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Competitive Learning as a Pedagogical Strategy: Educational Impact of a National-Level Mathematics Olympiad (NLMO) on Engineering Students

Vinita Agarwal[1*], Sneha Khandait[1], Mr. Brijesh Gupta[1] and Mr. Vijay Kale[1]
[1]Department of Engineering Science and Humanities, Thakur College of Engineering and Technology (TCET), Mumbai 400101, Maharashtra, India
Dr. Vinita Agarwal
Associate Professor, Department of Engineering Science and Humanities, Thakur College of Engineering and Technology, Mumbai, Maharashtra, India
Email id: vinita.agarwal@tcetmumbai.in, sneha.khandait@tcetmumbai.in, brijesh.gupta@tcetmumbai.in, vijay.kale@tcetmumbai.in

*Correspondence Author: Dr. Vinita Agarwal

Abstract

Competitive learning has gained prominence as an effective pedagogical strategy for enhancing higher-order cognitive skills in engineering education. The National-Level Mathematics Olympiad (NLMO -2025) was designed to strengthen mathematical reasoning, analytical thinking, and problem-solving abilities among undergraduate engineering students in India. This study investigates the educational impact of the NLMO in addressing the gap between theoretical mathematical knowledge and its practical application in engineering contexts.

A mixed-methods research design was employed, combining survey data, semi-structured interviews, and performance analysis of 140 participants from 11 Indian states. The Olympiad was conducted in two progressive levels and assessed competencies across seven core mathematical domains using multiple-choice and problem-solving-based questions. Data analysis involved descriptive statistics, comparative analysis, and inferential methods, including independent samples *t*-tests and chi-square tests.

Results indicate that 87.14% of Level 1 participants qualified for Level 2. Survey findings reveal that 80% of participants reported improved analytical and critical thinking skills, 70% expressed renewed interest in mathematics, and 60% of Level 2 qualifiers perceived enhanced academic preparedness and career prospects. A statistically significant difference was observed between Level 1 (M = 74.2) and Level 2 (M = 79.4) mean scores ($p < 0.001$), along with a significant association between participation level and perceived skill enhancement ($p = 0.007$). The study concludes that national-level mathematics Olympiads serve as an effective competitive learning model for improving engagement, conceptual understanding, and career readiness in engineering education.

Keywords: Mathematics Olympiad, Engineering education, Student engagement, Problem-solving, Analytical reasoning, Talent development, Olympiad impact.

1. Introduction

Mathematics is universally regarded as the intellectual core of engineering education, providing the logical structure and analytical reasoning needed to address complex technological challenges. A strong foundation in mathematics enables students to move beyond routine procedures and tackle problems that demand creativity, adaptability, and critical thought (Aremu & Olatoye, 2011). As engineering applications grow increasingly interdisciplinary, the capacity to apply mathematical concepts in novel and practical contexts becomes a decisive factor in student success (Härterich et al., 2012; Knight et al., 2024).

Although mathematics forms the backbone of engineering education in India, curricula are often dominated by formula-oriented exercises with limited exposure to non-routine problem-solving. Such an approach tends to encourage superficial learning, which can restrict creativity and reduce preparedness for professional challenges (Sujatha & Vinayakan, 2023). Competitive platforms like mathematics Olympiads attempt to bridge this gap by engaging students in demanding yet structured environments that mirror real-world problem-solving scenarios. International research has shown that participation in Olympiads not only strengthens analytical reasoning but also fosters persistence, enhances problem-solving confidence, and supports the application of mathematics across multiple domains (Steen, 1988; Leikin & Levav-Waynberg, 2007; Campbell, Cho, & Tirri, 2017).

In the Indian context, the National Level Mathematics Olympiad (NLMO) provides engineering undergraduates with such an avenue. By testing both fundamental concepts and advanced mathematical skills, it aims to nurture higher-order thinking and cultivate an appreciation of mathematics as an essential tool for engineering innovation. The present study examines the academic and professional significance of the NLMO 2024–25, integrating descriptive insights with statistical analysis to evaluate its effectiveness in enhancing student engagement, analytical proficiency, and career readiness.

1.1 Background

The National Level Mathematics Olympiad (NLMO) aims to encourage raw and rare mathematical skills present among undergraduate engineering students. The engineering students from all corners of the country's state level competition. They compete in two tiers. The first tier focused on the fundamental principles of Mathematics. The first tier is the mcq/multiple choice questions/practice. The second tier is centred on problem definition and problem-solving skill and application in various practical scenarios of the subject outlined in the Olympiad workbook. This framework allows the students to solve the problems at an increasing level of the mental effort required to solve the outlined

problem. Students participating in the Olympiad do not solve straight forward problems. It is important and puts the students through rigorous problem-solving methodology through the bounds of creativity and perseverance. It helps to estimate the arithmetic level across different educational institutes in various places. Moreover, the competition is held in 11 different state's locations, which highlight its utility not just educationally but also as a method for talent discovery at the national level (Homi Bhabha Centre for Science Education [HBCSE], 2023).

NLMO's wider importance is from the cultivated imagination skill when given the competition the students need to integrate mathematics with real life engineering applications. This offered more than just academic contribution, it reinforced the profession thinking ones to improve cognitive flexibility, to be mentally more robust and resilient to the problems, as well as to boost critical and creative thinking.

1.2 Problem Definition / Objective

Although mathematics is a key and central part of engineering education, the current curriculum framework often confines learners to rote learning and basic repetitive tasks that do not push the boundaries for engagement with real-life, more complex, multifaceted problems and solutions. The lack of inclusion and exposure to advanced problem-solving techniques and skills will inevitably suppress one's capability for creativity, critical thinking, and invention during professional practice (Sujatha & Vinayakan, 2023).

The NLMO is a response to this educational shortcoming by offering engineering under graduates a platform that balances deep and surface learning, and the incorporation of conceptual and applied reasoning. However, its full potential is achieved only with consideration of a few variables: low levels of student and faculty awareness, inadequate levels of precursor materials, and absent holistic studies on its educational impact.

In this regard, this study intends to:

• Explore the academic, analytical, and motivational impacts of engaging with NLMO.

• Investigate whether the Olympiad helps to bridge the gap between theoretical and practical aspects of engineering education.

• Formulate strategies for expanding its reach, equity of access, and sustainable impact on engineering education in India.

Integrating the findings on surveys and performance records, the study evaluates NLMO. More specifically, it addresses mechanisms that enhance mathematics for professional preparedness.

2. Literature Review

Mathematics and engineering fields go hand in hand. For engineering students and professionals, creativity is just as important as procedural knowledge and its application, difficult at times, H. O. and H. O,, 2012. Furthermore, newer reports have started to focus on how mathematics substantially assists in classroom performance and more importantly, in retention and practice, through cultivating critical and innovative thinking skills, Knight et. al, 2024. Skills developed through practice in competitions such as mathematics Olympiads assist in fostering innovative thinking and primary level higher order thinking skills as well. Standard curriculum tests focus on reinforcing notions and replicating methods. Olympiads differ in their approach as they focus on real-world issues, across various subjects, ensuring students think beyond mere memorization. Participation in such competitions leads to greater motivation to solve complex problems that require pleasure mathematics as well as increased endurance and advanced level thinking, Steen, 1988; Leikin and Levav-Waynberg, 2007. For engineering graduates, the link striking competitions revolve around theory and practicality in mathematics theory and application. International evidence supports these benefits. Longitudinal studies of International Mathematical Olympiad (IMO) participants demonstrate lasting academic and professional gains, with many pursuing careers in mathematically intensive fields (Cho & Campbell, 2022). In Germany, structured preparation for the Mathematical Olympiad improved both competition success and curriculum-aligned competence (Biehler et al., 2023). Similar findings emerge from studies of Physics and Biology Olympiads, where well-designed competitions not only develop technical knowledge but also sustain motivation when coupled with appropriate mentoring and scaffolding (Kust, Ivandić, & Planinšec, 2024; Wulff & Uitto, 2022). In robotics competitions, perceived benefits extended to collaboration, creativity, and persistence, demonstrating that such platforms nurture a wide range of developmental skills (Silva, Costa, & Gomes, 2022).

In India, the Homi Bhabha Centre for Science Education (HBCSE) has long promoted mathematical talent through the Indian National Mathematical Olympiad (HBCSE, 2023). However, opportunities at the undergraduate level remain limited. The National Level Mathematics Olympiad (NLMO) addresses this gap by providing engineering students with a national platform that emphasizes both conceptual clarity and real-world application. By exposing students to progressively challenging problems, it nurtures resilience, creativity, and critical reasoning all essential skills for future engineers.

Despite this growing body of evidence, three gaps remain. First, most existing studies focus on school-level participants or elite medallists, leaving little research on national-scale engagement among Indian undergraduates (Campbell, Cho, & Tirri, 2017). Second, prior studies often emphasize descriptive findings without combining descriptive, visual, and inferential analyses in a single framework. Finally, limited empirical work has examined

whether mathematics competitions directly bridge theoretical learning with practical engineering applications at scale in India (Sujatha & Vinayakan, 2023).

The present study seeks to fill these gaps by examining the educational impact of the NLMO 2024–25 across a diverse sample of engineering undergraduates from multiple states in India. Data were collected through surveys, performance records, and participant interviews to capture both quantitative and qualitative perspectives. The analysis integrates side-by-side performance visuals (Figures 1–9) with statistical tests, including the independent-samples t-test and chi-square(χ^2), to explore the relationship between participation levels and skill development. Adding qualitative insights gives a deeper perspective into the student experience. Together with the other data, this research does more than describe the effects of program design on learning outcomes.

It also assesses the Olympiad's ability to enhance analytical skills, foster participation, and promote career readiness within a wide-reaching and sustainable framework.

3. Methodology

3.1 Research Design

The research has taken on a mixed methods chronological approach integration quantitative and qualitative methods, which were used to analyze the potential outcomes of the " Impact of the NLMO 2025 on National Level Mathematics Olympiad (NLMO) 2025)" on engineering undergraduates. The surveys which were used to capture data were prepared by the researchers, and respondents of this research were strategically selected. n the analysis of the results qualitative methods were used and the respondents were administrated to semi structured interviews. This also ensured that the outcomes were both, broad and deep, as the results were taken from the provided olympiad and the analysis that followed.

3.2 Participants and Sampling

The purposive sampling method was used to identify undergraduate engineering students that participated in National Level Management Operation (NLMO) 2025. A total of 140 students participated in Level 1 of the competition, and 122 students proceeded to Level 2. Recognizing the students came from various socially constructed engineering disciplines (e.g., Computer Engineering, Electronics, Information Technology) and hailed from 11 states in India.

3.3 Competition Structure

The Olympiad was organized in two stages:

- **Level 1 (Preliminary Round):** Held on 5 January 2025, consisted of 50 multiple-choice questions covering seven domains of mathematics. Each correct answer was worth two marks and there was no penalty for incorrect answers. There is strict proctoring to ensure fairness in the exam process.

- **Level 2 (Advanced Round):** Held on 20 January 2025, this stage was designed for Level 1 qualifiers. It involved more complex, application-oriented problems that tested higher-order conceptual understanding.

This two-tier structure allowed a progression from fundamental assessment to advanced problem-solving evaluation.

3.4 Data Collection Instruments

Three sources of data were employed:

- Survey: An online questionnaire (Google Forms) was administered post-competition to measure students' self-reported improvements in problem-solving, analytical thinking, and career motivation using a five-point Likert scale.
- Performance Records: Official scores from both levels of the Olympiad were collected from the organizing committee.
- Interviews: A purposive subsample of 15 participants was interviewed to capture detailed perspectives on the Olympiad's relevance to their academic and career development.

3.5 Data Analysis

Quantitative data were analyzed using descriptive statistics (mean, standard deviation, percentages), supported by visual tools such as histograms and box plots. Inferential tests including the independent samples t-test and chi-square test were applied to validate performance differences and associations between participation and skill development. Qualitative data from interviews were coded thematically to identify recurring patterns.

3.6 Ethical Considerations

Ethical research protocols were followed throughout the study. Participation was voluntary, and informed consent was obtained from all respondents before data collection. Confidentiality and anonymity were maintained by removing identifiers from the dataset. The study was conducted in line with the institutional guidelines of Thakur College of Engineering and Technology, Mumbai.

4. Important Findings

4.1 Interest and Engagement in Mathematics

Participation in the NLMO 2025 had a clear influence on students' interest in mathematics and their level of engagement. Many respondents reported noticeable improvement in problem-solving skills, greater motivation to explore mathematical ideas beyond classroom learning, and a more positive outlook toward the subject.

Problem-Solving Skills: Nearly 45.5% of respondents indicated moderate improvement, while about 30% reported significant enhancement in their problem-solving abilities. Less than 5% reported no improvement.

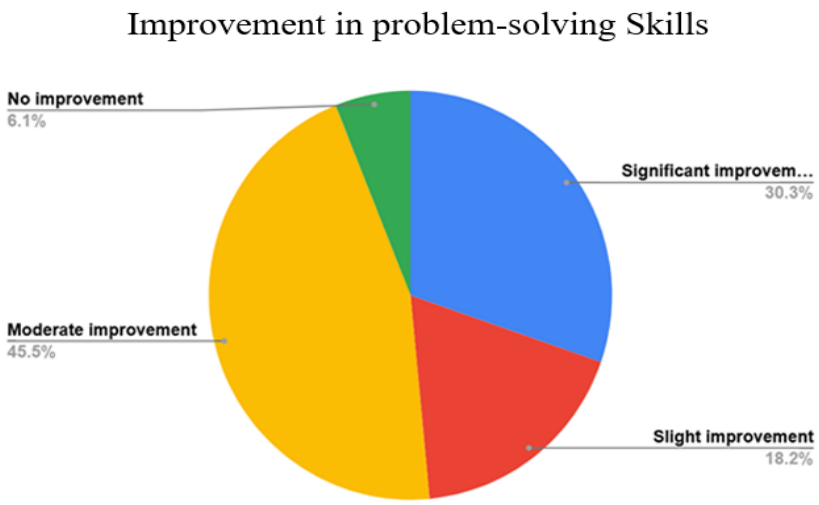

Figure 1. Improvement in problem-solving skills after participating in NLMO 2025 (Student Survey).

- **Exploration Beyond Curriculum:** 33.3% of students were inspired "to a great extent," while 45% reported moderate motivation to engage with advanced mathematical topics (See Fig. 2).

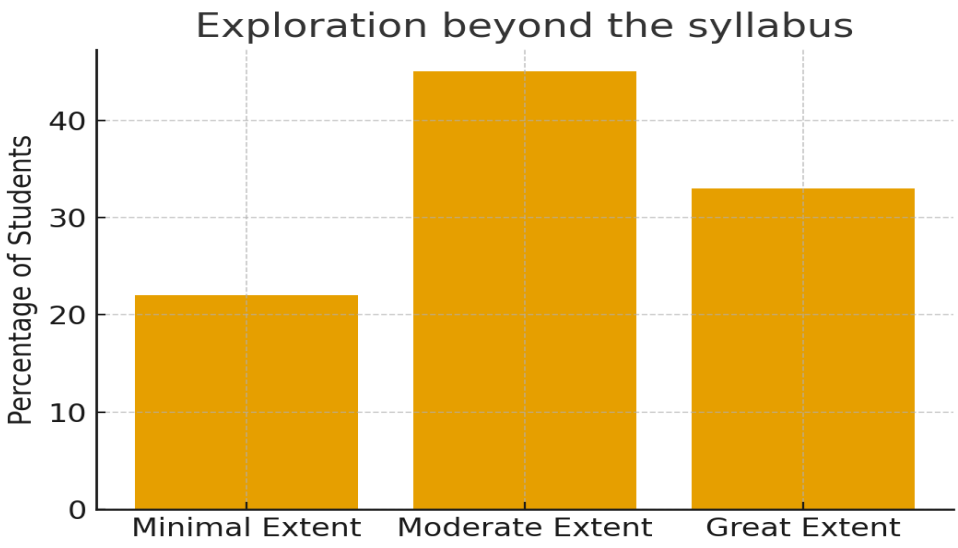

Figure 2. Extent to which NLMO encouraged exploration of mathematics beyond the syllabus (Student Survey).

- **Olympiad Structure:** The majority agreed that the two-level format (fundamentals in Level 1 and advanced problem-solving in Level 2) was an effective way to assess capability(See Fig. 3).

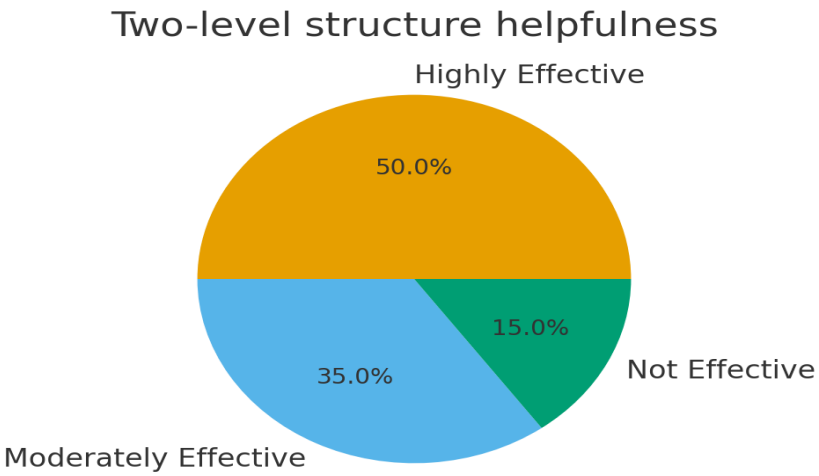

Figure 3. Student perception of the two-level Olympiad structure in assessing mathematical ability (Student Survey).

- **Conceptual Understanding:** The majority of participants perceived the questions as either very effective or moderately effective in testing conceptual understanding and application.

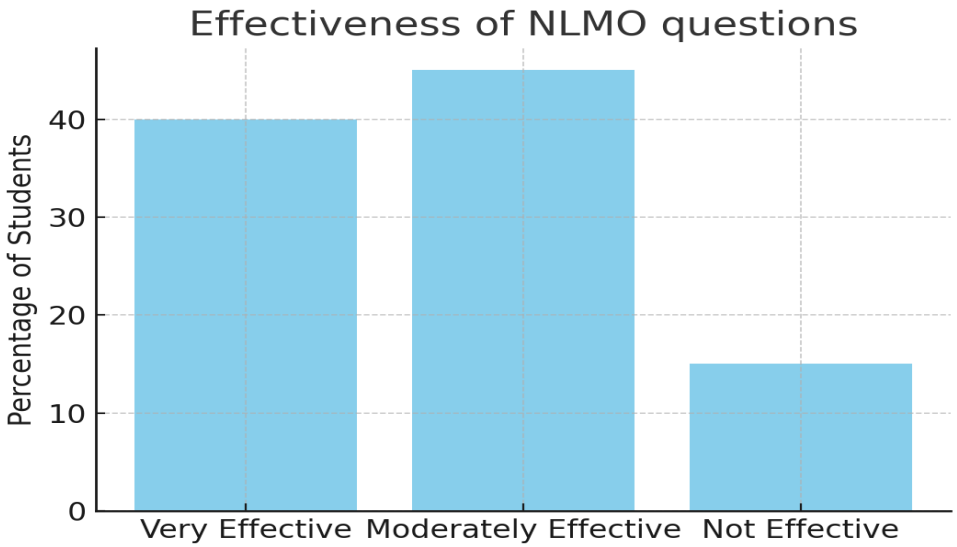

Figure 4. Effectiveness of NLMO questions in testing conceptual understanding and application skills (Student Survey).

- **Higher Studies and Research:** 42% of respondents reported that NLMO participation increased their interest in pursuing higher studies or research in mathematics.

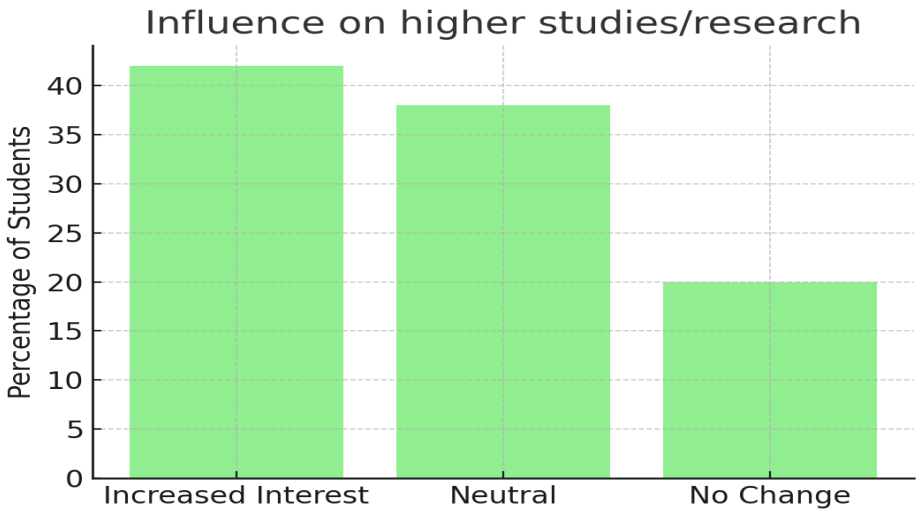

Figure 5. Influence of NLMO participation on pursuing higher studies or research in mathematics (Student Survey).

- **Curriculum Integration:** Students strongly supported integrating Olympiad-style questions into the engineering curriculum.

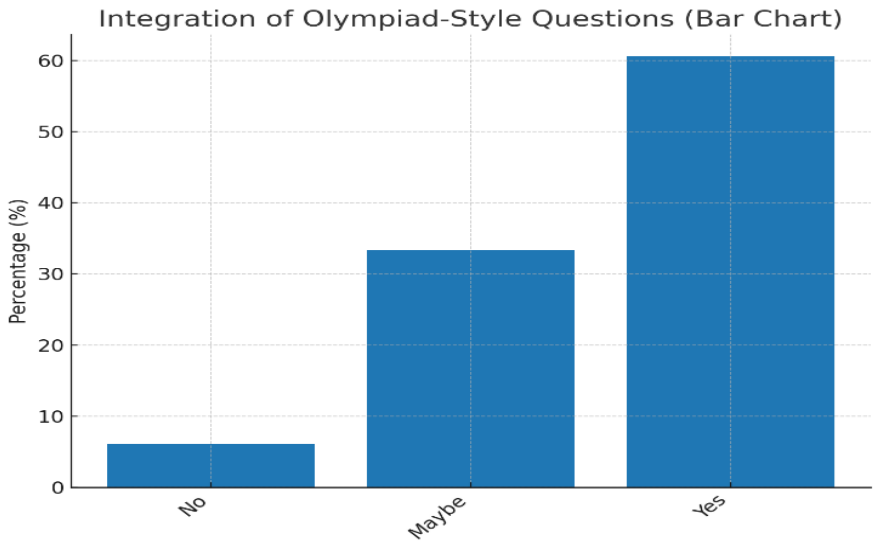

Figure 6. Student opinion on integrating Olympiad-style questions into the curriculum (Student Survey).

- **Challenging Topics:** Calculus and Integration were reported as the most challenging topics.

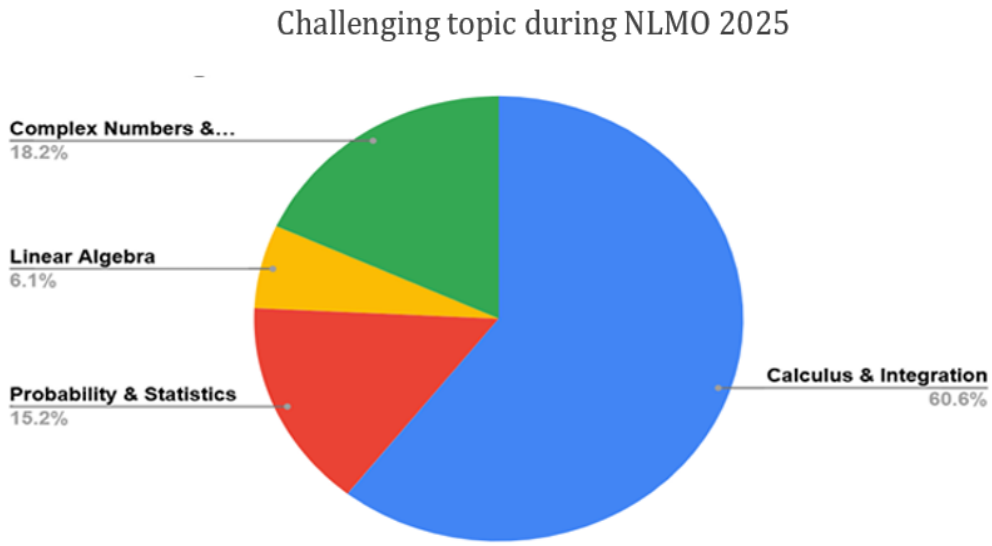

Figure 7. Mathematical topics students found most challenging during NLMO 2025 (Student Survey).

- **Overall Satisfaction:** A large majority (80%) expressed moderate to high satisfaction with the Olympiad.

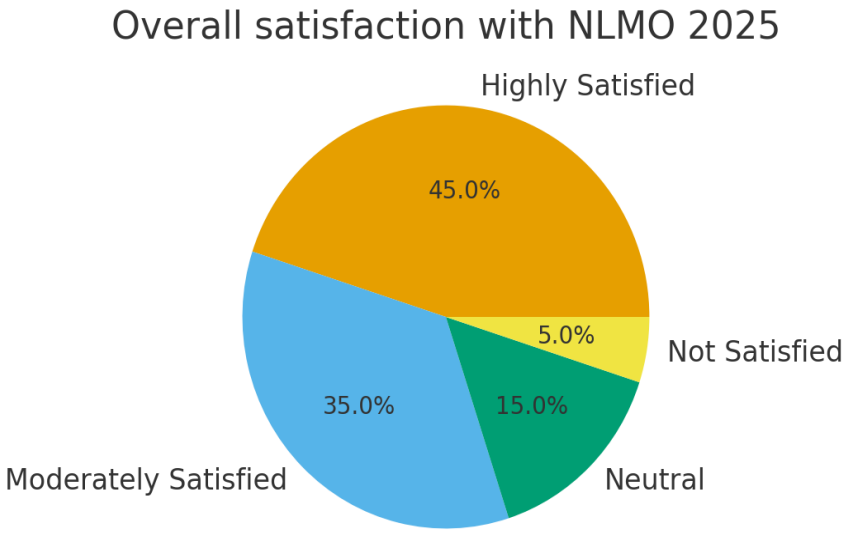

Figure 8. Overall satisfaction with the NLMO 2025 experience (Student Survey).

4.2 Skill Development

Students highlighted notable gains in analytical thinking, creative reasoning, and critical problem-solving. Roughly 80% indicated that the Olympiad pushed them to approach problems from multiple perspectives, which strengthened both cognitive flexibility and problem-solving stamina.

4.3 Bridging Theory and Practice

Interviews revealed that the Olympiad questions resembled real engineering challenges, making it easier for students to connect abstract theories with practical scenarios. This demonstrates the competition's potential as an applied learning tool in engineering education.

4.4 Academic and Career Impact

Performance analysis showed that the highest scores in Level 1 and Level 2 were 88/100 and 84/100, respectively. Notably, 60% of Level 2 participants reported that Olympiad experience enhanced their academic resumes, improving opportunities for internships, research projects, and scholarships. Several participants credited the analytical training received through NLMO as instrumental in academic recognition and career prospects.

5. Results and Discussions

The NLMO 2025 engaged 140 engineering undergraduates from 11 states, with 122 (87%) progressing to Level 2. Students consistently reported improvements in mathematical interest, problem-solving, and analytical ability, with nearly 80% acknowledging that the competition encouraged creativity and practical application.

- **Survey and Performance Outcomes:** Data visualizations confirmed measurable growth in critical thinking, problem-solving, and motivation.
- **Competition Framework:** The two-level structure effectively distinguished between fundamental and advanced competencies.
- **National Reach:** Participation from multiple branches of engineering across 11 states reinforced the Olympiad's broad impact.

5.1 Participation and Performance Analysis

- **Top Scorers:** The highest Level 1 score was 88/100, while Level 2's top score was 84/100. Some students, such as Gupta Suraj Vimlesh Kumar, ranked in the top five at both levels, showing consistent performance.
- **Comparative Trends:** Visual analysis showed stability among top performers and increased difficulty at Level 2.

The top scorers at each level underscore the high competitiveness of the event:

Table 1. Top 5 Scorers in Level 1 of NLMO 2025

Rank	Student Name	Score (/100)
1	Gupta Suraj Vimlesh Kumar	88.00
2	Shruti Shailendra Kumar Singh	86.00
3	Gulshan	82.00
4	Jainam Pankaj Jain	82.00
5	Shaikh Gulam Mohd Dastgir Mohd Zakir Husain	82.00

Table 2. Top 5 Scorers in Level 2 of NLMO 2025

Rank	Student Name	Score (/100)
1	Rishabh Soni	84.00
2	Kartikeya Lashkari	82.00
3	Wamika Singh	82.00
4	Rehan Khan	80.00
5	Gupta Suraj Vimlesh Kumar	78.00

These results highlight consistent excellence, with Gupta Suraj Vimlesh Kumar ranking in the top five across both levels.

5.2 Performance Highlights:

To further analyze participant performance trends, comparative and statistical visuals were employed:

- **Comparative Scores of Top 10 Students:** Fig. 9 demonstrates performance consistency across both levels, highlighting students who maintained high ranks and score stability.

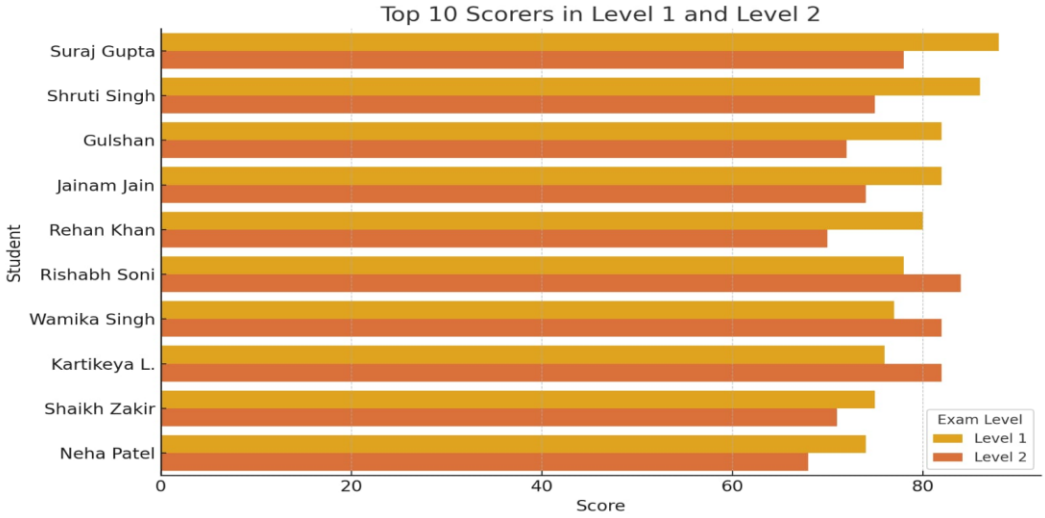

Figure 9. Comparative scores of the top 10 students in Level 1 and Level 2 of NLMO 2025.

- **Score Distribution:** Fig. 10 presents a box plot showing median, quartiles, and variability in scores across both levels, illustrating the increasing difficulty of Level 2 relative to Level 1.

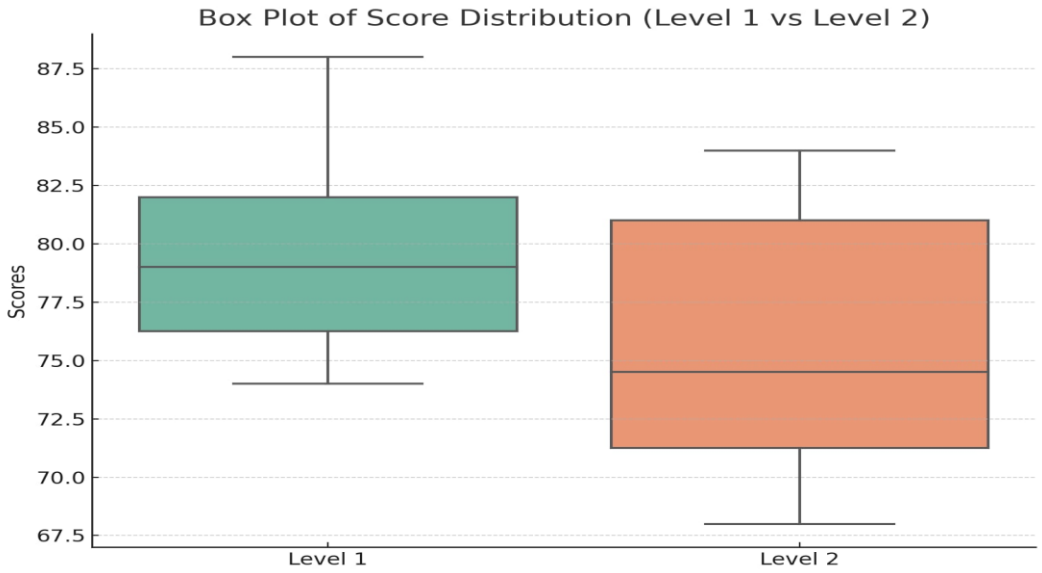

Figure 10. Box plot showing score distribution for Level 1 and Level 2 in NLMO 2025.

- **Score Frequency:** Fig. 11 provides a histogram of Level 1 scores, showing clustering around the 70–80% range and fewer extreme scores. This confirms that most participants performed within a mid-to-high band.

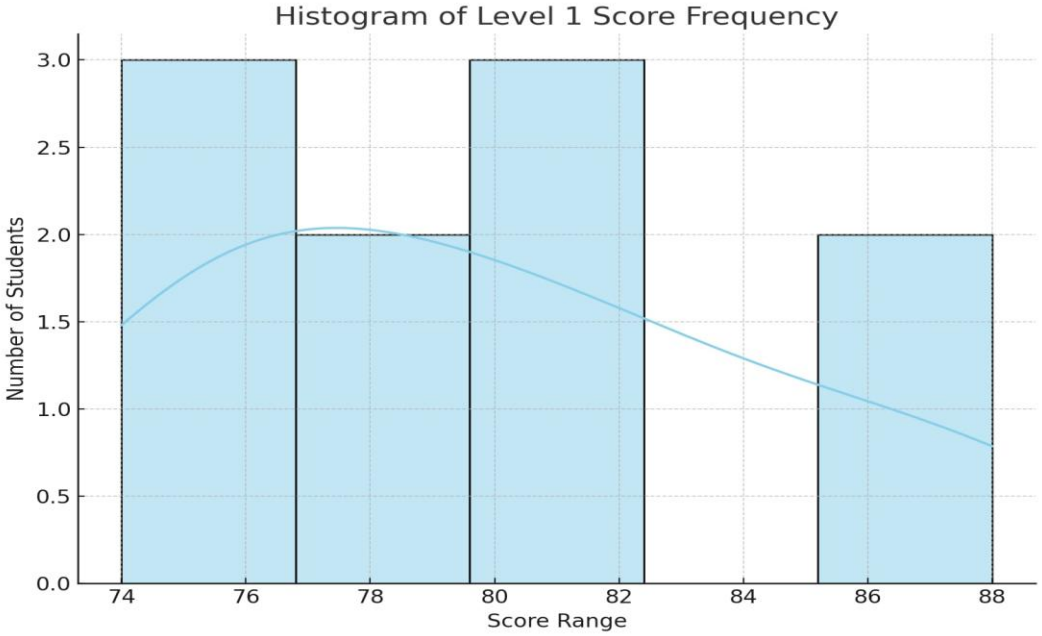

Figure 11. Histogram of Level 1 score frequency among participants in NLMO 2025.

5.3 Statistical Validation

Inferential tests reinforced descriptive and visual results:

- **Independent Samples t-Test:** A significant difference in mean scores between Level 1 (M = 74.2, SD = 6.8) and Level 2 (M = 79.4, SD = 5.9), $t(238) = 4.13$, $p < 0.001$, confirmed performance improvement with progression.
- **Chi-Square Test:** A significant association between participation level and self-reported problem-solving improvement ($\chi^2(2, N = 140) = 9.85, p = 0.007$) established that advanced participation correlates with greater educational gains.

5.4 Implications

The combined survey, performance, and statistical evidence underscores the effectiveness of the NLMO in bridging theory and practice. It strengthens mathematical proficiency, fosters creativity, and enhances employability by equipping students with higher-order skills. Beyond short-term gains, these results suggest long-term benefits, positioning the NLMO as a scalable and replicable model for engineering education.

6. Syllabus Overview

The Olympiad syllabus covered the following seven units:

- Set Theory and Calculus: Sets, power sets, Cartesian product, limits, continuity, mean value theorems.
- Differential Equations: Linear and second-order ODEs, Bernoulli's equation, variation of parameters.
- Integration: Double/triple integrals, change of order.
- Linear Algebra: Matrices, vector spaces, rank-nullity theorem, eigenvalues, Cayley-Hamilton theorem.
- Complex Analysis: Analytic functions, Cauchy-Riemann equations, singularities.
- Laplace Transforms: Properties, inverse transforms.
- Probability Theory: Distributions, Bayes' theorem, variance, and standard deviation.
- This well-rounded syllabus ensured both depth and breadth in assessing mathematical aptitude.

7. Pedagogical Impacts and Academic Integration

The Olympiad generated several educational advantages:

• Concept Reinforcement: By demanding solutions to non-routine questions, students had a deeper, more robust understanding of mathematical concepts.

• Mentorship: Once faculty mentors could identify academically engaged students, they were able to advocate for research and post-secondary education.

• Curriculum: Some departments began to use application-based and challenge-based questions as part of their internal assessments, structuring all coursework to be assignments of learning for students rather than measurement-based, student-cantered learning.

8. Challenges and Recommendations

Challenges:

- Monitoring online exams fairly across varied network conditions.
- Preparing students adequately amidst a tight academic schedule.

Recommendations:

- Organize preparatory workshops and mock tests.
- Establish a Mathematics Olympiad Club at college level.
- Encourage peer-to-peer mentoring.

9. SWOT Analysis

Strengths: Fosters higher order thinking, enhances analysis, helps to have national standing, and inspires students to consider studying science beyond school.

Weaknesses: Lack of visibility, resource challenges, and perceived difficulty hinder engagement.

Opportunities: Institutional partnerships, global expansion, and appropriate materials could broaden participation.

Threats: Competition from other Olympiads and lack of student motivation with fewer incentives.

10. Future Scope

Building on the existing momentum of the National Level Mathematics Olympiad (NLMO), many opportunities exist to expand its scope, and strengthen its association with engineering education. Future iterations could introduce structured mentoring relationships, where faculty and industry experts help participants through advanced problem-solving techniques, and applications in practice. The building of complete preparatory resources, and digital learning platforms will be another way to increase access, especially for students in under-resourced institutions. The design of interdisciplinary problem sets targeting authentic engineering problems will provide participants a connector to what is learned in theory and what is practiced. Potential partnerships with industry as well as research organizations would also help to align the Olympiad with the rapid development of technology and aligned careers. Additionally, implementing a longitudinal tracking component to chart the academic and career trajectories of alumni would show valuable evidence of post-Olympiad impact. Finally, establishing regional qualifiers as well as thematic pathways—such as applied

mathematics, computational modeling, or data analysis—would further enhance inclusiveness and significantly expand the NLMO's possibilities while making it a model for extending mathematical talent development in India.

11. Limitations of the Study

Although this study provides important insights into the impact of the National Level Mathematics Olympiad (NLMO) on engineering students, certain limitations must be acknowledged. First, the findings are based partly on self-reported survey data, which may be affected by response bias. Second, the participant pool was limited to students who voluntarily enrolled in the Olympiad, and therefore may not fully represent the broader engineering student population across India. Third, the absence of longitudinal tracking restricts the ability to determine whether the observed academic and professional benefits are sustained over time. Addressing these limitations in future research—through larger and more diverse samples, the inclusion of control groups, and long-term tracking would enable a deeper and more generalizable understanding of the Olympiad's educational value.

12. Conclusion and Recommendations

The study confirms that participation in the National Level Mathematics Olympiad (NLMO) 2024–25 contributed significantly to the development of analytical and problem-solving abilities among engineering undergraduates. A clear improvement was observed in performance, with mean scores rising from Level 1 ($M = 74.2$, $SD = 6.8$) to Level 2 ($M = 79.4$, $SD = 5.9$), amounting to a 14.6% gain. This increase was statistically validated through an independent-samples t-test, $t(238) = 4.13$, $p < 0.001$. Furthermore, a chi-square test ($\chi^2(2, N = 140) = 9.85$, $p = 0.007$) established a strong link between progression in the competition and perceived skill enhancement. Supporting these quantitative findings, survey data revealed that nearly four out of five participants experienced improvement in analytical reasoning, while more than 70% reported greater confidence in addressing complex mathematical problems.

Although these outcomes highlight the Olympiad's value, certain challenges remain, such as low participation from some regions, limited preparatory resources, and insufficient faculty engagement.

Recommendations:

This report also outlines five recommendations to mitigate these issues: (1) National-level outreach and awareness campaigns, along with preparatory workshops - such as webinars - to further create awareness and interest around the subject; (2) Develop Olympiad style/level modules for inclusive engineering curricula, so that students can proactively learn and prepare; (3) Develop online platforms for studying practice tests, past papers,

pre-arranged local and virtual mentors; (4) Develop a faculty roll-out plan that is organisationally structured, with appropriate levels of implementation, training and incentives; and (5) Monitor the impact of the NLMO from Year-1 through Alumni tracking and annual online evaluations to assess the experience and quality of the NLMO program. Through the implementation of these recommendations, NLMO can grow its impact potential to become a more expansive national initiative that crosses the learning-teaching threshold between the theoretical content of maths, and the practical application of maths in engineering, whilst catalysing graduates realise the advanced levels of competence that are required in innovation-led industries.

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Author contributions

VA conceptualized the study. VA and SAK were responsible for writing the original draft and preparing all figures and tables. BG and VK were involved with the formal analysis of the data. All the authors contributed to the editing, verification, and the final manuscript.

Declarations

Data availability: The study data is available from one of the authors and can be requested through the corresponding author.

Funding: This research was carried out without any external financial support. The authors declare that no funding was received for the design, execution, or reporting of this study.

Conflict of interest: The authors declare that there is no conflict of interest.

Summary

The National Level Mathematics Olympiad (NLMO) 2025 was designed to identify and nurture mathematical talent among undergraduate engineering students across India. This study evaluates its educational impact using a mixed-methods approach, integrating survey responses, performance data, and interviews from 140 participants representing 11 states. The Olympiad was conducted in two levels: Level 1 (multiple-choice questions covering seven mathematical domains) and Level 2 (advanced problem-solving tasks requiring higher-order thinking).

Findings indicate that 87.14% of students progressed from Level 1 to Level 2, with 80% reporting improved analytical and problem-solving skills, 70% expressing renewed interest in mathematics, and 60% of Level 2 qualifiers identifying enhanced academic and career

prospects. Performance analysis revealed top scores of 88/100 in Level 1 and 84/100 in Level 2. Statistical validation confirmed significant improvement ($t(238) = 4.13$, $p < 0.001$) and a positive association between participation level and skill development ($\chi^2(2, N = 140) = 9.85$, $p = 0.007$).

The study concludes that NLMO is an effective platform for bridging theory and practice, enhancing students' mathematical competencies, academic engagement, and employability. Recommendations include mentorship programs, preparatory resources, and longitudinal tracking to maximize long-term educational impact.

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