few of them may continue with higher studies related to the subject inconsistent and do not show an increase or a decrease in the trend .The previous data revealed that approximately 3000 students appeared for the class XII exams. However, in spite of this, only a handful of students opt for Mathematics as an Honours paper. Mathematics is believed to be the key for all other subjects but it is surprising that most students fail and yet pass in other subjects. Some of the reasons may be because there is a negative attitude towards mathematics, fear due to pressure from friends that the subject is tough, limited or even lack of learning materials or lack of enough practice by the students. The present exploratory example is simply an attempt to quantify crudely the success level of students at different level of education in the subject mathematics, and this failure rate may not have a connection to the methods of teaching and curriculum of the subject. However this study is simply an attempt to bring out new ideas for making the subject more interesting and appealing to the learners, which in the process can also benefit the students in enhancing employability by the choices of optional papers listed above.

3. Conclusion

At present, we are in the developing needs of our general public and the necessities of the teach itself, except if we make solid ameliorative strides, the rate at which we are improving is simply not going to be sufficient. In the event that we investigate we can see numerous holes and lacunae that require prompt recuperating. There is a prerequisite to both works out long haul methodologies and simultaneously to likewise have great attainable transient objectives. To summarize, the educational program in the majority of the high weightage undergrad science Programs appear to be centered on optimizing youngsters and ladies to be explore Mathematicians. All things considered, be that as it

may, considerably less than a fourth of undergrad Mathematics understudies really choose to seek after a scholastic vocation in science. Further the teaching method and evaluation designs followed really don't do a lot to cultivate or upgrade the capacity to think initially or to basically investigate and understand concealed inquiries. In this way on normal the undergrad programs in arithmetic flop in any event two significant ways: right off the bat, they are not so much preparing and preparing the minority that intend to take up a profession in science in the way they should; also, the lion's share are neither increasing any comprehension of the job of science in the public arena nor are they learning the aptitudes required by all as far as correspondence, introduction, or the utilization of present day PC innovation.

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