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# Evaluating Pedagogical Competencies in Mathematics Among Secondary-Level Student Teachers: A Comprehensive Assessment

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#### ABSTRACT

The standard of education determines the quality of a country, and the standard of education determines the quality of a teacher. The achievement of teacher competences in pedagogy subject specialty can be used to determine a teacher's quality and it plays a pivotal role in the teaching-learning process and those skills are very crucial to nurture pupils' knowledge and pedagogical knowledge in the teacher training program. To convey mathematical concepts and skills in way that accessible and engaging by uses of suitable pedagogical approaches and skills for learners needed to be mastered in the pedagogy of mathematics. The present study aimed to assess pedagogical competencies in mathematics among student teachers at secondary level. The main objective of the study was to find out the level of attainment of pedagogical competencies in mathematics and compare those competencies with different teacher educational programmes. The survey method was adopted and the size of the sample was all student teachers of four year and six-year teacher education programme. The investigator administrated the tool of an achievement test in skills and strategies of teaching mathematics. The study's conclusions showed that, in the pedagogy of mathematics, 15% of student teachers had attained non-mastery, 69% had achieved partial mastery, and 16% had achieved mastery level. Additionally, there was no discernible difference between the four-year and six-year student teachers in the teacher education program.

**Keywords:** Pedagogical Competencies, Student teachers, Secondary level, Assessment, Mathematics Education.

#### **1.0 Introduction:**

The effectiveness of an education system is largely dependent on the competencies of its teachers, particularly in subjects like mathematics, where conceptual clarity and problem-solving skills are essential (Sharma, 2019; Darling-Hammond, 2000; Ball, Thames, & Phelps, 2008). In India, inconsistencies in curriculum design and teacher preparation have been long-standing concerns, directly impacting student learning outcomes (National Education Policy, 2020; NCERT, 2018). While structured teacher education programs exist, the need to evaluate the pedagogical competencies of student teachers remains critical for improving instructional effectiveness (Grossman, Hammerness, & McDonald, 2009; Shulman, 1987).



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Mathematics presents unique challenges for both students and educators. Students demonstrate varying levels of comprehension, making it necessary for teachers to adopt effective instructional strategies (Ball, Hill, & Bass, 2005; Hill, Rowan, & Ball, 2005). Effective mathematics teaching requires a deep understanding of subject matter, the ability to simplify abstract concepts, and the use of diverse teaching methodologies (Kilpatrick, Swafford, & Findell, 2001; Schoenfeld, 2013). Therefore, teacher education programs must prioritize equipping student teachers with the pedagogical skills necessary to enhance learning outcomes at the secondary level (Garet et al., 2001; Zeichner, 2012).

#### 1.1 Teacher Education Programmes in India

India's teacher education system has witnessed significant policy-driven reforms aimed at enhancing teacher preparation and professional competencies. The National Council of Educational Research and Training (NCERT) and the National Council for Teacher Education (NCTE) have played a pivotal role in structuring various teacher training programs, including the two-year B.Ed., four-year integrated B.Ed., and six-year teacher training programs (NCERT, 2018; NCTE, 2014). These programs are designed to equip pre-service teachers with pedagogical knowledge, subject-specific expertise, and practical teaching experience necessary for effective classroom instruction (Sharma & Sharma, 2020; Kumar, 2017). Furthermore, initiatives such as internships and micro-teaching sessions have been integrated to provide hands-on teaching experience, fostering confidence and adaptability among student teachers (Ghosh, 2019; Rao, 2021).

The National Education Policy (NEP) 2020 emphasizes the importance of continuous professional development (CPD) to ensure that teachers remain updated with evolving pedagogical trends and methodologies (National Education Policy, 2020; MHRD, 2020). CPD programs involve workshops, competency-based training, and mentorship opportunities that aid in refining teaching strategies and improving classroom engagement (Cochran-Smith & Zeichner, 2005; Darling-Hammond & Bransford, 2005). Research highlights that teacher who undergo structured professional development exhibit improved instructional effectiveness and student engagement (Garet et al., 2001; Guskey, 2002). Additionally, the NEP 2020 advocates for the integration of technology in teacher training, enabling educators to leverage digital resources and innovative teaching methods (Mishra & Koehler, 2006; NCTE, 2021).

Despite these advancements, challenges persist in teacher education programs, particularly in ensuring uniform quality across different institutions and states (Singh, 2018; Batra, 2019). Variability in curriculum design, lack of standardized evaluation mechanisms, and limited access to resources continue to hinder the effectiveness of teacher training initiatives (Joshi, 2020; Mukhopadhyay, 2021). Research suggests that stronger policy implementation and periodic curriculum revisions are essential to address these disparities and enhance the overall quality of teacher education (Pandey & Mishra, 2017; Banerjee, 2020). Furthermore, studies advocate for a shift towards experiential learning models that emphasize real-world teaching scenarios, problem-solving skills, and reflective practice (Zeichner, 2012; Korthagen, 2017).

To improve teacher education in India, policymakers and institutions must prioritize research-based reforms that focus on pedagogical competency, subject-matter expertise, and inclusive teaching practices (Darling-Hammond, 2017; Mehta, 2022). Establishing robust assessment frameworks, fostering collaboration between academic institutions and schools, and investing in teacher education infrastructure are crucial steps in strengthening the effectiveness of training programs (Agarwal & Sharma, 2020; Nanda, 2021). By aligning teacher preparation with contemporary educational needs and global best practices,



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India can enhance the overall quality of its education system and ensure better learning outcomes for students (NCERT, 2018; National Education Policy, 2020).

#### 1.2 Key pedagogical competencies in Mathematics:

Pedagogical competence in mathematics encompasses a range of skills, including subject knowledge, instructional design, assessment strategies, and fostering analytical thinking among students (Shulman, 1986; Ball et al., 2008). Essential competencies include:

- 1. **Mathematical Content Knowledge** Mastery of mathematical concepts and their interrelations (Ma, 1999; Kilpatrick et al., 2001).
- 2. **Pedagogical Content Knowledge (PCK)** The ability to teach mathematical concepts effectively and address student misconceptions (Shulman, 1987; Ball et al., 2008).
- 3. Classroom Management Skills Techniques for creating an engaging and inclusive learning environment (Marzano, Marzano, & Pickering, 2003).
- 4. Assessment and Feedback Strategies The capacity to measure student progress and provide constructive feedback (Black & Wiliam, 1998; Shepard, 2000).
- 5. Adaptability in Teaching Differentiating instruction to cater to diverse student needs (Tomlinson, 2001; Darling-Hammond, 2006).
- 6. **Reflective Teaching Practices** Self-evaluation and continuous improvement in instructional methods (Schön, 1983; Zeichner & Liston, 1996).

#### **1.3 Importance of competency Assessment:**

Assessing pedagogical competencies is essential to determining the effectiveness of teacher training programs (Darling-Hammond, 2010; Grossman et al., 2009). Various evaluation models, such as the TPACK framework (Technological Pedagogical Content Knowledge) and the Danielson Framework for Teaching, provide structured approaches for assessing teaching effectiveness (Mishra & Koehler, 2006; Danielson, 2007). In addition, observational assessments and standardized evaluations can offer deeper insights into student teachers' readiness for classroom challenges (Hattie, 2009; Pianta, La Paro, & Hamre, 2008).

To improve India's education system, evaluating the pedagogical competencies of mathematics student teachers is essential (National Education Policy, 2020; NCERT, 2018). As the landscape of mathematics education evolves, teacher education programs must adapt to provide student teachers with the necessary tools to succeed (Darling-Hammond & Bransford, 2005; Garet et al., 2001). Establishing strong assessment mechanisms will help educators refine training programs, ultimately leading to improved instructional quality and better student learning outcomes.

#### 2.0 Rationale for the study:

The quality of school education depends on the quality of the teacher, efficiency, and teacher competencies which include various pedagogical practices, teaching classroom skills like writing learning objectives, reinforcement skills, identifying suitable methods, content knowledge, pedagogical content knowledge, etc. Furthermore, developing mathematical skills depends on the quality of mathematics teachers which means mathematics teachers must be able to solve mathematical, professional, and teaching problems successfully. Hence, student teachers must be highly motivated to learn new innovative approaches, and teaching techniques and acquire various teaching-learning skills to become proficient teachers in the field of teaching that are helpful to build toward nation development. There are some policies also suggested that there is a need to evaluate the effectiveness of existing teacher education programs in order to identify



the level of attainment in pedagogical competencies and to develop high quality curriculum. (NCTE,2019; &Justice Verma committee,2012). Moreover, the skills that are required to become proficient teachers, the student teachers during their pre-service program need to learn different skills under different conditions, therefore, the researcher intended to find out the teacher competencies level of student teachers who are studying an integrated undergraduate program, and to understand the areas that student teachers are facing in learning in the pedagogy of mathematics.

#### **3.0 Statement of the problem:**

Evaluating Pedagogical Competencies in Mathematics Among Secondary-Level Student Teachers: A Comprehensive Assessment.

#### 4.0 Objectives:

- 1. To determine the level of attainment of the pedagogical competencies in mathematics.
- **2.** To compare the levels of attainment in pedagogical competencies in mathematics among student teachers of different teacher education programs

#### 5.0 Hypothesis:

There is no significant difference between in the attainment of pedagogy competencies of mathematics among student teachers of 4-year and 6-year Teacher education programs.

#### 6.0 Methodology of the study:

The present study aims to assess the level of achievement of teacher competencies among student teachers enrolled in integrated teacher education programs at the Regional Institute of Education (RIE) Mysore. To achieve this objective, the investigator adopted a descriptive survey method, which is well-suited for evaluating existing conditions and analyzing differences among groups. The study sample comprises student teachers specializing in the pedagogy of mathematics within four-year and six-year teacher education programs at RIE Mysore. This specific focus enables a comparative analysis of competency attainment among student teachers enrolled in different program durations. The study is delimited to the fourth-year students of both programs to ensure consistency in the level of training received and to provide an accurate representation of the effectiveness of these integrated programs. To measure teacher competencies, the study utilizes an achievement test in skills and strategies for teaching mathematics, originally developed and validated by Prof. K. Doraswamy (1986) and Y. Nirmala (1992). This tool systematically analyzes curriculum components and evaluates teacher competencies essential for mathematics instruction at the secondary level. The instrument consists of 20 teacher competencies, with each competency assessed through 10 items. Competency scores reflect the degree of attainment in specific pedagogical areas, while cumulative competency scores indicate overall competency achievement. The data collected is subjected to statistical analysis using SPSS software. Descriptive statistics, frequency analysis, and independent sample t-tests are employed to analyze the data in alignment with the study's objectives and hypotheses. For data collection, the researcher ensured the suitability of the tool for fourth-year and sixth-year student teachers enrolled in BSc. Ed and MSc. Ed programs, where pedagogy of mathematics is taught alongside major subjects. Prior to administering the test, the investigator established rapport with the participants to facilitate accurate and reliable responses. The structured assessment method ensures a comprehensive evaluation of the teacher competencies attained



by student teachers in these integrated programs, contributing valuable insights into teacher education quality and professional readiness.

#### 7.0 Data Analysis and Interpretation:

**Objective 1:** To determine the level of attainment of the pedagogical competencies in mathematics.

In order to attain the first objective of the study namely" To determine the level of attainment of the pedagogical competencies in mathematics" A test was administered to the 4<sup>th</sup> year BSc. Ed and MSc. ED student teachers of RIE Mysuru and scores were recorded. The results are indicated in the following table:

Statistic	Value
Mean	81.28
Median	81.00
Mode	69.00
Std. Deviation	25.77
Skewness	-0.127
Kurtosis	-0.704

Table 01: Descriptive statistics of student-teacher competencies in the pedagogy of mathematics.

The results from Table 1 indicate the mean, median, and mode values of the total score of student-teacher competencies in the pedagogy of mathematics are 81.28, 81, and 69 respectively. The standard deviation value is 25.77. which shows that the total achievement scores are relatively packed within the distribution from the mean. The skewness value is -0.12, which indicates a slightly negatively skewed distribution. The kurtosis value is -0.70, which indicates a slightly platykurtic distribution. That means it shows that teacher education programs need to focus on the development of teacher competencies in a comprehensive manner. Figure-1 represents the distribution of achievement scores of student-teacher competencies in the pedagogy of mathematics slightly away from the normal distribution. Hence there is a need to emphasise or focus on developing student-teacher competencies in the pedagogy of mathematics.



Fig 1. Descriptive statistics of attainment of student-teacher competencies in the pedagogy of mathematics.

Attainment level	Frequency	Percentage	
Non-Mastery	10	14.9	
Partial Mastery	46	68.7	
Overall Mastery	11	16.4	

## Table No:02 Frequency and Percentage of attainment of student-teacher competencies in the nedagogy of mathematics.

The results from the table 2 indicate that there are 67 participants in the sample. It is evident that 14.9% of the student teachers are non-mastery in attaining the pedagogy of mathematics competencies which shows poor attainment than the mean value (81.28) while 68.7 % of the student teachers are partially mastered in the attainment of pedagogy of mathematics competencies. It shows that average attainment than the mean value and 16.4% of the student teachers are mastery in attaining the pedagogy of mathematics competencies. Which indicates that they have attained overall teacher competencies in the pedagogy of mathematics.

**Objective 2:** To compare the levels of attainment in pedagogical competencies in mathematics among student teachers of different teacher education programs

To find the whether there is a significant difference in the levels of attainment of student teachers' competencies in the pedagogy of mathematics with respect to different teacher education programs. In order to achieve the second objective of the study namely "To compare the levels of attainment in pedagogical competencies in mathematics among student teachers of different teacher education programs" The following hypothesis is formulated for testing.

#### Hypothesis-1:

There is no significant difference between in the attainment of pedagogy competencies of mathematics among student teachers of four-year and six-year Teacher education programs.

The above hypothesis is tested by using t-test. The summary of the test result is given in Table 3.

Course programme	Ν	Mean	St. Deviation	t-Test			
BSc. Ed	31	83.22	25.34	0.57 <sup>ns</sup>			
MSc. Ed	36	79.61	26.38				

 Table No:03 Descriptive statistics- level of attainment of student teachers in the pedagogy of mathematics. (Course wise)

#### ns = not significant

It is inferred from the above table that the t value is less than the table value at 5% level of significance. So, the null hypothesis is accepted. Hence, there is no significant difference between the four-year and six-year student teachers of teacher education programs in the attainment of teacher competencies in the pedagogy of mathematics.

#### 8.0 Major findings of the study:

The major findings of the study were

• The overall observation of student-teacher attainment of teacher competencies in the pedagogy of mathematics percentages obtained by the student-teacher revealed that more than 83% of the students indicate that low level of teacher competencies.



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- 14.9% of the student teachers are non-mastery in attaining the pedagogy of mathematics competencies which shows poor attainment than the mean value (81.28)
- 68.7 % of the student teachers are partially mastered in the attainment of pedagogy of mathematics competencies.
- 16.4% of the student teachers are mastery in attaining the pedagogy of mathematics competencies.
- The mean score of the four-year (BSc. Ed) is 83.22 which is higher than that of the six-year (MSc. Ed) which is 79.61. Indicate that four-year student teachers attained teacher competencies greater than the six-year student teachers through both teacher education programs student teachers get similar training over a longer period of time along with the major subject.
- There is no significant difference between the four-year and six-year student teachers of teacher education programs in the attainment of teacher competencies in the pedagogy of mathematics at 5% significance level.

#### **9.0 Discussion of the findings:**

The present study reveals that the attainment of student-teacher competencies in the pedagogy of mathematics at the secondary level differs significantly between four-year and six-year integrated teacher education programs. The study explores the level of attainment of student-teacher competencies and compares the significance level in the attainment of student-teacher competencies in the pedagogy of mathematics of both programs. The development of student-teacher competencies in mathematics pedagogy has a direct impact on student learning and academic achievement.

Hattie and Yates (2014) highlight the importance of quality mathematics instruction and the role of teachers in the teaching-learning process. They suggest that developing student-teacher competencies in the pedagogy of mathematics will help student teachers become more effective in imparting mathematical concepts, improving learning outcomes, aligning with curriculum reforms, addressing math anxiety, and fostering a deeper understanding among students. The findings of this study align with their research by emphasizing the need for structured training in mathematics pedagogy to ensure effective teaching.

Furthermore, the findings of the present study support the recommendations of Tapan Kumar Basantia and Krushna Chandra Patra (2021), who argue that the implementation of four-year integrated programs has not yet been satisfactory. They recommend that these programs should be regularly revised or modified. This study similarly found that most student teachers attained only non-mastery or partial mastery of student-teacher competencies in mathematics pedagogy. Therefore, it is essential to revise the curriculum periodically to enhance competency development and ensure proficient teacher preparation.

The study is limited to fourth-year students of four-year and six-year integrated teacher education programs at RIE-Mysore, with a relatively small sample size. Future research could expand the scope by including student teachers from various institutions and diverse educational backgrounds. Additionally, longitudinal studies tracking competency development over time would provide deeper insights into the effectiveness of these programs.

The present study's findings also support the National Education Policy 2020 (NEP, 2020), which emphasizes the need for continuous professional development of teachers. NEP 2020 calls for the transformation of teacher education programs to ensure comprehensive training in pedagogical methods for mathematics, including changes to the B.Ed. curriculum to align with the evolving demands of the education sector. The policy also recommends that teacher competencies should be assessed regularly to identify areas where they need additional support in mathematics pedagogy.



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The study conducted by Lee and Wang (2020) further corroborates these findings. Their research highlights that assessing student-teacher competencies within mathematics pedagogy can help identify the actual challenges faced in teaching mathematics. They emphasize the importance of micro-teaching sessions, which include various teaching skills and methods, and the assessment of different strategies to help student teachers become more effective educators. Their findings align with this study's conclusion that competency assessment plays a crucial role in enhancing teaching effectiveness.

Overall, the findings underscore the need for continuous curriculum evaluation, competency-based assessment, and professional development to improve the quality of mathematics pedagogy in teacher education programs. By addressing these critical aspects, the education system can better prepare student teachers to meet the evolving challenges of mathematics instruction and ensure improved learning outcomes for students.

#### **10.0** Conclusion and Future recommendations:

The findings of this study revealed that most student teachers in both four-year and six-year integrated programs attain non-mastery or partial mastery levels in student-teacher competencies in the pedagogy of mathematics. Only a small percentage of student teachers achieved full mastery of these competencies. Therefore, it is imperative to provide guided training and practical experience to help student teachers attain essential pedagogical competencies, ensuring their effectiveness in mathematics instruction.

The National Education Policy (NEP, 2020) underscores the significance of high-quality teacher training that integrates content mastery, pedagogy, and practical application. The Justice Verma Committee (2012) and the NCTE (2019) have similarly emphasized the need for evaluating and improving teacher education programs to enhance pedagogical competencies.

To strengthen the teacher education framework, integrated programs should incorporate diverse teaching strategies, classroom management techniques, and assessment methods through hands-on training. Additionally, fostering an experiential learning environment will enhance teaching effectiveness and promote the acquisition of essential competencies.

#### **Future Recommendations:**

- **Curriculum Enhancement:** Regularly revise and update teacher education curricula to align with evolving pedagogical needs and technological advancements.
- **Competency-Based Assessment:** Implement structured evaluation mechanisms to identify areas requiring additional support and provide targeted training.
- **Experiential Learning:** Increase practical teaching experiences, including classroom simulations, peer observations, and mentorship programs.
- **Professional Development:** Facilitate ongoing professional training programs to ensure continuous skill enhancement and adaptability to emerging teaching trends.
- **Inclusive Pedagogical Strategies:** Develop methodologies that cater to diverse student learning needs, ensuring equitable education for all learners.

By implementing these recommendations, teacher education programs can be refined to produce highly competent and effective mathematics educators, ultimately improving student learning outcomes and the overall quality of education.



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