



## Role of numerical skills in enhancing mathematical ability in competitive examinations

Ramya Rajendran<sup>1</sup>, Dr. G Rajeswari<sup>2\*</sup>

<sup>1</sup> Research Scholar, Alagappa University College of Education, Alagappa University, Karaikudi, Tamil Nadu, India

<sup>2</sup> Assistant Professor, Alagappa University College of Education, Alagappa University, Karaikudi, Tamil Nadu, India

Corresponding Author: Dr. G Rajeswari

### Abstract

Numerical skills play a fundamental role in shaping mathematical ability, particularly in the context of competitive examinations where speed, accuracy, and reasoning are critical. This article examines the significance of numerical competence in enhancing mathematical performance, drawing on contemporary research in mathematics education, cognitive science, and assessment practices. Numerical skills are not limited to basic computation but extend to number sense, estimation, and problem-solving strategies that influence overall mathematical proficiency. The paper explores how numerical abilities contribute to performance in competitive examinations by supporting logical reasoning, analytical thinking, and efficient problem-solving. It also highlights pedagogical approaches that strengthen numerical skills, including activity-based learning and technology-supported instruction. This discussion incorporates culturally responsive perspectives, emphasizing the role of indigenous knowledge systems in shaping numerical understanding. While challenges such as numeracy difficulties and performance pressure persist, strengthening numerical skills remains a key pathway to improving mathematical ability. The article concludes with implications for teaching practices and recommendations for enhancing numeracy-focused instruction in competitive learning environments.

**Keywords:** Numerical skills, mathematical ability, competitive examinations, problem solving, numeracy literacy

### Introduction

Mathematical ability is increasingly recognised as a multidimensional construct that extends beyond procedural knowledge to include reasoning, problem-solving, and numerical competence. In competitive examinations, where time-bound performance and accuracy are crucial, numerical skills serve as the foundation for efficient and effective mathematical thinking. These skills enable learners to interpret quantitative information, perform calculations with precision, and apply logical reasoning in unfamiliar problem contexts. Numerical skills, often referred to as numeracy or numerical literacy, encompass a range of competencies including number sense, estimation, mental calculation, and quantitative reasoning. These skills are essential for understanding mathematical relationships and for applying mathematical concepts in practical situations. Research has shown that numerical ability is closely linked to mathematical achievement, as it supports the development of higher-order cognitive processes required for problem-solving (Elliott *et al.*, 2019) [3]. In this sense, numerical skills act as a bridge between basic arithmetic operations and advanced mathematical reasoning.

From a conceptual perspective, numerical skills are not merely mechanical abilities but involve flexible thinking and conceptual understanding. Learners who possess strong numerical skills are better able to recognise patterns, make connections, and choose appropriate strategies when solving problems. This is particularly important in competitive examinations, where problems often require quick interpretation and strategic decision-making rather than routine application of formulas. Studies on mathematical competencies highlight that effective assessment of mathematical ability must consider these underlying numerical processes (Boesen *et al.*, 2018) [1]. At the same time, numerical skills are shaped by both cognitive and

environmental factors. Cognitive research suggests that early numerical understanding, such as approximate number sense, plays a significant role in later mathematical development (Elliott *et al.*, 2019) [3]. Educational experiences, including teaching methods and learning environments, further influence how these skills are developed and applied. For instance, learners exposed to structured problem-solving approaches and numeracy-focused instruction tend to demonstrate stronger mathematical performance.

In the context of competitive examinations, the importance of numerical skills becomes even more pronounced. These examinations often test not only knowledge but also the ability to apply that knowledge under pressure. Numerical competence allows candidates to process information quickly, reduce computational errors, and allocate time efficiently across questions. Conversely, a lack of numerical proficiency can hinder performance, even when conceptual understanding is present. As noted in studies on numeracy difficulties, gaps in basic numerical skills can significantly affect learners' confidence and problem-solving ability (Chinn, 2020) [2]. Thus, numerical skills form the core of mathematical ability, influencing both learning outcomes and performance in high-stakes assessments. Understanding their role is essential for designing effective instructional strategies and for preparing learners to meet the demands of competitive examinations.

### Cultural Foundations of Numerical Skills

Numerical skills are shaped not only through formal instruction but also through cultural practices and everyday experiences. Indigenous knowledge systems embed mathematical thinking in activities such as trade, measurement, and pattern recognition, allowing learners to develop intuitive understanding of numbers. These

experiences provide a contextual foundation that supports the development of number sense and practical reasoning. When learners connect mathematical concepts with familiar cultural contexts, their comprehension becomes more meaningful and sustained.

In many traditional settings, numerical reasoning is acquired through real-life engagement rather than abstract instruction. Practices such as estimating quantities, managing resources, and recognizing proportional relationships contribute to the development of flexible numerical thinking. Integrating these practices into formal education can enhance conceptual clarity and application skills. Research indicates that culturally responsive approaches in mathematics education improve learners' ability to interpret and solve numerical problems effectively (Prahmana *et al.*, 2026) <sup>[10]</sup>. The role of culture is particularly important in diverse and multilingual classrooms, where learners interpret mathematical ideas through their own linguistic and cultural frameworks. Contextualizing numerical problems within familiar settings has been shown to improve understanding and problem-solving performance (Ntumi *et al.*, 2026) <sup>[9]</sup>. Additionally, traditional computational techniques, including mental calculation methods, can enhance speed and efficiency, which are essential in competitive examinations (Priya & Thakur, 2026) <sup>[11]</sup>. Thus, integrating cultural knowledge with formal instruction supports the development of strong numerical skills by linking abstract concepts with practical experience, thereby improving both understanding and performance.

#### **Mathematical Ability in Competitive Examinations**

Mathematical ability in competitive examinations is not limited to the recall of formulas or routine procedures; it reflects a combination of numerical fluency, logical reasoning, and strategic problem-solving. Competitive examinations typically assess how effectively candidates can interpret problems, select appropriate methods, and arrive at accurate solutions within strict time constraints. This requires a high level of cognitive efficiency, where numerical skills act as the underlying support for more complex mathematical operations.

#### **Nature of Mathematical Ability in Competitive**

**Contexts:** Mathematical ability in competitive settings is characterized by speed, accuracy, and adaptability. Candidates are often required to process large amounts of numerical information quickly while maintaining precision in their calculations. Unlike classroom assessments, competitive examinations frequently include non-routine problems that test conceptual understanding and the ability to apply knowledge in unfamiliar situations. This demands flexibility in thinking and the ability to shift between different strategies based on the problem context.

Research on mathematical competencies indicates that effective performance depends on the integration of conceptual understanding and procedural fluency. Learners who can efficiently manipulate numbers and recognise patterns are better equipped to handle complex tasks under time pressure (Boesen *et al.*, 2018) <sup>[1]</sup>. Thus, mathematical ability in competitive examinations is closely linked to the strength of underlying numerical skills.

#### **Cognitive Processes Involved in Mathematical**

**Performance:** The performance of candidates in competitive examinations is influenced by several cognitive

processes, including working memory, attention, and reasoning ability. Numerical tasks often require simultaneous processing of multiple steps, making cognitive load a critical factor. Studies on problem-solving highlight that different types of mathematical problems demand different combinations of cognitive skills, such as reasoning, interpretation, and calculation (Strohmaier *et al.*, 2022) <sup>[15]</sup>. Numerical skills reduce cognitive load by enabling quicker mental calculations and efficient information processing. When basic numerical operations become automatic, learners can allocate more cognitive resources to higher-order thinking tasks. This enhances their ability to analyse problems and develop effective solution strategies, which is essential in competitive environments.

#### **Influence of Competitive Pressure on Mathematical**

**Ability:** Competitive examinations introduce an additional layer of complexity through performance pressure. Time constraints, high stakes, and comparison with peers can significantly affect mathematical performance. Research suggests that competitive pressure can influence problem-solving behaviour and even widen performance gaps among learners (Iriberry & Rey-Biel, 2019) <sup>[4]</sup>. In such situations, strong numerical skills can act as a stabilising factor, enabling candidates to maintain accuracy and confidence under pressure.

Learners with well-developed numerical competence are less likely to experience anxiety when dealing with quantitative tasks. Their familiarity with numbers and problem-solving strategies allows them to approach questions systematically, reducing the likelihood of errors. This highlights the importance of strengthening numerical skills not only for academic development but also for performance in competitive settings.

#### **Assessment Patterns in Competitive Examinations:**

Competitive examinations often include a wide range of question types, such as arithmetic problems, data interpretation, logical reasoning, and quantitative aptitude. These questions are designed to evaluate both accuracy and efficiency. The ability to perform quick calculations, estimate values, and identify shortcuts becomes crucial in such contexts.

Studies on numeracy literacy indicate that performance in standardized assessments is strongly influenced by numerical competence, particularly in tasks involving real-world problem contexts (Megawati & Sutarto, 2021) <sup>[6]</sup>. Similarly, research on numerical ability in assessment settings shows that students with strong numeracy skills perform better in solving complex and multi-step problems (Susanto *et al.*, 2023) <sup>[16]</sup>. These findings reinforce the idea that mathematical ability in competitive examinations is deeply rooted in numerical proficiency.

#### **Role of Numerical Skills in Problem Solving and Reasoning**

Numerical skills play a decisive role in shaping how learners approach and solve problems in competitive examinations. These examinations demand not only correctness but also speed and strategic thinking. In such contexts, numerical competence supports the transformation of problem statements into workable mathematical forms, enabling candidates to move efficiently from interpretation to solution.

**Fluency:** Numerical fluency allows candidates to perform basic operations quickly without interrupting the reasoning process. In competitive settings, delays in simple calculations reduce the time available for higher-order thinking. Learners who can mentally process fractions, percentages, and ratios tend to solve problems more efficiently, as they avoid unnecessary intermediate steps. This fluency directly contributes to faster decision-making during problem solving (Lee-Post, 2019)<sup>[5]</sup>.

**Structuring:** Problem solving in competitive examinations often involves multiple steps that must be organized logically. Numerical skills help learners identify relevant quantities, prioritize operations, and maintain consistency across steps. Without this structuring ability, even well-understood problems can lead to incorrect results. The ability to coordinate multiple operations is therefore essential for handling complex questions (Strohmaier *et al.*, 2022)<sup>[15]</sup>.

**Cognition:** The cognitive demand of solving mathematical problems increases when basic numerical operations are not automated. Numerical skills reduce this burden by freeing working memory for reasoning and interpretation. When learners do not need to consciously focus on calculation, they can allocate more attention to analyzing the problem and selecting appropriate strategies. This connection between numerical processing and mathematical performance has been widely observed (Elliott *et al.*, 2019)<sup>[3]</sup>.

**Estimation:** Estimation enables learners to evaluate the plausibility of answers without performing full calculations. In competitive examinations, where multiple-choice questions are common, this skill allows candidates to eliminate incorrect options quickly. It also supports error detection by providing a reference point against which exact answers can be checked.

**Patterns:** Many mathematical problems rely on recognizing numerical relationships such as ratios, sequences, and proportional changes. Numerical skills support this

recognition by helping learners identify underlying structures within the problem. This reduces reliance on memorized procedures and encourages flexible reasoning, which is particularly useful in unfamiliar problem situations (Torres-Peña *et al.*, 2025)<sup>[17]</sup>.

**Technology:** While technology can support numerical reasoning, its effectiveness depends on the learner's foundational skills. Digital tools may assist in computation, but they do not replace the need for understanding numerical relationships. Learners with strong numerical skills are better able to use such tools effectively and interpret their outputs correctly (Zhang *et al.*, 2023)<sup>[18]</sup>.

### Influence of Numerical Skills on Performance in Competitive Examinations

- Strong numerical skills increase speed of computation, enabling candidates to attempt more questions within limited time.
- Numerical competence improves accuracy, reducing calculation errors and enhancing overall score reliability.
- It supports efficient problem interpretation, allowing quicker understanding of quantitative information and question demands.
- Numerical skills enhance adaptability across problem types, including data interpretation, arithmetic reasoning, and quantitative comparisons (Megawati & Sutarto, 2021)<sup>[6]</sup>.
- They reduce cognitive load, allowing learners to focus on reasoning rather than basic calculations (Susanto *et al.*, 2023)<sup>[16]</sup>.
- Under competitive pressure, strong numeracy helps maintain confidence and consistency, minimizing performance fluctuations (Iriberry & Rey-Biel, 2019)<sup>[4]</sup>.
- Numerical skills contribute to effective time management and strategic decision-making, which are key determinants of success in competitive examinations (Ramya & Rajeswari, 2024)<sup>[13]</sup>.

### Types of Numerical Skills in Competitive Examinations

Type of Numerical Skill	Description	Example in Competitive Examinations
Number Sense	Ability to understand magnitude, relationships between numbers, and flexible use of numbers.	Identifying which is greater: 0.75 or 3/4 without calculation; simplifying ratios quickly.
Mental Calculation	Performing arithmetic operations without written steps using shortcuts and strategies.	Calculating 25% of 480 mentally or finding $18 \times 5$ quickly during aptitude tests.
Estimation	Approximating values to check plausibility or eliminate wrong options.	Approximating $\sqrt{50} \approx 7$ to eliminate incorrect answer choices in MCQs.
Arithmetic Fluency	Accuracy and speed in basic operations such as addition, subtraction, multiplication, and division.	Solving time and work problems requiring repeated calculations of fractions and percentages.
Proportional Reasoning	Understanding relationships between ratios, percentages, and proportions.	Solving problems on profit and loss or mixture and allegation.
Data Interpretation Skills	Ability to read, analyse, and compute from tables, graphs, and charts.	Interpreting bar graphs or pie charts in bank or SSC exams.
Algebraic Manipulation	Simplifying expressions and solving equations efficiently.	Solving quadratic equations or simplifying algebraic fractions in aptitude sections.
Logical Numerical Reasoning	Applying logic to numerical patterns and sequences.	Identifying the next number in a series: 2, 6, 12, 20, ?
Speed Calculation Techniques	Using shortcuts such as Vedic Maths or approximation methods for faster computation.	Quickly calculating squares or percentages using shortcut methods.

### Pedagogical Strategies to Enhance Numerical Skills

Strengthening numerical skills for competitive examinations requires deliberate instructional design that targets speed, accuracy, and reasoning simultaneously. The following strategies align classroom practice with exam demands.

- Explicit Instruction:** Teach core operations (fractions, percentages, ratios) using worked examples and step reduction. Model shortcuts (e.g., percentage–fraction conversions) and gradually fade support so learners internalize efficient procedures.

- **Practice:** Use spaced and interleaved practice with mixed problem sets (DI, arithmetic, algebra). Short, frequent drills build automaticity, while mixed items improve selection of appropriate strategies under time constraints.
- **Problem-Based Learning:** Design multi-step, context-rich tasks that mirror exam formats (time–work, profit–loss, data interpretation). Encourage students to plan solution paths before computing to strengthen structuring skills.
- **Estimation:** Embed estimation routines (rounding, bounds, option elimination) in every lesson. Ask learners to predict ranges before exact calculation to improve speed and answer verification.
- **Strategies:** Teach heuristic methods—ratio tables, unitary method, substitution, and simplification—first approaches. Compare multiple solution paths to promote flexible thinking rather than single-method dependence.
- **Games:** Use card and board games targeting numeracy (fractions, percentages, mental math) to increase engagement and fluency; game-based practice has been shown to support numeracy development (Singh *et al.*, 2021)<sup>[14]</sup>.
- **Assessment:** Implement timed quizzes and mock tests with item analysis. Provide feedback on accuracy, time per question, and error types to guide targeted remediation.
- **Differentiation:** Group learners by need and provide scaffolded worksheets (foundational to advanced). Address numeracy difficulties explicitly to prevent persistent calculation errors (Chinn, 2020)<sup>[2]</sup>.
- **Learning Management System (LMS):** Use digital platforms for adaptive practice, instant feedback, and data interpretation tasks. Technology should reinforce, not replace, core numerical understanding.
- **Metacognition:** Train students to monitor time, choose questions strategically, and reflect on errors. Self-regulated routines improve decision-making during high-pressure tests.

### Implications and Recommendations

Numerical skills must be treated as a core component of mathematical ability, especially in the context of competitive examinations. Educational practices should move beyond procedural teaching and emphasize the development of number sense, estimation, and reasoning skills from early stages. Curriculum design needs to integrate numeracy-focused activities that promote both speed and conceptual understanding. Regular exposure to exam-oriented problem types, along with timed practice, can help learners adapt to performance demands. Instructional strategies should also incorporate culturally relevant contexts to strengthen engagement and comprehension. Additionally, targeted support must be provided for learners with numeracy difficulties to prevent long-term gaps in

mathematical performance. The use of technology and interactive tools can further enhance numerical skill development when aligned with strong foundational understanding. Overall, a balanced approach that combines conceptual learning, strategic practice, and contextual application is essential for improving mathematical ability and performance outcomes.

### Conclusion

Numerical skills form the foundation of mathematical ability and play a critical role in determining performance in competitive examinations. The discussion highlights that effective problem solving in such contexts depends not only on conceptual understanding but also on the ability to process numerical information quickly and accurately. Skills such as mental calculation, estimation, pattern recognition, and proportional reasoning enable learners to approach problems strategically and manage time efficiently. The article also emphasises that numerical skills are shaped through both instructional practices and contextual experiences. Pedagogical strategies that focus on structured practice, problem-based learning, and metacognitive awareness contribute significantly to strengthening numeracy. In addition, integrating culturally grounded knowledge supports meaningful learning and enhances learners' engagement with mathematical concepts. While challenges such as computational errors, cognitive overload, and performance pressure persist, these can be addressed through targeted instructional interventions and continuous practice. Strengthening numerical skills not only improves mathematical performance but also builds confidence and adaptability in high-stakes testing environments. Therefore, a comprehensive approach that integrates conceptual understanding, practical application, and strategic learning is essential for enhancing mathematical ability in competitive examinations.

### Acknowledgement

Ramya Rajendran (first author) sincerely acknowledges the University Grants Commission (UGC), Government of India, for the financial assistance provided through the National Eligibility Test–Junior Research Fellowship (UGC NET–JRF), which has supported the scholarly contributions of the author.

### Reference

1. Boesen J, Lithner J, Palm T. Assessing mathematical competencies: an analysis of Swedish national mathematics tests. *Scandinavian Journal of Educational Research*, 2018;62(1):109-124. <https://doi.org/10.1080/00313831.2016.1212256>
2. Chinn S. *The trouble with maths: A practical guide to helping learners with numeracy difficulties*. Routledge, 2020.
3. Elliott L, Feigenson L, Halberda J, Libertus ME. Bidirectional, Longitudinal Associations Between Math Ability and Approximate Number System Precision in Childhood. *Journal of Cognition and Development*, 2019;20(1):56–74. <https://doi.org/10.1080/15248372.2018.1551218>
4. Iriberry N, Rey-Biel P. Competitive pressure widens the gender gap in performance: Evidence from a two-stage competition in mathematics. *The Economic Journal*, 2019;129(620):1863-1893.

- <https://doi.org/10.1111/eco.j.12617>
5. Lee-Post A. Developing numeracy and problem-solving skills by overcoming learning bottlenecks. *Journal of Applied Research in Higher Education*,2019;11(3):398–414. <https://doi.org/10.1108/JARHE-03-2018-0049>
  6. Megawati LA, Sutarto H. Analysis numeracy literacy skills in terms of standardized math problem on a minimum competency assessment. *Unnes Journal of Mathematics Education*,2021;10(2):155-165. <https://doi.org/10.15294/ujme.v10i2.49540>
  7. Mok A. “It’s a skill that can be trained”: How Chinese parents view mathematics and what this means. *New Zealand Journal of Educational Studies*,2020;55(1):73-89. <https://doi.org/10.1007/s40841-020-00154-4>
  8. Nieder A. The making of number: from content to representation. *Trends in Cognitive Sciences*, 2026.
  9. Ntumi S, Adzifome SN, Nyamekye T, Vedor FK. Culturally responsive assessment in mathematical word problems and numerical cognition in multilingual education. *Scientific Reports*, 2026. <https://doi.org/10.1038/s41598-026-35864-0>
  10. Prahmana RCI, Ma'arif S, Pramudiani P. Indigenous Knowledge as Educational Asset: Culturally Responsive Mathematics Education and Equity Pursuit in Indonesia’s Multilingual Contexts. *Mosharafa: Jurnal Pendidikan Matematika*,2026;15(1):37-59. <https://doi.org/10.31980/mosharafa.v15i1.3532>
  11. Priya B, Thakur GK. *Indian Knowledge System: Mathematical Foundations and Engineering Applications*. Geh press, 2026.
  12. Rajkumar R, Hema G. Factors affecting mathematical problem solving competence of undergraduate students in facing competitive examinations. *IMPACT: International Journal of Research in Humanities, Arts and Literature (IMPACT: IJRHAL)*,2019;7(2):319, 328.
  13. Ramya R, Rajeswari G. Math Skills as a Key Determinant of Success in Competitive Exams. *INTERNATIONAL JOURNAL*,2024;3(7):387-390. <https://doi.org/10.70333/ijeks-03-07-032>
  14. Singh P, Hoon TS, Nasir AM, Ramly AM, Rasid SM, Meng CC. Card Game as a Pedagogical Tool for Numeracy Skills Development. *International Journal of Evaluation and Research in Education*,2021;10(2):693-705. <https://doi.org/10.11591/ijere.v10i2.20722>
  15. Strohmaier AR, Reinhold F, Hofer S, Berkowitz M, Vogel-Heuser B, Reiss K. Different complex word problems require different combinations of cognitive skills. *Educational Studies in Mathematics*,2022;109(1):89-114. <https://doi.org/10.1007/s10649-021-10079-4>
  16. Susanto E, Fransiska H, Susanta A. Students’ numerical ability on minimum competency assessment in junior high school. *International Journal of Trends in Mathematics Education Research*,2023;6(1):47-53. <https://doi.org/10.33122/ijtmer.v6i1.175>
  17. Torres-Peña RC, Peña-González D, Lara-Orozco JL, Ariza EA, Vergara D. Enhancing numerical thinking through problem solving: A teaching experience for third-grade mathematics. *Education Sciences*,2025;15(6):667. <https://doi.org/10.3390/educs15060667>
  18. Zhang B, Zhou K, Wei X, Zhao X, Sha J, Wang S, *et al.* Evaluating and improving tool-augmented computation-intensive math reasoning. *Advances in Neural Information Processing Systems*,2023;36:23570-23589.