Community Research and Application Journal
Vol. 2 No. 1 (2025) 15 – 21
Available online at https://journal.innoscientia.org/index.php/craj

Pre-Competition Training for Kompetisi Sains Madrasah (KSM) at MTs Negeri 1 Pati

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ABSTRACT

The Kompetisi Sains Madrasah (KSM) is a prestigious science competition organized by the Ministry of Religious Affairs of Indonesia to enhance student achievement in science and technology at madrasah institutions. Effective preparation through intensive coaching is essential for students to perform optimally in this competition. This community service project aimed to provide pre-competition training for KSM participants at MTs Negeri 1 Pati, preparing students and supervising teachers for the 2026 KSM. The training was conducted from October 9th – November 22nd, 2025, involving 3 students and 1 supervising teacher who participated in an intensive coaching program covering physics topics required for the KSM. The training materials included mechanics, scientific skills and scientific methods, heat and temperature, solar system, electricity and magnetism, matter and substances, light and optics, forces, energy and energy transformation, and earth and space science. The program utilized direct instruction, question-and-answer sessions, intensive problem-solving practice, simulation exercises, and final evaluations. Instructors from the Physics Department of UIN Walisongo Semarang facilitated the training, providing comprehensive coverage of physics concepts and extensive practice with KSM-style problems. Challenges encountered included limited training time and dense material coverage that reduced opportunities for extensive problem-solving practice. To address time constraints, instructors provided participants with example problems and solutions for continued independent study. The training successfully equipped participants with a deeper understanding of physics concepts relevant to KSM and improved their problem-solving skills through intensive practice. This collaboration between university faculty and madrasah demonstrates an effective model for supporting student preparation for academic competitions and enhancing the quality of science education in madrasah.

Keywords:
Kompetisi Sains Madrasah; Science Competition Training; Physics Education; Madrasah; Problem Solving

Introduction

The Kompetisi Sains Madrasah (KSM) is an annual science competition for madrasah students organized by the Ministry of Religious Affairs of Indonesia. This competition serves as a strategic platform for students to develop cognitive abilities, problem-solving skills, creativity, and sportsmanship (Pranata, 2024). KSM aims to improve the quality and competence of students in mastering science and technology while providing equitable opportunities for achievement across madrasah institutions throughout Indonesia. The competition encompasses various fields including mathematics, biology, physics, chemistry, economics, and geography, depending on the educational level (Kementerian Agama, 2024).

Science competitions like KSM provide valuable opportunities for students to challenge themselves beyond regular classroom instruction. Research on science olympiads and competitions has shown that participation enhances students' scientific knowledge, problem-solving abilities, and motivation for STEM learning (Güven & Sülün, 2012). However, competitions alone cannot produce desired outcomes without adequate support and facilitation from schools. Student motivation and enthusiasm must be cultivated, and their preparation must be directed toward achieving the competition's intended goals. Therefore, coaching and training to prepare for science competitions are critically important activities that schools must undertake to ensure students have clear direction and purpose in competition participation (Tapilouw et al., 2017).

Pre-competition training for students at the madrasah tsanawiyah level is expected to provide understanding about KSM and prepare them to face this competition effectively. Teachers play crucial roles in coaching students for such competitions, and proper training enables them to enhance the quality of student achievement outcomes. Training to prepare for KSM helps students understand and solve problems effectively while also preparing their mental readiness to tackle competition problems that are more challenging than typical classroom exercises (Zubaidah et al., 2018).

Comprehensive coaching and training for science competitions for both teachers and students is essential to ensure that science education proceeds effectively and produces graduates with competencies and interests in science fields. Coaching can take the form of training or mentoring from science experts or experienced science educators. It may also involve discussions and question-and-answer sessions about science content being taught. When supervising teachers thoroughly understand their roles and functions, they can significantly help students face competitions. Intensive and continuous training and guidance conducted by teachers cultivate student enthusiasm and motivation for learning and competing (Pranata, 2023).

The distinctive characteristic differentiating KSM from other science competitions is its integration of science with Islamic values and perspectives. This integration of science and Islam has become increasingly important given the strengthening dichotomy between the two domains (Pranata, 2024). Addressing this integration requires specialized preparation that helps students understand both scientific concepts and their connections to Islamic teachings and values.

MTs Negeri 1 Pati, as one of the madrasah institutions in Pati Regency, participates actively in KSM and seeks to optimize student achievement in this competition. Recognizing the importance of thorough preparation, the school collaborated with the Faculty of Science and Technology at Universitas Islam Negeri Walisongo Semarang to provide intensive pre-competition coaching for KSM participants. This collaboration represents an effective model of partnership between higher education institutions and schools in supporting student achievement and enhancing science education quality.

This community service project aimed to prepare students from MTs Negeri 1 Pati for the 2026 Kompetisi Sains Madrasah and to equip supervising teachers with knowledge and strategies for coaching students in KSM preparation. The training focused on physics topics required for the competition, providing both conceptual understanding and extensive problem-solving practice to build student competence and confidence.

Methods

The pre-competition training program for KSM was implemented through three main stages: preparation, implementation, and evaluation.

Stage I: Preparation

The preparation phase involved comprehensive planning and coordination between the organizing team from the Faculty of Science and Technology at Universitas Islam Negeri Walisongo Semarang and MTs Negeri 1 Pati. The organizing committee, consisting of faculty and students from the Physics Department, prepared all administrative materials including official correspondence, promotional flyers, invitations, and evaluation report formats.

The committee coordinated directly with instructors to discuss training activities, confirmed instructor attendance, obtained instructor curricula vitae, and reviewed training materials to be delivered. Coordination with the information technology team and control room staff was conducted to ensure smooth technical operations during the training sessions. Training materials were developed covering all physics topics required for the MTs-level KSM based on the official KSM curriculum and guidelines.

The training schedule was designed for five consecutive days from October 9th – November 22nd, 2025, at MTs Negeri 1 Pati. Two instructors from the Physics Department - Sheilla Rully Anggita, M.Sc were assigned to deliver the training, with each instructor responsible for specific topic areas based on their expertise.

Stage II: Implementation

The training program was conducted from October 9th – November 22nd, 2025, at MTs Negeri 1 Pati. Three students who had been selected to represent the school in KSM participated in the training, along with one supervising teacher who would continue supporting students after the intensive training period concluded.

The training followed a structured schedule covering comprehensive physics content relevant to the KSM. October 9th, 2025, Sheilla Rully Anggita, M.Si. presented materials on mechanics, scientific skills and the scientific method, and heat and temperature. The mechanics session covered fundamental concepts including motion, forces, Newton's laws, and their applications in problem-solving. The scientific skills and scientific method session emphasized understanding the inquiry process, experimental design, data analysis, and drawing evidence-based conclusions. The heat and temperature session addressed thermal concepts including temperature scales, heat transfer mechanisms, thermal expansion, and specific heat capacity.

On October 14th, 2025 delivered materials on the solar system, electricity and magnetism, matter and substances, and light and optics. The solar system session covered celestial bodies, planetary motion, gravity, and astronomical phenomena. The electricity and magnetism session addressed electric circuits, current, voltage, resistance, magnetic fields, and electromagnetic induction. The matter and substances session covered states of matter, properties of materials, density, and changes of state. The light and optics session included reflection, refraction, lenses, mirrors, and optical instruments.

October 21st, 2025 was dedicated to simulation exercises and evaluation conducted by Sheilla Rully Anggita, M.Sc. Students practiced solving KSM-style problems under time constraints similar to actual competition conditions. This simulation helped students develop time management skills, identify areas needing additional practice, and build confidence in their problem-solving abilities. Following the simulation, detailed review and feedback were provided to help students understand solution strategies and identify common pitfalls.

On October 25st, 2025 presented materials on forces, energy and energy transformation, and earth and space science. The forces session provided deeper exploration of force types, force diagrams, equilibrium, and force applications. The energy and energy transformation session covered forms of energy, conservation of energy, work, power, and energy conversions in various systems. The earth and space science session addressed geological processes, earth structure, weather and climate, and space phenomena.

The final day, November 14th, 2025, consisted of comprehensive final evaluation conducted by Sheilla Rully Anggita, M.Sc. This evaluation assessed students' mastery of all topics covered during the training and provided final feedback and recommendations for continued preparation.

Throughout the training, sessions followed a consistent format combining direct instruction, interactive question-and-answer discussions, and intensive problem-solving practice. Instructors presented concepts clearly, provided numerous examples, and engaged students in working through progressively challenging problems. Students received immediate feedback on their problem-solving approaches, helping them refine their strategies and deepen their conceptual understanding.

Stage III: Evaluation

The evaluation phase assessed both the training implementation and participant learning outcomes. Evaluation of implementation focused on the smoothness of training activities, effectiveness of coordination, and adequacy of preparation. Participant feedback was gathered regarding the clarity of instruction, relevance of materials, and usefulness of problem-solving practice.

Several challenges were identified during the evaluation. The limited training time of only five days proved insufficient for comprehensive coverage of all topics combined with extensive problem-solving practice. The density of material coverage reduced opportunities for students to practice with as many problems as would be ideal for competition preparation. Time constraints limited the depth of exploration possible for complex topics and reduced opportunities for individualized attention to address specific student difficulties.

To address these challenges, instructors provided participants with files containing example problems and detailed solutions for continued independent study. This enabled students to continue practicing beyond the formal training period and reinforced concepts through additional examples. Supervising teachers were encouraged to continue regular practice sessions with students leading up to

the competition, using the provided materials and building on the foundation established during the intensive training.

Results and Discussion

The pre-competition training for KSM at MTs Negeri 1 Pati successfully provided intensive preparation for three students and one supervising teacher over the five-day program. The training covered comprehensive physics content aligned with KSM requirements and provided extensive problem-solving practice to develop student competencies (Figure 1).

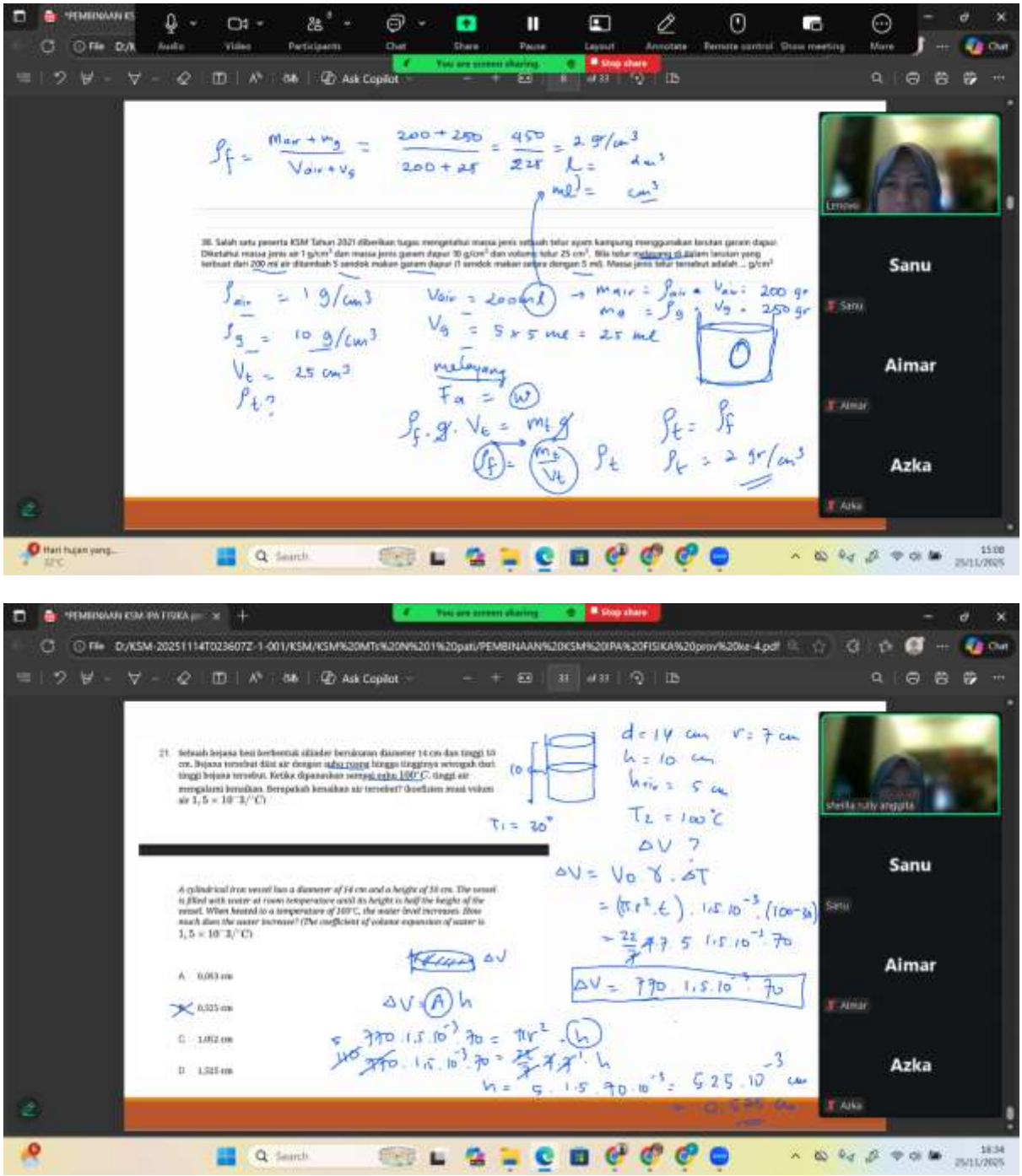

Figure 1. The training covered comprehensive physics content aligned with KSM requirements

Participants engaged actively throughout the training sessions, demonstrating increasing confidence and competence as the program progressed. The structured progression from foundational concepts to more complex applications helped students build understanding systematically. Interactive discussions during question-and-answer sessions revealed students' developing conceptual understanding and their growing ability to apply concepts to novel problem situations.

The mechanics session established essential foundations in understanding motion and forces, with students practicing problems involving kinematics, dynamics, and applications of Newton's laws. These fundamental concepts underpin many other physics topics, making thorough understanding crucial. Students worked through problems requiring force analysis, motion calculations, and application of physical principles to real-world situations, developing both computational skills and conceptual reasoning.

Scientific skills and the scientific method session emphasized the inquiry process central to scientific practice and assessed in KSM. Students learned to identify variables, design investigations, analyze data, and draw valid conclusions. This training in scientific thinking complements content knowledge and helps students approach unfamiliar problems systematically. Emphasis on evidence-based reasoning and critical evaluation of results develops skills applicable beyond competition settings.

The heat and temperature session addressed common misconceptions and helped students distinguish between these related but distinct concepts. Practice problems involved heat transfer calculations, thermal equilibrium, phase changes, and thermal properties of materials. Understanding thermal physics requires both mathematical facility and conceptual understanding of energy transfer mechanisms, both of which were developed through varied practice problems.

Solar system content connected physics principles to astronomical contexts, helping students see applications of mechanics and gravity at cosmic scales. Students appreciated seeing how fundamental physics concepts explain celestial phenomena they can observe. This connection to observable phenomena makes abstract concepts more concrete and memorable. The integration of Islamic perspectives on celestial phenomena, where appropriate, helped students recognize complementarity between scientific and religious understanding.

Electricity and magnetism topics challenged students with more abstract concepts involving invisible fields and forces. Careful use of diagrams, analogies, and worked examples helped make these concepts more accessible. Students practiced circuit analysis, magnetic field problems, and electromagnetic induction calculations, developing facility with both conceptual reasoning and quantitative problem-solving. These topics are typically challenging for students but are consistently represented in KSM, making thorough preparation essential.

Matter and substances content addressed fundamental chemistry and materials science relevant to physics applications. Understanding properties of materials, states of matter, and molecular behavior provides essential foundation for many physics topics. Students practiced problems involving density, pressure, and material properties, connecting macroscopic observations to particle-level explanations.
Light and optics offered opportunities for both conceptual understanding and geometric problem-solving. Students worked with ray diagrams, lens equations, and applications to optical instruments. Many students found these visual and geometric approaches engaging and accessible. Connections to everyday experiences with mirrors, lenses, and optical phenomena helped make abstract principles tangible.

The mid-training simulation provided valuable assessment of student progress and identification of areas needing additional attention. Experiencing competition-like conditions helped students develop time management skills and emotional regulation under pressure. The simulation revealed both strengths to build on and weaknesses to address in remaining training time. Detailed review of simulation results provided targeted feedback to guide continued preparation.

Forces, energy, and energy transformation sessions built on earlier mechanics foundations, exploring energy concepts more deeply. Conservation of energy provides powerful problem-solving approaches that students practiced applying to diverse situations. Understanding energy transformations helps students analyze complex systems by tracking energy flows. These concepts appear frequently in KSM problems and develop broadly applicable analytical skills.

Earth and space science content integrated physics, geology, and atmospheric science, showing interdisciplinary connections. Students explored how physical principles explain geological processes,

weather phenomena, and space science applications. This integration demonstrates the unity of scientific understanding across traditional disciplinary boundaries, helping students develop more coherent understanding.

The final evaluation assessed comprehensive understanding across all topics and identified areas for continued development. Results showed substantial progress from the training start, with students demonstrating improved problem-solving skills, deeper conceptual understanding, and greater confidence. Areas of remaining difficulty were identified for focused attention in continued preparation.

The limited training time proved challenging for comprehensive coverage combined with extensive practice. Five days, while intensive, cannot provide the depth of preparation that ongoing, sustained coaching over longer periods enables. However, the training established essential foundations and provided direction for continued independent and teacher-supported preparation. The materials and strategies introduced during the training equipped both students and the supervising teacher to continue effective preparation beyond the formal training period.

Material density necessitated relatively rapid coverage of topics, sometimes limiting depth of exploration. Some complex topics would benefit from more extended treatment with additional examples and practice opportunities. The instructors addressed this limitation by providing supplementary materials including example problems with detailed solutions, enabling continued practice beyond training sessions. Supervising teachers were encouraged to use these materials to facilitate ongoing practice sessions leading up to the competition.

The training demonstrated effective collaboration between university faculty and madrasah schools in supporting student achievement. University faculty brought specialized content expertise and experience in advanced problem-solving, while school teachers understood student backgrounds and ongoing educational contexts. This complementary expertise created synergistic benefits for student learning. Such partnerships can be expanded to benefit more schools and students, leveraging university resources to enhance educational quality more broadly.

The training's focus on problem-solving skills alongside content knowledge reflects research showing that effective competition preparation requires both conceptual understanding and strategic problem-solving approaches (Güven & Sülün, 2012). Students need not only to know concepts but to apply them flexibly in novel situations under time pressure. The training's balance of instruction and practice addressed both dimensions, though more practice time would be beneficial.

The inclusion of the supervising teacher in training proved valuable for ensuring continuity of preparation beyond the intensive period. Teachers who understand both content and effective coaching strategies can provide ongoing support to students. This capacity-building dimension extends the training's impact beyond the immediate participants to potentially benefit future student cohorts as teachers apply and refine their coaching skills over time (Tapilouw et al., 2017).

The integration of Islamic perspectives where appropriate, characteristic of KSM, was addressed throughout the training. Students were encouraged to see scientific inquiry as complementary to religious understanding, both as ways of appreciating creation and understanding natural phenomena. This integration helps students in madrasah contexts connect their scientific learning to their broader worldview and educational experience.

Conclusion

This pre-competition training successfully prepared students from MTs Negeri 1 Pati for the 2026 Kompetisi Sains Madrasah through intensive instruction covering comprehensive physics content and extensive problem-solving practice. Three students and one supervising teacher participated in the five-day training program conducted October 9th – November 22nd, 2025, covering mechanics, scientific methods, heat and temperature, solar system, electricity and magnetism, matter, optics, forces, energy, and earth and space science. Despite challenges of limited time and dense material coverage, the training established essential foundations and equipped participants with enhanced understanding and problem-solving skills. Instructors provided supplementary materials to support continued preparation, and collaboration between university faculty and madrasah demonstrates an effective model for supporting student achievement in academic competitions.

Acknowledgments

The author thanks MTs Negeri 1 Pati for their collaboration in this training program. Thanks also to Universitas Islam Negeri Walisongo Semarang for institutional support for this community service initiative.

Conflicts of Interest

The author affirms that she has no conflicts of interest.

References

Güven, Y., & Sülün, Y. (2012). The effects of problem-based learning and traditional teaching methods on students' academic achievement in science courses. *Procedia - Social and Behavioral Sciences*, 46, 1961-1965. https://doi.org/10.1016/j.sbspro.2012.05.415

Kementerian Agama. (2024). Kompetisi Sains Madrasah Nasional 2024 resmi dibuka, menag dorong inovasi dan sportifitas. Retrieved from https://kemenag.go.id/nasional/kompetisi-sains-madrasah-nasional-2024-resmi-dibuka-menag-dorong-inovasi-dan-sportifitas-lszKz

Pranata, O. D. (2023). Pelatihan Olimpiade Sains Nasional Bidang Kebumian melalui pendekatan strategis. *Jurnal Pengabdian Masyarakat MIPA dan Pendidikan MIPA*, 7(1), 56-62. https://doi.org/10.21831/jpmmp.v7i1.51410

Pranata, O. D. (2024). Pendampingan Kompetisi Sains Madrasah (KSM) melalui kerja sama dan kolaborasi madrasah-kampus. *Jurnal Riset dan Pengabdian Masyarakat*, 4(1), 137-145. https://doi.org/10.22373/jrpm.v4i1.3334

Tapilouw, M. C., Firman, H., Redjeki, S., & Chandra, D. T. (2017). The important and performance level of biology teacher competency in West Java, Indonesia. *AIP Conference Proceedings*, 1868, 100009. https://doi.org/10.1063/1.4995225

Zubaidah, S., Fuad, N. M., Mahanal, S., & Suarsini, E. (2018). Improving creative thinking skills of students through differentiated science inquiry integrated with mind map. *Journal of Turkish Science Education*, 14(4), 77-91. https://doi.org/10.12973/tused.10218a