Revival and Innovations in Mathematics Pedagogy: A Case Study

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Abstract

Mathematics Education is an area of considerable debate and concern across global. In developing countries like India, where education is the most significant route for social and economic mobility, mathematics is considered as a subject of high intellect and social prestige. Students who are not good in mathematics are considered dump and non-serious. The acute pressure on school students to perform well in mathematics clubbed with severe shortage of well qualified mathematics teachers, multiplies the challenges to provide meaningful mathematics learning. The present paper presents a crisp and coherent outlay of an innovative experiment that has taken place in Cluster Innovation Centre (CIC), University of Delhi, India. Two leading central universities of India, University of Delhi and Jamia Millia Islamia have started Meta University based Masters' degree program in Mathematics Education in the country. The conception of the course is historical as it is the first and maiden Meta University based course in the country. The course is a landmark development in the history of mathematics education in India as it is the first education course offered at post graduate level in subject specific domain. The author presents snapshots of the course while discussing important highlights of the course..

Keywords

Meta University, Innovation, Pedagogy.

1. Introduction

Mathematics is understood as a subject of logic and application. It is also a discipline of utmost beauty and intuition. Mathematics is also treated as a formal discipline of rules and linguistic construct. There is always a considerable debate about nature of mathematics and how it shall be presented in school mathematics curriculum. Shall mathematics be taught only as tool of application in other fields or shall it be taught as a subject of disciplinary values such as aesthetics and integrity?

There may possibly be a long list of the objectives of teaching mathematics at school level, students always share love and hate relationship with this subject. The informal relation they share with mathematics while using it consciously or subconsciously is simply astonishing. You cannot find any window of your everyday activity where you don't use mathematics. Students are well aware of the fact that mathematics is an integral part of their everyday lives. The challenge with the educators is to develop same comfort level while dealing with formal mathematics which students are taught in schools. School mathematics deals with more formal and technical aspect of mathematics where student is required to use prescribed mathematical language, rules and procedures. The way mathematics is being presented in school mathematics curriculum seems highly rigid, unsocial and unfriendly. It lacks social and practical orientation to the subject. Formal mathematical concepts and procedures are taught as there is no freedom and exploration in doing mathematics. Together, it presents a very scary picture of mathematics for school students and consequently majority of students hate mathematics.

Mathematics teaching is an area of concern across countries. In spite of major reforms and suggestions by various organizations and research bodies, school mathematics education is one of the most challenging areas of school education. Challenges and issues related to school mathematics education in India are same or even worse. Participation of only two states of India in PISA-2009+ and the subsequent results were debated at length without any conclusive outcome. India's withdrawal in future PISA assessment is clearly an indicator that Indian children are not prepared for an international level assessment. Though many issues were raised against PISA, such as biased and unfamiliar

context of the questions asked in PISA, the fact is that Indian students are not prepared to use, or to play with mathematical knowledge or to shift the acquired mathematical learning from one context to another context.

The beauty of mathematics learning lies in its over-reached applications and the freedom to generalize results in similar contexts. Mathematics learning shall aim to prepare learners to mathematize their experiences and to freely use mathematics learning in multiple contexts. The latest, tenth Annual Education Survey Report (ASER) also came out with the findings that majority of children in primary grades are far behind their expected levels of mathematical learning (ASER, 2012-13).

There is considerable concern to raise the standards of school mathematics education in the country. Efforts have been made to strengthen mathematics abilities of learners at school level by introducing comprehensive vision of school mathematics in National Curriculum Framework-2005 (NCF-2005). In its vision statement, NCF-2005 proposed an ambitious vision:

- Children shall enjoy learning mathematics
- Children shall learn important mathematics
- Mathematics learning shall become meaningful part of children's lives
- Children shall learn to pose and solve mathematics problems
- Children shall develop logical thinking to abstract and generalize mathematical ideas
- Children shall understand basic structures of mathematics
- Teacher shall work to engage every child in mathematics learning

(Position paper on Teaching of Mathematics, NCF-2005, NCERT)

The needle of reforms has also been targeted towards quality training of mathematics teachers and their continual professional development. NCF-2005 strongly observed that lack of adequate training of teachers is one of the most significant factors of students' poor/faulty understanding of mathematical concepts. How shall we prepare our teachers so that they can help students learn mathematics without burden and more so, to develop positive relation with the subject?

Education system needs to prepare teachers who can freely link textbook mathematics with everyday life experiences, who themselves possess positive disposition for the subject, who firmly believe that all students can learn elementary mathematics without fear, who are resourceful to employ differentiated instructional strategies and resources to teach mathematics meaningfully to diverse leaners and last but not the least, who continuously enjoy challenge to grow themselves as professionally inclined mathematics educators.

Taking up the challenge to prepare creative and resourceful mathematics teachers, University of Delhi and Jamia Millia Islamia, two leading central universities of the country, initiated first Meta-University based post graduate course in Mathematics Education. The foundations of the course, titled as, M. Sc (Mathematics Education) is unique in many sense. It is the first and maiden course in the country which is based on the concept of Meta University, the concept strongly proposed by National Knowledge Commission, 2009.It is the first Masters' level course in the country that offers a subject ct specialized education course. It is the first time, any university in the country has offered a program which has given "Mathematics Education", a status of academic discipline where perspectives in mathematics education can be developed and debated. The urgent aim of the course is to prepare professionally inclined, resourceful mathematics teachers who can play holistic role in school mathematics teaching. The long term aim of the course is to establish Mathematics Education as an academic and active research field where community of mathematics educators, teachers, researchers and others can contribute continuously. The ultimate aim of the course is to bring informed and conscious changes in the policies and practices of mathematics education in the country.

The structure and design of the course is highly innovative and challenging. The course is started at Cluster Innovation Centre (CIC) in University of Delhi and AJK Mass Communication and Research Centre in Jamia Millia Islamia. ClC as the name suggest, is a newly established centre in Delhi University with mandate to establish linkages with academia, industry and society. The centre aims to promote innovative practices which can benefit different clusters, namely industry, education and society at large. The centre adopts interdisciplinary and project based learning approach where projects are chosen from real time setting and have potential for outreach applications.

Mathematics Education program is taught, both at CIC, University of Delhi and AJKMCRC, Jamia Millia Islamia so that students can utilize and get benefit of academic resources of both the universities. At CIC, students unlearn and re-learn important mathematical concepts related to school mathematics, they learn art of teaching mathematics through innovative pedagogy. The program also equips students to design, fabricate and develop creative learning tools to rectify misconceptions developed by school students. Students also spend considerable time in practicing as interns in schools. As students progressed towards the end of the course, they are

expected to develop research skills by working on challenging research projects. The course is purposefully integrated with AJKMCRC, Jamia Millia Islamia, which is amongst the premier institute of Mass Communication in the country. India has a challenge and mandate to make education accessible to all citizens. With Right to Education in place, it has become essential to provide meaningful education to all children in the age group of 6-14 years. Acute shortage of trained teachers in the country along with demographic diversity makes the challenge multifold. The problem can be answered using multi-media technology as a medium to make educational resources accessible to the masses. As a student of JMI at AJKMCRC, students learn numerous ways to use media techniques in education settings. It includes art of communication, skills to use multimedia technology such as radio production and broadcasting, issues related to values and ethics in journalism, art of scripting and creative writing and others. Core components are taught using mathematics teaching as objectives. Widely spread course content is taught in a coherent and cohesive manner to develop unconventional and interesting routes to teach mathematics.

Below is a glimpse of some of the innovations taken up by students:

2. Revival of Mathematical Board Games

Initiated as a semester long project by small group of students, it aims to include mathematics into the everyday activities lives of learners' using board games and to use board games as a teaching strategy. The innovative game deigns are original and conceptually sound. Each game in the series, targets one or more than one mathematical concepts.

Fig 1 Sample Template of Board Games (Prepared by Era Kaila & Atul Anand, MME 2013-15)

The level of games increases by increasing the difficulty and rigor of the concepts. The games have attractive outlook, easy rules and manageable size. The games have enough scope to engage minds in mathematical exploration.

3. Mathematics for Visually Impaired

In majority of situations, Mathematics teaching is focused on average learners. Children with special needs rarely get attention in planning and designing teaching resources. Visually impaired children face considerable difficulty in learning mathematics, particularly concepts related to space, shapes and measurement. Students of MME course, under the guidance of mentors from CIC, designed Mathematical Kit for Visually Impaired learners. The unique kit designed by the students, includes basic geometrical instruments such as scale, protector and compass. It also includes a specially designed board for visually challenged students which can be used to draw geometrical shapes. Another segment of kit includes 'Abacus with forms and shapes' to teach number and place value system, 'Tactile board' to understand coordinate system and 'Block Design' to teach numbers with different properties.

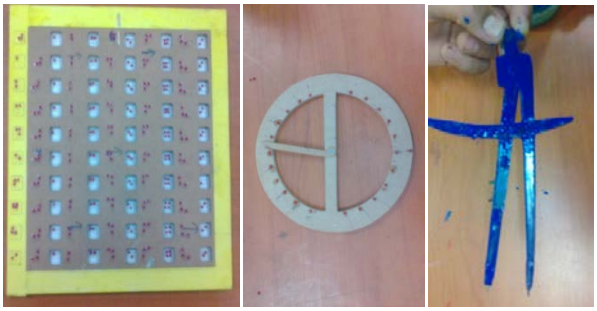

Fig 2 Sample template of Mathematical Kit for Visually Challenged Learners (designed and prepared by Garima Singhal, Abhishek, Naim Akram, Mohamad Rashid and Madhav Kundan, MME 2012-15)

4. Radio as a means of communication to teach Mathematics

Radio is the easiest and simplest means of communication used by people in many situations. MME students used their learning experience in mass media and communication to start on-air radio show to popularize mathematics among masses. Students identified mathematics topics which could get appeal common people. They did ample research in preparing the content of each episode and did plenty of rehearsal to communicate mathematical ideas only through audio channel.

These are some of the ideas tried out by the students. The freedom to use multiple strategies without compromising the principles of mathematics pedagogy is the essence of this

program. The scope of the program expands multifold as it inherited the spirit of taking challenges, looking into possibilities and taking benefits from existing resources to make mathematics teaching-learning as an enjoyable experience for both teachers and learners. Another important factor that can make such programs happen is the liberal administrative support and effective use of technology.

It is an experimental program that has been commissioned in respond to the growing concerns over long standing issues in school mathematics education. The course aims to prepare wholesome teachers who are teachers from the heart and learners from the minds. It gives wings to the teachers to fly, to explore and to reach to the undefined boundaries of teaching –learning where infinity is the limit. Though success of the program will be judged by the stakeholders in due course of time when the products of the course will be able to make visible change in the quality of mathematics teaching in the schools, success of such programs will surely give confidence to many educationists who speak their minds and who believe in innovations. It will be the real time to re-write the vision of school mathematics in the country:

"*A classroom where no child is scared of mathematics, where mathematics is a subject of conversation and cheers, when students opt for mathematics by their own choice, not by any force or compulsion, when mathematics classroom is an interactive session of discovery, dialogue and without boundaries., when mathematics learning is fun for everyone".*

References

[1] Annual Status of Education Report, Pratham, 2014.
[2] Learning Without Burden, Report of the National advisory Committee, Ministry of Human Resource Development, Department of Education, India, 2004
[3] National Curriculum Framework- NCERT, 2005
[4] National Knowledge Commission Report-2009
[5] National Curriculum Framework for Teacher Education, NCTE-2010.
[6] Position Paper By National Focus Group On Teaching Of Mathematics, NCERT, 2005.