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# Issues and Challenges of Mathematics Teacher Education: An Indian Outlook

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## Abstract

*Mathematics is considered as one of the most difficult core subjects worldwide. Mathematics Education faces a lot of challenges, many of which arises from issues in the teacher education. The quality of teacher education plays a crucial role in shaping the quality of mathematics instructions in schools. In this present educational context, teaching-learning process has undergone a paradigm shift, especially with the emergence of technology. Teaching-learning has become more student-centric and teachers' role has become more of a facilitator. Despite ongoing reforms, several problems persist in mathematics teacher education, including inadequate subject knowledge and pedagogical skills of pre-service and in-service teachers, limited opportunities for practical training, and lack of integration of technology, which impacts their ability to deliver engaging and conceptually rich lessons. Most teacher education programmes give emphasis on theory rather than practical teaching experiences which creates a disconnect between training and real classroom situations. Furthermore, shortage of qualified mathematics teachers, especially in the rural and far-flung areas, elevates the problem, leading to larger class sizes and reduced individualized instruction. Thus, the responsibility in making of a competent mathematics teacher lies in the quality of teacher education. There arises an urgent need for updating teacher education and the whole education system by bringing in qualitative improvement of teacher education. This research study brings out the issues and challenges in teacher education with regard to mathematics education, and provides suggestive measures to address the same.*

**Keywords:** *Issues, Challenges, Mathematics Teacher Education, Teacher Educators, Teacher trainees*

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## 1. Introduction

Mathematics plays a crucial role in shaping cognitive ability and problem-solving skills. India is a country with rich heritage in mathematics dating back to mathematicians like Ramanujan and Aryabhatta. Teacher education is fundamental in preparing future educators with necessary skills and knowledge for effective classroom instruction. Multiple reports from Government bodies, NGOs and International evaluations have highlighted that there are various obstacles that impede the efficient teaching and understanding of mathematics in Indian schools (Sharma & Bhardwaj, 2024). Mathematics is considered one of the most difficult core subjects in the schools even today. Teaching-learning of mathematics require for both the teachers and students to effectively communicate. Therefore, need arises for good and competent mathematics teachers at all levels of schooling. For this, quality of teacher education plays vital part as it directly impacts on quality of math teachers it produces. Good mathematics teacher preparation is crucial due to the subject's abstract nature and its importance in STEM fields. The processes in solving mathematics involves certain type of reasoning that can be generalized to solve challenges we face in everyday life. As per the ASER (2018-2023) and NAS (2019-2022) reports, many mathematics teachers struggle with pedagogical skills that are needed to make the subject engaging. Instruction mostly follows traditional, lecture-based techniques instead of being more interactive, student-centered methods. Most pre-service and in-service mathematics teachers often face significant challenges with mathematical processes like

problem-solving, generalization, and abstraction. These processes are fundamental to mathematics, so it is essential for future math teachers not only to master them but also to understand them and how mathematics differs from other subjects. Mathematics teacher education in India is plagued by systemic issues such as inadequate training, resistance to adopt modern teaching methods, and lack of subject-specific pedagogical knowledge. This paper aims to analyze these challenges and propose suggestive measures for enhancing the preparation as well as career advancement and growth of mathematics teachers.

### 1.1 Teacher Education

Teacher Education is a major part of the educational system which is closely linked to the society and influenced by the values, traditions and identity of the nation. The National Council for Teacher Education (NCTE) has described teacher education as "A programme of education, research and training of persons to teach from pre-primary to higher education level". Thus, in order to meet the demands of the profession and address the challenges it presents, we can see that teacher education is a programme that focuses on developing proficiency and competency of teachers.

Teaching is a service-driven profession which demands dedication and selflessness. It is one of the most common yet impactful careers in the society as teachers work with the most delicate and significant subject-children (Anees, 2015). As for a mathematics teacher, it takes more effort and undue challenges to remove the fear of mathematics among the students. to enhance quality of school education, especially for mathematics teachers, professional teacher training is essential. Investigation carried out by Arthur et al. (2017) revealed that students' performance in mathematics was affected by several factors such as the teacher's quality, both the teacher's and student's motivation, the efficacy of the teaching methods and teacher's self-confidence in their abilities. The goal of advancing the nation into the 21st century, especially with the advancement in STEM education, it cannot be realized without equipping mathematics teachers with the requires pedagogical skills and expertise, which can be cultivated only through a structured and modernized approach to revitalizing teacher education programmes.

### 1.2 Status of Mathematics Teacher Education in India

India has made fundamental contributions to mathematics, such as the discovery of zero, the development of the decimal number system, and the introduction of negative numbers. However, despite all these rich mathematical heritage, India's current influence in the field of mathematics is minimal (Thakur, 2020). In the words of Bhargava, this may be due to a major misstep in India's higher education system after independence where division between teaching and research occurred. The teaching sector, particularly the state universities largely lack research activities. Several studies have shown that a lack of good trained mathematics teachers, especially in the rural areas where most of the learners are first generation learners and they rely entirely on their teachers for learning. Mathematics teaching in schools have become very monotonous and thus there is need for teachers to go beyond their textbooks and not only think about completing their syllabus, which trend most teachers follow. A recent study conducted by EI, an EdTech company found that almost 80% of in-service mathematics teachers in India struggle with basic fundamental concepts, including ratio, proportional reasoning, algebraic thinking, estimation, and logical reasoning (The Economic Times, 2024).

#### 1.2.1 Recommendations for Teacher Preparation given by MHRD, Govt. of India

i. Pre-service Teacher Education

Curriculum of teacher education progammes encompasses D.El.Ed. and B.Ed. should be reviewed with a focus on science, mathematics and technology. The revised curriculum should emphasize problem-solving, critical thinking, reflective learning, and integrating technology into teaching, learning, pedagogy, and assessment in Science and Mathematics.

ii. Capacity Building for In-service Teachers

The most skilled and experienced Science and Mathematics teachers in each State/Ut should be identified as Master Teachers. They will be made responsible for developing specialized training modules and training

programmes for teachers at different levels- primary, elementary, secondary and higher secondary. These training modules should promote inquiry-based activities, investigations, and real-life application of the concepts.

Teacher educators from SCERTs, CTEs, IASEs, DIETs, and Block/Cluster Resource Centers should also receive capacity-building training. This will help them effectively design and implement in-service training programmes for Science and Mathematics.

iii. Mentoring System

Higher Education Institutions (HEIs), R&D Institutions, and private science and technology organizations should mentor science and mathematics teachers. The mentoring framework should include:

- Resource Support: Providing materials such as printed and digital content, lab resources, maps, posters, audio-visual aids, and interactive handbooks for strengthening the teachers' conceptual understanding.
- Collaborative Learning: Organizing Block/Cluster-level meetings for teacher circles to encourage peer learning, discussions, student learning behaviour, and ways to make classroom instruction more effective.
- Hands-on Training: Offering teachers with opportunities to observe, practice, and reflect on their teaching methods. They should be given classroom and practical exposure under expert guidance, with emphasis on inclusive pedagogy.
- Academic Guidance: Providing access to Resource Persons for professional support, feedback and fostering innovation in teaching.

iv. National Teachers Science / Mathematics Congress

Teachers should be encouraged and supported to present and share innovative teaching methodologies and concepts at various forums. Mentoring institutions should help identify and guide science and mathematics teachers to actively participate in such platforms.

v. Teachers as Agents of Change

School Head Maters and teachers should be oriented to serve as facilitators, rather than must educators to help in fostering student-led science and mathematics clubs. Their role would be to create enthusiasm and curiosity among students, motivating them to explore and engage with science, mathematics and technology beyond the classroom.

## 2. Objectives

Following are the objectives of the study:

i. To identify underlying issues and challenges of Teacher Education in relation to Mathematics Education.
ii. To provide suggestive measures to address the issues and challenges of Teacher Education in relation to Mathematics Education.

## 3. Methodology

This research paper employs an analytical approach and relies on secondary data. The information has been gathered multiple sources such as official government reports, newspapers, NEP 2020 document, and research articles from various online sources.

## 4. Issues and Challenges in Mathematics Teacher Education

Teachers are the most crucial component of the whole teaching process (Amiruddin, 2023). The most important thing in solving the students' mathematical problem is the role of a good mathematics teacher. Teacher education further enhances credentials and improves teaching skills (Bala, 2018). However, today mathematics teachers face

several challenges in delivering justice to their roles. In mathematics teacher education, some of the main problems and difficulties are:

i. **Lack of Qualified Mathematics Teacher Educators**

One of the major issues that we are facing today is the shortage of qualified mathematics teacher educators in the Teacher Education Institutions (TEIs) and District Institutes of Education and Training (DIETs). Because there aren't enough certified teacher educators specializing in mathematics education, student teachers are deprived of opportunity of receiving quality instructions, and as such their teaching of mathematics subject gets badly affected. Many teacher educators have secondary school teaching experience but are not trained in primary-level mathematics instruction. Thus, leading to ineffective training for primary school teachers.

**ii. Poor academic performance background of teacher trainees**:

Mostly candidates getting admission in teacher training programmes often have poor academic background who have no intrinsic motivation to become an efficient teacher (Bala, 2018). Thus, deserving candidates with good academic background lose the opportunity to the less competent candidates.

**iii. Inadequate Mathematical Content Knowledge**

The entry behaviour (prior knowledge) of the teacher trainees who join the teacher education programmes speaks volume about how successful a mathematics teacher they are in the making. Most teacher education programmes do not provide an in-depth knowledge of the subject. The NITI Aayog STEM Report (2021) highlighted that many teachers themselves lack strong understanding of the mathematical concepts which makes it difficult for them to teach beyond the textbooks. Thus, mathematics teachers who join teaching lack the required mathematical knowledge and content.

**iv. Inappropriate Internship for Teacher-trainees.**

Internship plays a crucial part in training mathematics teachers by offering hands-on teaching experience and allowing them to apply theoretical knowledge in a real classroom situation. However, poorly designed internships can negatively affect the teaching abilities of future teachers. Teaching methods remain the typical traditional approach, emphasizing on lecture -based method and giving less importance to student-teacher interaction that is student-centric (Sharma & Bhardwaj, 2024).

**v. Lack of Proper Supervision and Mentorship**

Supervising teacher-educators or mentors themselves may not have received adequate training to be able to support and guide the teacher-trainees in improving their teaching strategies. At times, the lesson-plans prepared by the interns are superficially evaluated and there is no or little interaction with the subject expert. This may lead to disconnect between theory and practice.

**vi. Limited Duration of Course and Exposure**

In India, the time duration for teacher-training programmes have been extended to two years in order to make it possible to produce competent prospective teachers (Desai, 2012). The duration for internship is quite short for the teacher-trainees for gaining meaningful teaching experiences. Some interns focus on the prepared lesson rather than engaging in the lesson-planning and classroom instruction. Also, there is little or no exposure of teacher-trainees to diverse classrooms and learning styles of students which leads to the teacher-trainee's inability to adapt to varying teaching methods.

**vii. Outdated Teaching Methods**

Teacher training programmes including both pre-service and in-service have become outdated with less focus on innovative teaching practices. The way teachers learn mathematics affects the way they teach the subject (Abramovich & Connell, 2014). Moreover, several schools where the teacher-trainees / interns are sent for internship, rely mostly on rote learning and teacher-centered instructional methods. The lack of emphasis on

inquiry-based and problem-solving approaches badly reduces the intern's ability to develop an in-depth analytical skills about the students. Also, due to limited time period, teacher-trainees / interns hardly get opportunity to integrate technology and hands-on activities into their teaching.

**viii. Lack of Classroom Management Skills of Mathematics Teachers**

Asare et al (2024) investigated the effect of teacher effectiveness and classroom management on mathematics proficiency and found that effective classroom management during mathematics class have positive influence on the mathematics achievement of students, and that mathematics achievement was negatively impacted by the quality of math teacher.

**ix. Mismatch between Training Content and Real Classrooms Needs**

Many teacher training programmes are designed without taking into consideration the practical difficulties that teachers face in the real classroom setting. This gives rise to disconnect between the content covered during the training sessions and the real-world teaching challenges.

**x. Poor Attitude of the Older In-service Mathematics Teachers towards Use of Latest Pedagogical Approaches**

The field of education is constantly evolving with new pedagogical approaches being introduced to enhance students' learning. However, many older in-service mathematics teachers often show reluctance or resistance to adopt the modern teaching methods. This may be due to older mathematics teachers who have been using the traditional method of teaching, may be uncomfortable in using the latest technologies and incorporating them into their classroom teaching practices.

## 5. Suggestions to Address the Issues and Challenges of Teacher Education in relation to Mathematics Education

Numerous factors could contribute to enhancement of mathematics teachers' teaching strategies. If these are considered with seriousness, we could see significant improvement in the teachers' teaching and students' achievements.

**i. Strengthening the Present Teacher Education Curriculum and Pedagogical Training**

Current programs for teacher education need to be revised in order to align with the modern / 21st century mathematics curricula. Accordingly, teacher educators should be competent enough to help the teacher-trainees incorporate problem-solving skills, critical thinking, and real-life applications into mathematics instruction. Teacher Education Institutions (TEIs) should promote student-centric learning approaches among the teacher-trainees.

**ii. Professional Development of Teacher Educators:**

Teacher educators are parent-figure to the teacher trainees. Both pre-service and in-service teachers are supposed to be proficient and nurtured by capable teacher educators in Teacher Education Institutions (TEIs). They are expected to perform their best in the real classroom setting. Thus, the teacher educators, both new and old are to be given exposure to the new emerging trends in education. Regular refresher courses should be conducted for teacher educators (Chand, 2015). TEIs should frequently make necessary arrangements for the teacher educators to receive continuous professional growth and support from a variety of specialists in their respective fields as well as in education and related disciplines (NEP 2020).

**iii. Retaining High-quality Mathematics Teachers and Teacher Educators**

Teacher quality represents the sum of a teacher's overall efficacy, abilities, and traits that support effective instruction and students' growth (Kowalski & Mark, 2020). As a result, schools ought to give top priority to recruiting and keeping qualified teachers (Asare et al, 2024). NEP 2020 also gave recommendations for faculty with trainings in respective pedagogy to be drawn in and upheld in Teacher Education Institutions (TEIs) in

enhancing the transdisciplinary education of educators as well as deliver comprehensive training in conceptualization.

**iv. Integration of Technology in Mathematics Teaching**

The COVID-19 pandemic worsened the existing educational challenges, especially in mathematics teaching and learning. UNESCO (2021) report highlighted that mathematics is a subject which requires consistency in practice, that has been now severely disrupted due to inability to get access to online resources. This inconsistent use of technology in mathematics education has further expanded the gap between the urban and rural students. Thus, the present-day mathematics teachers, both serving in urban and rural areas ought to develop skills and knowledge to integrate technology while teaching mathematics to make it more fun learning and reach out to all students without any disparity.

**v. Uniformity in Admission Standards for Teacher Education**

Teacher education, premier institution establishment of future proficient educators. Consequently, Admission to pre-service teacher preparation programs must be determined by appropriate subject matter and aptitude tests administered by the National Testing Agency in order to preserve consistent standards in teacher education. (NEP 2020). Standardization must account for the linguistic diversity of learners in our nation.

**vi. Developing a network of Teacher Education Institutions with Government and Private Schools**

To work closely, Teacher Education Institutions (TEIs) should build a good network with the government and private schools so that the teacher trainees will get opportunity to engage in student teaching without any hindrances on the part of the school authorities, especially during their internships.

**vii. Emphasize on Pre-service Teachers Training**

The professional growth of teachers is not properly addressed at pre-service level, despite continuous emphasis on professionalism by teacher educators (Naik, 2008). Pre-service teacher education programmes are designed to qualify individuals for future teaching roles. Most pre-service teachers are young and dynamics individuals who will be more than willing to learn technology integration and modern pedagogical skills in their teaching mathematics. This is quite the opposite to the older in-service mathematics teachers.

**viii. Strengthening In-service Teacher Training Programmes**

Regular refresher courses and workshops can be organized for mathematics teachers. The training programmes can be designed in such a way that it addresses the real classroom challenges and provide hands-on learning experiences for the teacher trainees. During the workshops, the experienced teachers can guide and mentor the new teachers on the various modern teaching methods.

**ix. Improving Institutional Support**

Improved Institutional Support for mathematics teacher education can significantly enhance the teaching of mathematics by providing teachers with better access to professional development opportunities, updated and enriched curriculum materials, strong mentorship and a robust support network which can ultimately lead to improved student learning outcomes in mathematics.

**x. Promotion of Mathematics Teacher Circles**

Mathematics teachers in the schools can be organized into teacher circles by mentoring institutions at decentralized levels on a voluntary basis. These mentor institutions will work together towards enhancing teachers' abilities to teach mathematics in an innovative and effective ways, making the learning more engaging and enjoyable for students (Ministry of Education, GOI).

## 6. Conclusion

With implementation of NEP 2020, the education system in India is undergoing an alarming change, emphasizing more on the practical and skill aspects rather than theory. There are many skillsets which could be honed and polished in the students with the proper knowledge of mathematics. In order to improve the status of mathematics achievement in our country, we really need to deliberate upon the issues and challenges identified and try to surmount all challenges hindering the advancement of mathematics education in the country. Teacher Education should revitalize its curriculum and practical training of in-service and pre-service mathematics teachers so that quality of teaching of subject is improved. The teachers, both young and old must stay updated with the latest pedagogical approaches.

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