

Science Coaching for Kompetisi Sains Madrasah (KSM) at Elementary Madrasah Level in Pati District

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ABSTRACT

The Kompetisi Sains Madrasah (KSM) is an important science competition platform for madrasah students in Indonesia, requiring comprehensive preparation for both students and supervising teachers. This community service project aimed to provide science coaching for KSM at the elementary madrasah (MI) level in Pati District, preparing teachers and students for the provincial-level competition. The training was conducted from July 16-27, 2024, through a hybrid format combining online sessions via Zoom and offline sessions at the Ministry of Religious Affairs office in Pati. Sixteen students and five supervising teachers from various madrasah ibtidaiyah in Pati District participated in the program. The training covered comprehensive science topics required for KSM, including mechanics, heat and temperature, solar system, electricity and magnetism, matter and substances, light and optics, forces, energy and energy transformation, and earth and space science. Four instructors from the Physics Department of UIN Walisongo Semarang facilitated the training, with two instructors (Istikomah and Affa Ardhi Saputri) delivering sessions fully online. In contrast, the lead instructor (Sheilla Rully Anggita) conducted both online and offline sessions. The program utilized interactive presentations, question-and-answer discussions, and intensive problem-solving practice to develop participants' conceptual understanding and competitiveness skills. Challenges encountered included limited preparation time, technical issues with equipment during online sessions, and scheduling conflicts that prevented some participants from attending complete sessions. Solutions implemented included thorough equipment testing before sessions, careful time management, and coordination to minimize scheduling conflicts. The training successfully enhanced participants' understanding of KSM requirements and equipped teachers with strategies for ongoing student coaching, demonstrating effective collaboration between higher education institutions and the Ministry of Religious Affairs to support madrasah science education.

Keywords:

Kompetisi Sains Madrasah; Elementary Madrasah; Science Competition; Teacher Training; Hybrid Learning

Introduction

The Kompetisi Sains Madrasah (KSM) is an annual science competition organized by the Ministry of Religious Affairs of Indonesia for students at madrasah ibtidaiyah (MI), madrasah tsanawiyah (MTs), and madrasah aliyah (MA) levels throughout the country. This competition serves multiple important purposes: improving student quality and competence in mastering science and technology, providing equitable opportunities for student achievement across madrasah institutions, and serving as a strategic platform for students to develop cognitive abilities, problem-solving skills, creativity, and sportsmanship (Pranata, 2024). The competition encompasses various scientific fields including mathematics, biology, physics, chemistry, economics, and geography, with specific subjects depending on the madrasah level.

Research on science competitions and olympiads has demonstrated that such competitions provide valuable opportunities for talented students to challenge themselves beyond regular classroom instruction and develop advanced problem-solving skills (Güven & Sülün, 2012). However, competitions alone cannot produce desired outcomes without adequate support and facilitation from educational institutions. Student motivation must be cultivated, their preparation must be directed systematically, and they require guidance to achieve the competition's intended goals (Zubaidah et al., 2018). Therefore, coaching and training programs to prepare for science competitions are critically

important activities that schools must undertake to ensure students have clear direction and purpose in their competition participation.

Coaching for science competitions at the madrasah ibtidaiyah level presents unique challenges and opportunities. Elementary-level students require age-appropriate pedagogical approaches that balance conceptual development with competition preparation. Teachers at this level need support in understanding competition requirements, developing effective coaching strategies, and creating learning environments that nurture scientific curiosity while preparing students for competitive challenges (Tapilouw et al., 2017).

The role of teachers in competition preparation is paramount. Teachers equipped with thorough understanding of their roles and functions can significantly help students face competitions effectively. Intensive and continuous training and guidance conducted by teachers cultivate student enthusiasm and motivation for learning and competing (Pranata, 2023). With proper training, teachers can enhance the quality of student achievement outcomes. Competition preparation 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.

Comprehensive coaching 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 various forms including training sessions, mentoring from science experts or experienced science educators, and facilitated discussions addressing science content and pedagogical strategies. When properly supported, teachers can provide the sustained, high-quality coaching that students need for success (Zubaidah et al., 2018).

The integration of science with Islamic values, characteristic of madrasah education, presents both opportunities and challenges in competition preparation. KSM emphasizes not only scientific competence but also the integration of science understanding with Islamic perspectives, addressing the dichotomy that sometimes exists between scientific and religious knowledge (Pranata, 2024). Effective KSM coaching must help students develop both scientific competencies and appreciation for the complementarity of scientific inquiry and religious understanding.

Pati District, located in Central Java, has numerous madrasah ibtidaiyah institutions whose students participate in KSM. Recognizing the importance of systematic preparation, the Ministry of Religious Affairs of Pati District collaborated with the Faculty of Science and Technology at Universitas Islam Negeri Walisongo Semarang to provide comprehensive coaching for KSM participants and their supervising teachers. This partnership leverages university expertise in science education and competition preparation to support madrasah institutions in achieving excellence.

This community service project aimed to provide multiple benefits for participants. The training sought to provide knowledge and insights regarding KSM science coaching, strengthen capacity for conducting intensive and sustained competition preparation, prepare competent teachers for guiding KSM training, develop needs analysis for effective KSM coaching, identify challenges in conducting KSM science coaching, and provide alternative solutions for problems encountered during competition preparation. Through achieving these objectives, the program aimed to enhance the quality of KSM preparation in Pati District and improve student performance in the competition.

Methods

The KSM coaching program was implemented through three main stages: preparation, implementation, and evaluation.

Stage I: Preparation

The preparation phase involved comprehensive planning and coordination by the organizing committee from the Faculty of Science and Technology at Universitas Islam Negeri Walisongo Semarang in collaboration with the Ministry of Religious Affairs of Pati District. The organizing team, consisting of faculty members Sheilla Rully Anggita, Istikomah, and students Dela Ayu Puspita, Siti Nurfadhilah Murtado, and Affa Ardhi Saputri, prepared all necessary administrative materials including official correspondence, promotional flyers, invitations, Zoom meeting links, and evaluation report formats.

The committee coordinated directly with all instructors to discuss training activities, confirmed instructor attendance, obtained instructor curricula vitae, and reviewed training materials to be delivered. Special attention was given to coordinating the hybrid format combining online and offline sessions, ensuring that technology infrastructure would support effective online delivery while also preparing appropriate facilities for offline sessions. Coordination with the information technology team was conducted to ensure smooth technical operations during online sessions.

Training materials were developed covering all science topics required for the MI-level KSM based on official KSM curriculum and guidelines. Materials were designed to be appropriate for both online and offline delivery modes, with interactive elements to maintain participant engagement regardless of delivery format.

The training schedule was designed for implementation from July 16-27, 2024, with most sessions conducted online via Zoom and a final offline session on July 27, 2024, at the Ministry of Religious Affairs office in Pati District. Four instructors were assigned to deliver the training: Istikomah and Affa Ardhi Saputri would conduct sessions fully online, while Sheilla Rully Anggita would facilitate both online and offline sessions, with support from student assistants Dela Ayu Puspita and Siti Nurfadhilah Murtado.

Stage II: Implementation

The training program was conducted from July 16-27, 2024, through a hybrid format. Sixteen students selected from various madrasah ibtidaiyah in Pati District to represent their schools in KSM participated in the training, along with five supervising teachers who would continue supporting students after the formal training period concluded.

The training followed a structured schedule covering comprehensive science content relevant to the KSM. On July 16, 2024, Istikomah and Dela Ayu Puspita presented online sessions on mechanics and scientific skills and methods. The mechanics session covered fundamental concepts including motion, forces, simple machines, and their applications in problem-solving appropriate for elementary level. The scientific skills and methods session emphasized understanding the inquiry process, observation techniques, simple experimental design, data recording, and drawing conclusions from evidence.

On July 17, 2024, Istikomah and Dela Ayu Puspita continued with online presentation on heat and temperature. This session addressed thermal concepts including temperature measurement, heat transfer through conduction, convection, and radiation, thermal effects on materials, and practical applications of thermal principles in everyday contexts.

July 18, 2024, featured online sessions by Istikomah and Dela Ayu Puspita on the solar system. The session covered celestial bodies in our solar system, characteristics of planets, the sun as our star, Earth's moon, day and night cycles, seasons, and basic astronomical phenomena observable from Earth. On July 20, 2024, Sheilla Rully Anggita and Siti Nurfadhilah Murtado conducted online sessions on electricity and magnetism. The presentation covered electric circuits, conductors and insulators, static electricity, current electricity, batteries, simple circuits, magnetic properties of materials, magnetic fields, and electromagnets.

July 22, 2024, returned to online sessions by Istikomah and Dela Ayu Puspita focusing on matter and substances. This session addressed states of matter (solid, liquid, gas), properties of materials, changes of state, mixtures and solutions, separating mixtures, and physical versus chemical changes.

On July 23, 2024, Sheilla Rully Anggita and Siti Nurfadhilah Murtado presented online sessions on light and optics. The content included properties of light, light sources, shadows, reflection and mirrors, refraction, lenses, simple optical instruments, and formation of images.

July 24, 2024, featured online presentation by Sheilla Rully Anggita and Siti Nurfadhilah Murtado on forces. This session explored types of forces, gravity, friction, balanced and unbalanced forces, force effects on motion, and applications of force principles.

On July 25, 2024, Sheilla Rully Anggita and Siti Nurfadhilah Murtado conducted online sessions on energy and energy transformation. The presentation covered forms of energy, energy sources, energy conversions, conservation of energy, renewable and non-renewable energy, and energy in living systems.

The final training day, July 27, 2024, included both online and offline components. Sheilla Rully Anggita and Siti Nurfadhilah Murtado presented on earth and space science. The online portion covered Earth's structure, rocks and minerals, soil, water cycle, weather and climate, and natural phenomena. The offline session at the Ministry of Religious Affairs office in Pati provided opportunity for face-to-face interaction, comprehensive review, final problem-solving practice, and direct discussion of remaining questions and challenges.

Throughout the training, sessions followed a consistent format combining direct instruction, interactive question-and-answer discussions, and problem-solving practice. Instructors presented concepts clearly using age-appropriate language and examples, engaged students in discussions, and provided numerous practice problems. Teachers received guidance on coaching strategies and materials for continued student support. The hybrid format allowed flexibility while maintaining engagement through varied delivery modes.

Stage III: Evaluation

The evaluation phase assessed both training implementation and participant outcomes. Evaluation of implementation identified several areas requiring attention. The training overall proceeded smoothly and successfully achieved its objectives, but certain challenges emerged that provide lessons for future programs.

Several technical and logistical challenges were identified. Limited preparation time before training commencement constrained the thoroughness of some preparatory activities. During one online session, the host computer experienced technical errors requiring time to resolve before the session could continue. Scheduling conflicts occurred as the training period coincided with other activities including regular teaching duties for some teachers, resulting in several participants being unable to attend complete sessions.

Based on these challenges, several solutions were identified for improving future program quality. The organizing committee recognized the need for more thorough preparation with adequate lead time, ensuring all activities are planned and coordinated well in advance. Equipment testing before each session was identified as essential to prevent technical disruptions. Careful selection of training timing to minimize conflicts with other obligations would increase participant attendance and engagement. Better time management by both organizers and participants would help prevent schedule conflicts and ensure full participation.

Participant feedback regarding training content and delivery was generally positive. Teachers expressed appreciation for the comprehensive topic coverage and practical coaching strategies. Students demonstrated engagement with the material and growing confidence in problem-solving abilities. The hybrid format was generally well-received, with online sessions providing convenience and accessibility while the offline session enabled personal interaction and relationship building.

Results and Discussion

The KSM coaching program for elementary madrasah level in Pati District successfully provided comprehensive preparation for 16 students and 5 supervising teachers through the hybrid training format conducted from July 16-27, 2024. The program covered extensive science content required for KSM and equipped participants with enhanced understanding and skills for competition preparation.

The hybrid delivery format combining online and offline sessions offered both advantages and challenges. Online sessions via Zoom provided accessibility and convenience (Figure 1), allowing participants from various locations across Pati District to participate without travel requirements. This accessibility is particularly valuable in rural or dispersed communities where transportation to centralized training locations presents barriers. The online format also allowed flexibility in scheduling and enabled recording sessions for later review. However, online delivery also presented challenges including technical issues, limitations in hands-on demonstrations, and potential difficulties maintaining student engagement through screens.

The offline session on the final day provided valuable opportunities for face-to-face interaction that complemented online learning (Figure 2). Direct personal contact enabled relationship building between instructors and participants, facilitated detailed discussions of complex concepts, allowed hands-on problem-solving activities, and created community among participants. Teachers particularly

valued the offline session for networking with colleagues and discussing implementation strategies. The hybrid model effectively balanced the benefits of both delivery modes, though future iterations might benefit from additional offline sessions at strategic points throughout the program.



Figure 1. The Online sessions via Zoom

The comprehensive topic coverage ensured participants received thorough preparation across all science areas assessed in KSM. The mechanics session established fundamental understanding of motion and forces that underpin many other physics topics. For elementary students, concrete examples and hands-on demonstrations help make abstract concepts more accessible. Teachers learned strategies for using everyday objects and phenomena to teach mechanics concepts effectively.



Figure 2. The offline session on the final day provided valuable opportunities

Scientific skills and methods training emphasized the inquiry process central to scientific practice. Elementary students benefit from learning observation skills, simple experimental procedures,

and evidence-based reasoning that form foundations for more sophisticated scientific work. Teachers received guidance on facilitating age-appropriate inquiry activities that develop scientific thinking while remaining accessible and engaging for young learners.

Heat and temperature content addressed concepts frequently encountered in daily life but often misunderstood. Distinguishing between temperature and heat, understanding heat transfer mechanisms, and recognizing thermal phenomena in familiar contexts help students develop accurate conceptual understanding. Practical examples and simple experiments make thermal physics accessible to elementary students while building foundations for more advanced study.

The solar system topic connected science to students' natural curiosity about space and celestial phenomena. Elementary students find astronomy inherently engaging, providing opportunities to develop interest in science while learning about our place in the universe. Understanding Earth's position in the solar system, planetary characteristics, and observable astronomical phenomena builds scientific literacy and inspires wonder about the natural world.

Electricity and magnetism topics introduced students to phenomena central to modern technology. Understanding circuits, conductors and insulators, and magnetic properties provides foundations for comprehending electrical and electronic devices students encounter daily. For elementary students, hands-on activities with simple circuits and magnets make these somewhat abstract concepts tangible and engaging. Teachers learned strategies for safe, effective demonstrations and student investigations in electricity and magnetism.

Matter and substances content developed understanding of material properties and changes fundamental to chemistry and physics. Elementary students can observe states of matter, changes of state, and material properties through accessible experiments and demonstrations. Understanding physical versus chemical changes, mixtures, and solutions builds foundations for more sophisticated chemistry study while connecting to everyday experiences with cooking, cleaning, and material use. Light and optics offered opportunities for both conceptual learning and engaging demonstrations. Properties of light, shadow formation, reflection, and refraction can be explored through simple but effective demonstrations that captivate elementary students while developing scientific understanding. Understanding how mirrors and lenses work provides foundation for explaining optical instruments and vision. Teachers learned demonstration techniques and inquiry activities that make optics accessible and engaging.

Forces content extended mechanics understanding, exploring various force types and their effects. Understanding gravity, friction, balanced and unbalanced forces, and force applications helps students explain and predict everyday phenomena from sliding objects to falling bodies. For elementary students, concrete experiences with forces through investigations and demonstrations build understanding more effectively than abstract presentations.

Energy and energy transformation topics addressed concepts central to understanding natural and technological systems. Elementary students can grasp that energy takes various forms, can be converted from one form to another, and is conserved in these transformations. Understanding energy sources, including renewable and non-renewable options, connects science to environmental education and prepares students for informed citizenship regarding energy issues.

Earth and space science integrated geology, meteorology, and astronomy, showing how physical principles explain Earth processes and phenomena. Understanding Earth's structure, rock formation, water cycle, weather patterns, and natural phenomena builds scientific literacy about our planet. For students in Indonesia, connecting general principles to local geological and meteorological phenomena increases relevance and engagement.

Throughout the training, instructors adapted content and pedagogy to elementary students' developmental levels while maintaining scientific accuracy and rigor. Age-appropriate language, concrete examples, visual demonstrations, and opportunities for hands-on exploration made complex concepts accessible. Teachers observed these pedagogical strategies and received guidance on implementing similar approaches in their own coaching.

The participation of both students and teachers proved valuable for ensuring sustained preparation beyond the formal training period. Students received direct instruction and practice, while teachers learned content and coaching strategies they could apply in continued preparation. This dual focus extends the training's impact, as teachers equipped with effective coaching skills can support not only current participants but also future student cohorts.

The challenges encountered during implementation provide valuable lessons for future programs. Technical difficulties during online sessions highlighted the importance of equipment testing and backup plans. Having alternative hosting devices ready and testing all technology before sessions can minimize disruptions. The scheduling conflicts that reduced some participants' attendance emphasize the need for careful coordination with schools and consideration of academic calendars when planning training dates.

Limited preparation time constrained some aspects of program planning and coordination. Future programs would benefit from earlier initiation of planning processes, allowing more thorough preparation and better coordination with all stakeholders. The density of content coverage within the available time limited opportunities for extensive problem-solving practice. While comprehensive topic coverage ensures students encounter all required content, additional time for practice would strengthen skill development. Follow-up sessions or provision of practice materials for independent work can supplement intensive training periods.

The collaboration between Universitas Islam Negeri Walisongo Semarang and the Ministry of Religious Affairs of Pati District exemplifies effective partnership between higher education institutions and government agencies in supporting madrasah education. Universities bring specialized content expertise and educational research knowledge, while government agencies provide access to schools, understanding of local contexts, and organizational support. Such partnerships can be expanded to benefit additional schools and students, leveraging complementary strengths of different institutions.

The training's success in preparing participants for KSM while also building teacher capacity for continued coaching demonstrates the value of comprehensive approaches to competition preparation. Rather than focusing solely on short-term competition outcomes, the program invested in developing sustainable capacity within the madrasah system. Teachers who understand both content and effective coaching strategies can provide ongoing support, potentially benefiting multiple student cohorts over time.

Conclusion

The KSM coaching program for elementary madrasah level in Pati District successfully prepared 16 students and 5 supervising teachers for provincial-level science competition through comprehensive training conducted July 16-27, 2024. The hybrid format combining online sessions via Zoom and an offline session at the Ministry of Religious Affairs office in Pati provided flexible, accessible training covering mechanics, scientific skills and methods, heat and temperature, solar system, electricity and magnetism, matter, light and optics, forces, energy, and earth and space science. Despite challenges including limited preparation time, technical issues during online delivery, and scheduling conflicts affecting attendance, the program achieved its objectives through effective coordination, comprehensive content coverage, and integration of both online and offline delivery modes, demonstrating successful collaboration between university and government institutions in supporting madrasah science education.

Acknowledgments

The authors thank the Ministry of Religious Affairs of Pati District for collaboration and support in organizing this training program. Thanks also to the participating students, teachers, and madrasah institutions for their engagement. We acknowledge Universitas Islam Negeri Walisongo Semarang for institutional support and Dela Ayu Puspita and Siti Nurfadhilah Murtado for their assistance in training delivery.

Conflicts of Interest

The authors affirm that they have no conflicts of interest.

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