



INNOVATIVE PRACTICES IN MATHEMATICS EDUCATION, COVERING GAPS IN MATH LEARNING

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ABSTRACT

At different levels of learning of Mathematics, one can observe the gaps in learning of lower level's mathematical concepts and skills. Is there any idea to cover up these gaps while keeping in view, time constrain at higher level; is a matter of great interest and concern. To make such an effort feasible, technology and teacher can play a crucial role to achieve this. The priority areas may be open educational resources (OER) based curriculum, intrinsic value based teacher training, interactive pedagogy and diagnostics assessment.

In this article the focus is on how OER can help the students of Mathematics to cover their gaps of learning keeping in view the specific skill or concept of Maths at each level of learning. In this digital age, how text books of NCERT are to be supported with downloadable multimedia contents from a repository of open educational resources?

Value based teachers training with emphasis on development of intrinsic qualities of Maths teacher and his capacity building is today's need. Specifically, the training needs on attitude, self-management. and samples on role model interpersonal and intrapersonal behaviour in classroom situations

Interactive teaching methodologies, primary focus should be how to combat the phobia of subject? How to make Maths classroom more democratic and participatory. What activities using instructional technology can be organized in comparatively flexible time table. Samples that how to introduce a concept in actual classroom situation.

Diagnostic assessments designed for every type of learner in class with linkage to conceptual clarity. Number of tests, quizzes, activities may be designed to cover up a range of learners from low performer to gifted one in the content banks.

These some of core areas of Maths teaching will help to a large extent to cover up the gaps in time bound manner and in Mathematizing the students. This is an earnest effort towards learner's interest based teaching especially in rural area.

KEYWORDS :

Introduction

Mathematics occupies central position in all subjects since ancient times. It involves ideas and manipulation of symbol. These ideas are like a closely knit structure from bottom to top so unless lower level concepts are clearly understood the upper levels are difficult to be mastered. Keeping this in view the Education Commission (1964-66) pointed out that "In the teaching of Mathematics emphasis should be more on the understanding of basic principles than on the mechanical teaching of mathematical computations". National curriculum framework 2005 emphasizes "mathematisation" as the main goal of Mathematics education and the higher aim is to develop the child's resources to think and reason mathematically, to pursue assumptions to their logical conclusion and to handle abstraction.

These are expected as outcome after school education however on the other hand, Pratham India's largest NGO-run annual survey, Annual Status of Education Report (ASER) 2005 and 2006 revealed that 50% of children in government schools could do basic arithmetic despite being in school for 4-5 years. ASER 2011 pointed that basic arithmetic levels achievement show a decline. Nationally, the proportion of Standard III children able to solve a 2 digit subtraction problem with borrowing has dropped from 36.3% in 2010 to 29.9% in 2011. This decline is visible in almost every state; Among Standard V children the ability to do the same task has dropped from 70.9% in 2010 to 61.0% in 2011 (Pratham, ASER 2011). In the age group of 14-18, 25% students cannot read the basic text fluently, in their own language. Also only 43% can perform division of 3 digits with one digit correctly (Pratham, ASER 2017). Thus the situation is alarming, as in majority, we observe the decline in student's performance in this subject year after year. Also in Tamil Nadu board 10 class results 2010 highest failure rate of students is in this subject . It may be attributed to the prevailing situation in schools, it is observed that in the average school today instruction specifically in rural areas still confirms to a mechanical routine, continues to be dominated by the old besetting evil of verbalism and therefore remains dull and not at par with learning needs of today's child. Also at the elementary level the focus is on specific problem solving and not on building the necessary foundations for understanding higher level maths. This low performance of

students in maths can be traced to these gaps of aspiration and achievement and method used to teach maths where concept clarity is rarity. Further critical thinking, analytical thinking, logical reasoning, decision-making, problem-solving etc. these objectives are difficult to be achieved only through verbal and mechanical methods which are usually used in the class of Mathematics.

Simultaneously we have mind-blowing technological tools that can help in improving the performance of students at each level and these are also child centric. The power of information and communication technology (ICT) intermixed with usual class can bring the effective changes in such a situation and its influence in dissemination of ideas generated on one forum to masses, cost effectiveness, easy reach motivates various stakeholders for its fruitful use. Thus a new instructional environment can be created through an equipped teacher with the use of these technological tools to deliver Mathematics concepts. Considering this and current compulsory educational provisions of Right of Children to Free and Compulsory Education Act (RTE) 2009, This leads to a need to rethink the reshaping of curricula, teacher training needs, school's pedagogic resource, assessment schemes, and possibly institutional priorities to cover up gaps in learning maths effectively and swiftly.

Curriculum and current needs

National Curriculum Framework (NCF) 2005 lays emphasis on ensuring that learning shifts away from rote methods and on enriching the curriculum to provide for over all development of children, rather than remain textbook centric. The RTE Act 2009 also provides that the curriculum builds up the child's knowledge, potentiality and talent through activities and play way. It requires redesigning of curriculum or at least supporting the present at every level with content banks having multimedia. Vivien, 2011 established that multimedia learning is more effective than many traditional educational methods. It can have variety of activities to introduce different concepts so that child understands the open-endedness of contents at each level of Mathematics. In curriculum, content and presentation of content are the two most important components. The developing of multimedia based contents can be done in the form of content banks.

Content Bank

Initially developing a structure such that each levels major skills and concepts of Maths are fragmented into number of micro skills and ideas. This list may be exhaustive so that a structure of mathematical skills is developed from initial to higher level showing clear interdependence. Initially the syllabus of NCERT for each level can be taken as such structure. The text based explanations of which are sufficiently available nationally but it's not same with multimedia based study material for these levels. It can be provided as bank of contents having multiple features keeping in view the level for which study material is provided. Such a version is still out of reach from school children especially rural, to Maths teachers and parents to other stakeholders.

Multimedia study material

Viven E Rolfe & Douglas Gray 2011 pointed that multimedia learning is more effective than traditional educational methods. Thus to make contents at every level more effective, interesting, systematic, organized, flawless, interactive and detailed the multimedia study material for each micro skill is to be developed. It may be in the form of animations having daily life examples with variety of sounds, presentations and explanations about that particular concept. If same concept appears at higher levels of learning then its online link can be provided with the lower levels of same concept say place value concept it appears in 3rd as well as in 5th standard. To make study material interactive, number of activities can be designed and linked with each micro concept of that level so that child has to become active and ready to get involved in the process of learning. Maths requires practice so having mathematical games, puzzles, skill tests, brain teasers etc. wherever possible with each skill may be added in content banks of that level. These mathematical games, puzzles and brain teaser help in developing a positive attitude and liking for subject. It helps child in making connections between Mathematics and everyday life. Thus he learns not only acquiring of mathematical knowledge but its application in daily life. Such a way of concept delivery, if provided, will help in minimizing gaps in learning at initial levels itself and speedy recovery at higher levels. These may be provided with samples of role model behavior and instruction in a classroom situation in downloadable form at NCERT web or in form of DVD's. Content banks may be linked online for wider exposure.

Providing content bank can also act as self-learning material at home, in which learner can proceed at one's pace. It has the characteristics of all sequential steps, learner's response, self-pacing, immediate feedback, reinforcement and self-evaluation. It is helpful in instructions of 3D concepts like volume, conic section, three dimensional geometry etc. and can be used as a remedy for slow learners to gifted ones at each level.

Value based teacher training

Bushra et al, 2011 conducted a study to compare the effectiveness of teaching of professionally trained and untrained teachers and the effect on achievement of students. The results of the study supported that the students taught by trained teachers showed better results. Teachers need to possess a complex set of interrelated skills. Research has shown that successful teacher training programmes have a noticeable impact on teacher's work in and out the class room (Villegas & Reimers, 2003). Information and communication technology, ICT can be thoughtfully integrated as a tool to promote these skills and higher order learning. This will improve subject mastery and enable learner-centred and active-learning pedagogies for teacher (Gaible and Burns, 2005). This teacher training program in the present times have deviation from holistic approach and deals basically with external world around us, lacks capacity building of a teacher and least related to the inner-self of an individual. Training programs are to be reoriented, instead of developing a person as a humane human being it is only directed towards superficial, surface level achievements. The contents of training program of teachers hardly consider self-management of Maths teacher which includes development of intrinsic values that can add largely to virtues like patience, kindness, truthfulness,

compassion and empathy. Some sessions on ego and attitude management may ease in brining desired outcomes after Maths class. This subject is highly abstract so its training should have sessions of professional skill development, self-management and may have some extra expectation as output of program in terms of consolidating the value structure of individual. Thus contents of training need to be redesigned keeping self-management of maths teacher on priority. Beside subject competencies these play a vital role in classroom situations every day. This can act as tool to understand and cover up the gaps of learning of child, to a technologically enriched subject competent teacher.

Instructional Technology

The effective delivery of contents is as important as contents itself. The success of text to multimedia based contents is highly proportional to how they are presented in classroom situation. Instructional technology is a growing field of study which uses technology as a means to solve educational challenges, both in the classroom and in distance learning environments. It is a tool for organizing, accessing, analysing, incorporating and evaluating information of content bank. It is a tool for developing new understandings and communicating. Mehta & Payal 2007 found instructional technology to be more systematic, organized and creative than lecture method. A large percentage of the respondents felt that instructional technology saved time and that there is greater student involvement and learning with instructional technology. Also the instructor availability is more with instructional technology than with lecture method mode of teaching. A large majority agreed that instructional technology lead to the global orientation of the students. An overwhelming majority of 80% respondents felt that instructional technology is highly beneficial for students. It supports independent inquiry and shared knowledge building. When used for mathematical investigations and modeling activities, technological tools can link the student with the real world, making Mathematics more accessible and relevant. It may help to combat phobia of this subject. However the role of teacher remains crucial as no technology can replace him. Multimedia in classroom should be used as a tool rather than a novelty. Multimedia has its place but certainly will not replace good teaching. The skill based content banks can give desired outcomes if they are delivered effectively by well-trained teacher. This instructional technology has simplified the job of teacher on effectiveness of content but posed challenges on the effective delivery of that. So to get desired performance of student, teacher has to make the classroom environment more democratic and participatory. While effective learning should be the driving force behind technology integration, it is important to keep up with technology advances in order to recognize potential solutions.

Assessment

ICT can play vital role in this domain. Assessing a child's Maths skills properly and accurately which are in study material of content bank is very important. This can be accomplished using a variety of methods and techniques. Multiple sources of assessment will involve different ways of presenting tasks to students as well as different ways of probing assessment information so that valid inferences about students' progress, in particular skill can be made and the gaps are sorted. These tasks can include a variety of formats. Effective teachers make use of a wide range of formal and informal assessments given in the form of written, oral, practical, can be closed or open-ended; real life or abstract; completed individually or as a group to monitor learning progress of a child. The integration of ICT can ease this work of assessment of each skill at any level as each micro concept can be linked with number of tests and interactive activities for its evaluation. Online linkage of various chapter tests can give real time feedback to learner. It may help him to diagnose the gaps by again referring to study material of that concept while taking assistance from teacher. The role of teacher is now to tutor him and not to teach.

In schools we have formative and summative assessments of a child periodically. Formative assessment is utilized to immediately

determine whether students have learned what the instructor intended. Summative assessment is cumulative in nature and is utilized to determine whether students have met the course goals or student learning outcomes at the end of a course or program. Thus we find here that contents are first delivered then assessment takes place. It hardly takes into consideration the pre-knowledge of student about that concept and mathematical skill. It gives the scope to diagnostic assessment. Diagnostic assessment helps to identify specific learning strengths and needs, and usually follows an initial assessment at the beginning of a learning program, where there is an indication of the need for further, more detailed assessment. It is related to specific skills needed for tasks before beginning a learning activity. They also provide a baseline for understanding how much learning has taken place after the learning activity is completed. Instructors usually build concepts sequentially throughout a course. Diagnostic assessments equip instructor with information about student's prior knowledge and misconceptions and intends to improve the learner's experience and their level of achievement. It assesses what the learner already knows and the nature of difficulties that the learner might have, which, if undiagnosed, might limit their engagement in new learning.

These assessments when collaborated with diagnostic assessment may help in assessing more accurately the gaps of lower level skills and providing diagnose. In content banks multimedia will have the various activities and tests to know the performance of child in each micro skill. In computational skills teacher and even child can know immediately that on which operation say multiplication of two digits or three digits or in their division he faces the problems. It will help in diagnosing the gap by referring to the study material of above concepts and then working on the interactive activities of this particular micro skill.

What we see in our routine schooling that most of stakeholders know about these gaps of learning of lower levels but without bothering much about it they try to continue cover up higher levels for child. It impedes the basic purpose of teaching of Maths and creating subject phobia among students. Also they hardly find any effective solution to such a situation. These multimedia based contents and evaluation can offer the solution to such a situation.

The need to have technology based assessment practices must be seen in the wider context of changes to society, and changes to the way we view, teach and learn Mathematics. Today's society has moved from an industrial to an information-based society that relies on a far greater use and application of technological understanding and has goals that promote equal opportunity for Mathematics learning for all its children.

It provides opportunities for students to evaluate their own work. These may include having students design their own test questions, share success criteria, write mathematical, or present evidence of growing understanding.

Conclusion

The duo of teacher and technology has immense potential to change the classroom scenario from what it is and what it should be? Some preliminaries are to be taken up by other stakeholders. The collaboration of new technologies in curriculum, classroom and assessment should be taken up on priority as mentioned. At the same time self-management and the technological capacity building of teacher may be emphasized. The reflection of this will help in bringing the Maths class interesting, creative and as per requirements of today's child. Further current research findings show that the nature of Mathematics teaching significantly affects the nature and outcomes of student learning. This highlights the huge responsibility teachers have for their students' mathematical well-being. These changes need to be negotiated and carried through in classrooms, schools, departments, and faculties, and in teacher education program. Innovation and reform must be provided with adequate resources. The schools, communities, and

nations need to ensure that their teachers have the knowledge, skills, resources, and incentives to provide students with the very best of learning opportunities.

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