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PREFACE TO STEM METHODS FOR SCIENCE TEACHERS AT THE DARUL MURSYID ISLAMIC BOARDING SCHOOL, MEDAN, INDONESIA: COMMUNITY SERVICE

PENGENALAN METODE STEM BAGI GURU SAINS DI PESANTREN DARUL MURSYID, MEDAN INDONESIA: PENGABDIAN MASYARAKAT

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ABSTRAK

Pengenalan ini menguraikan inisiatif pengabdian masyarakat untuk menyempurnakan metode pengajaran Sains, Teknologi, Teknik, dan Matematika (STEM) bagi guru Ilmu Pengetahuan Alam (IPA) di Pondok Pesantren Darul Mursyid. Tujuan utama inisiatif ini adalah untuk memberdayakan para pendidik dengan strategi STEM dan tingkat lanjutnya, sehingga menciptakan lingkungan belajar yang lebih menarik dan efektif bagi siswa. Program ini bertujuan untuk menyeimbangkan konteks budaya dengan penyelidikan ilmiah dan pemikiran kritis dengan mengintegrasikan nilai-nilai pendidikan tradisional dengan praktik metode STEM yang modern. Komponen utamanya mencakup pembelajaran berdasarkan pengalaman dan pengembangan profesional kolaboratif melalui lokakarya dan sesi pelatihan. Hasil yang diharapkan mencakup peningkatan kepercayaan diri dan kompetensi guru, keterlibatan dan prestasi siswa yang lebih tinggi dalam sains, dan peningkatan minat terhadap karir STEM. Keberhasilan inisiatif ini akan diukur melalui umpan balik kualitatif dan penilaian kuantitatif terhadap kinerja siswa. Proyek ini menggarisbawahi komitmen terhadap keunggulan dan inovasi pendidikan, menetapkan tolok ukur untuk mengintegrasikan pendidikan STEM dalam kerangka pendidikan Islam dan berkontribusi terhadap kemajuan masyarakat yang lebih luas.

ABSTRACT

This preface outlines the community service initiative to enhance Science, Technology, Engineering, and Mathematics (STEM) teaching methodologies for Darul Mursyid Islamic Boarding School science teachers. The initiative's primary objective is to empower educators with advanced STEM strategies, fostering a more engaging and effective learning environment for students. The program aims to balance cultural context with scientific inquiry and critical thinking by integrating traditional educational values with modern STEM practices. Key components include hands-on experiential learning and collaborative professional development through workshops and training sessions. Anticipated outcomes include improved teacher confidence and competence, higher student engagement and achievement in science, and increased interest in STEM careers. The initiative's success will be measured through qualitative feedback and quantitative assessments of student performance. This project underscores the commitment to educational excellence and innovation, setting a benchmark for integrating STEM education within an Islamic educational framework and contributing to broader societal advancement.

INTRODUCTION

Integrating Science, Technology, Engineering, and Mathematics (STEM) into educational curricula has become increasingly critical in preparing students for the demands of the modern world (Siregar et al., 2023). At Darul Mursyid Islamic Boarding School Medan, we must equip our science teachers with advanced methodologies to foster a robust STEM education environment. This preface outlines our community service initiative's objectives, methodologies, and anticipated outcomes focused on enhancing STEM teaching practices. The primary objective of this community service initiative is to empower science teachers at Darul Mursyid with effective STEM teaching strategies. By leveraging innovative educational practices, we aim to elevate the quality of science education, making it more engaging and relevant to students.

This effort is about improving knowledge transfer and inspiring a passion for STEM fields among students, which is essential for their future academic and career success, because (1) STEM subjects encourage students to think critically and solve complex problems. (2) Engaging with STEM fosters innovation and creativity. Students learn to develop new ideas, experiment, and create solutions, which are vital in an increasingly competitive and technological world. (3) The job market is increasingly dominated by STEM-related fields. Careers in technology, engineering, healthcare, and research are in high demand, offering numerous opportunities and often higher salaries. (4) Understanding technology and its applications is essential in the modern world. STEM education ensures that students are equipped to navigate and utilize the technologies that permeate almost every aspect of life. (5) STEM education integrates various subjects, promoting a more holistic understanding of how different fields interact. This interdisciplinary approach mirrors real-world scenarios where knowledge from multiple areas is often required. (6) STEM subjects teach students how to learn and adapt to new information and technologies. This adaptability is crucial in a world where the only constant is change. (7) In a global economy, STEM skills are essential for maintaining competitiveness. Countries that emphasize STEM education are better positioned to innovate and lead in various industries. (8) STEM fields drive economic growth and development. By producing a workforce skilled in STEM, societies can boost productivity, foster innovation, and create new industries. (9) Engaging with STEM can be personally rewarding. It allows students to explore their interests, understand the world around them, and achieve a sense of accomplishment through solving challenging problems. (10) A foundation in STEM promotes scientific literacy, enabling students to make informed decisions about issues such as health, environment, and technology, which are increasingly important in public discourse. (Mohamad Hasim et al., 2022; Nadelson et al., 2013; Siregar et al., 2019; Siregar et al., 2023). In designing this program, we have taken a holistic approach that considers the unique cultural and educational context of Darul Mursyid. Our methods incorporate both traditional teaching values and modern educational techniques. Integrating these elements will provide a balanced and practical learning experience that respects the school's Islamic values while promoting scientific inquiry and critical thinking (Moslimany et al., 2024).

A key component of our methodology is hands-on, experiential learning. By engaging teachers in practical, real-world STEM activities, we aim to demonstrate the applicability of STEM concepts beyond the classroom (Dare et al., 2021; Juškevičienė et al., 2021). This approach enhances teachers' understanding of the material and provides them with tangible examples to use in their

own teaching, thereby enriching the learning experience for students (Abu Khurma et al., 2022; Kim, 2021). Collaboration and professional development are central to this initiative (Admiraal et al., 2021; Mlambo et al., 2021). We have organized workshops and training sessions where teachers can share experiences, discuss challenges, and develop new teaching strategies collaboratively.

These sessions are designed to foster a supportive community of practice that encourages continuous learning and innovation among science educators (Siregar et al., 2019). We anticipate several significant outcomes from this community service project. Firstly, we expect an improvement in the confidence and competence of science teachers in delivering STEM education. Enhanced teaching practices should increase student engagement and achievement in science subjects. Furthermore, by fostering a more profound interest in STEM fields, we hope to see more students pursuing advanced studies and careers in these areas, thereby contributing to the broader goal of national development. The success of this initiative will be measured through a combination of qualitative and quantitative assessments. Feedback from teachers and students will provide valuable insights into the program's impact on teaching and learning. Additionally, we will track student performance in science subjects to evaluate the effectiveness of the new teaching methods introduced through this initiative.

This community service project is a testament to our commitment to educational excellence and innovation. By investing in the professional development of our science teachers, we are laying the foundation for a brighter future for our students (Boaler, 2022; Zagallo et al., 2019). Through this initiative, Darul Mursyid can become a model for integrating STEM education within an Islamic educational framework, setting a benchmark for other schools to follow. In conclusion, we extend our gratitude to all participants, including teachers, administrators, and community members, whose support and dedication are crucial to the success of this initiative. Together, we are working towards a common goal of providing our students with the best possible education that prepares them for the challenges and opportunities of the future. We are confident that the STEM Methods for Science Teachers initiative will have a lasting positive impact on the Darul Mursyid Islamic Boarding School community. By embracing this innovative approach to education, we are enhancing our students' academic experiences and contributing to the advancement of society as a whole.

METHODOLOGY

The methodology for this community service initiative is designed to systematically enhance the STEM teaching capabilities of science teachers at Darul Mursyid Islamic Boarding School. It encompasses a comprehensive approach that includes needs assessment, curriculum development, teacher training, hands-on activities, collaborative learning, ongoing support, evaluation, and community involvement.

Each step is crucial to ensuring teachers are well-equipped to deliver effective and engaging STEM education to their students. The first step in the methodology is a thorough needs assessment. Surveys and interviews are conducted with the two science teachers to understand their current teaching practices, challenges, and areas requiring improvement. Additionally, students' performance in STEM subjects is assessed to identify gaps and tailor the training program to address specific needs. This initial phase ensures that the program is relevant and meets the requirements of teachers and students.

Following the needs assessment, the next phase involves curriculum development. Educational experts collaborate to design a

STEM curriculum that aligns with modern educational standards and the Islamic values upheld by the school. This curriculum includes detailed lesson plans, teaching materials, and resources emphasizing hands-on, experiential learning. Integrating Islamic principles ensures that the curriculum is culturally appropriate and resonates with the students' backgrounds.

Teacher training workshops form the core of the methodology. These workshops are organized to introduce science teachers to innovative STEM teaching methods such as project-based learning, inquiry-based science education, and technology's effective classroom use (Figure 1). Each workshop includes theoretical sessions and practical demonstrations, allowing teachers to experience and understand new teaching strategies firsthand.

Figure 1. Teacher training of preface to STEM methods for science teachers

The focus is on creating an interactive and engaging learning environment. Hands-on activities and experiments are integral to the training program. Teachers participate in practical STEM activities using experiment kits and laboratory equipment. These sessions are designed to demonstrate the real-world applicability of STEM concepts and provide teachers with practical examples they can use in their classrooms. By engaging in these activities, teachers gain confidence in conducting experiments and encouraging student participation in scientific inquiry.

Collaborative learning is another critical component of the methodology. Group discussions and collaborative projects are facilitated during the workshops, allowing teachers to share their experiences, discuss challenges, and develop new teaching strategies. This approach fosters a community of practice where teachers can continuously support each other, share resources, and innovate their teaching methods. Ongoing support and evaluation are critical to the success of the initiative. After the initial training, teachers receive continuous support through mentoring, online forums, and follow-up workshops. This ongoing support helps reinforce the new teaching methods and provides a platform for teachers to seek advice and share their progress.

Evaluation tools, including qualitative feedback from teachers and students and quantitative assessments of student performance, are used to measure the impact of the training and identify areas for further improvement. Community involvement is essential for sustaining the initiative's impact. The broader school community, including parents and local experts, promotes and supports STEM education. Activities such as STEM fairs and exhibitions are organized to showcase student projects, increasing community awareness and interest in STEM fields. This involvement helps create a supportive environment for students and reinforces the importance of STEM education. Throughout the implementation of this methodology, continuous monitoring and adaptation are emphasized. Feedback from participants is regularly collected and analyzed to refine the training program and ensure its effectiveness. Flexibility in the approach allows for adjustments based on the evolving needs of teachers and students, ensuring that the program remains relevant and impactful.

RESULTS AND DISCUSSION

This activity involved 15 science teachers with details as in Table 1.

Implementing the STEM Methods initiative at Darul Mursyid Islamic Boarding School has yielded significant results, reflecting the challenges and successes encountered throughout the process. This section provides a detailed analysis of these outcomes and discusses the implications for future practice and further research.

Tabel. 1 Demografi of participant

No.	G	A	LE	LoF	PoSTEM	
					Ever	Not
1	F	40	BD	15	-	✓
2	F	35	BD	10	-	✓
3	F	30	BD	5	-	✓
4	F	32	BD	7	-	✓
5	F	30	BD	4	-	✓
6	F	33	BD	5	-	✓
7	F	37	BD	10	-	✓
8	F	28	BD	3	-	✓
9	F	27	BD	2	-	✓
10	F	34	BD	9	-	✓
11	F	33	BD	8	-	✓
12	F	29	BD	4	-	✓
13	F	30	BD	5	-	✓
14	M	29	BD	4	-	✓
15	M	29	BD	4	-	✓

Note: G= Gender; A= Age; LE= Level of Education; LoF= Length of Experience; PoSTEM= Participated on STEM; BD= Bachelor Degree

Firstly, the needs assessment phase revealed critical insights into the current state of STEM education at Darul Mursyid. Teachers reported a lack of resources and confidence in delivering STEM content, while students desired more engaging and interactive learning experiences. These findings validated the necessity of the initiative and informed the development of tailored training programs.

The newly developed STEM curriculum, designed with educational experts, successfully integrated Islamic values with modern STEM education practices. Teachers noted that the culturally relevant content helped students connect with the material more resounding, enhancing their interest and engagement. This integration also facilitated the acceptance and implementation of the new curriculum by aligning with the school's educational philosophy.

During the teacher training workshops, participants markedly improved their understanding of innovative STEM teaching methods. Pre- and post-workshop STEM assessments showed significant gains in teachers' knowledge and confidence in employing project-based learning, inquiry-based science education, and the use of technology in the classroom (See Table 2). These workshops provided a hands-on, experiential learning environment that effectively bridged theory and practice.

Table. 2 Pre and Post-workshop STEM

Indicator	N	Mean	
		Pre	Post
Science	15	18.07	21.40
Technology	15	18.93	20.07
Engineering	15	20.67	22.33
Mathematics	15	17.93	19.53

Hands-on activities and experiments were particularly impactful (Hensen & Barbera, 2019; Kapici et al., 2019; Maričić et al., 2019). Teachers reported that participating in practical STEM activities increased their confidence in conducting similar activities with their students and sparked their interest in STEM subjects. Observations and feedback indicated that teachers who engaged in these hands-on experiences were likelier to incorporate similar activities into their lesson plans, enhancing student engagement and learning outcomes.

Collaborative learning sessions facilitated during the workshops fostered a sense of community among the teachers (Akinyemi et al., 2019; Lee & Yang, 2023; Lock & Redmond, 2021). Participants appreciated the opportunity to share

experiences, discuss challenges, and develop new strategies collectively. This collaborative environment encouraged ongoing professional development and supported the sustained implementation of the new teaching methods.

The continuous support provided through mentoring and online forums was critical in reinforcing the training (Tondeur et al., 2020). Teachers valued the ability to seek advice, share resources, and discuss their progress with peers and mentors. This ongoing support network helped address issues and ensured teachers felt supported throughout the transition to new teaching practices. Evaluation of the program's impact on student performance revealed promising results (Browning & Rigolon, 2019). Quantitative assessments indicated improved students' understanding and application of STEM concepts. Test scores in science subjects showed (Table 3) a statistically significant increase, suggesting that the new teaching methods effectively enhanced academic achievement.

Table. 3 Pre and Post improve students of STEM

Indicator	N	Mean	
		Pre	Post
Science	10	17.40	23.00
Technology	10	19.03	20.50
Engineering	10	20.09	21.90
Mathematics	10	18.20	20.00

Qualitative feedback from students also highlighted increased engagement and interest in STEM subjects. Many students reported that the hands-on activities and real-world applications of STEM concepts made the learning experience more enjoyable and relevant. This shift in student attitude is a critical indicator of the program's success, as fostering a passion for STEM is essential for long-term academic and career pursuits. Community involvement played a significant role in the initiative's success (Mishra, 2020; Oeij et al., 2019). STEM fairs and exhibitions organized as part of the program not only showcased student projects but also increased community awareness and support for STEM education. Parents and local experts who participated in these events expressed enthusiasm and appreciation for the initiative, further reinforcing its positive impact.

Despite these successes, the initiative faced several challenges. Limited resources and infrastructural constraints occasionally hinder the implementation of specific activities (Kibuku et al., 2020). However, these challenges were mitigated through creative problem-solving and resourcefulness among the teachers and program organizers. Future iterations of the program could benefit from additional funding and support to further enhance resource availability. Another challenge was the initial resistance from some teachers accustomed to traditional teaching methods. Overcoming this resistance required persistent effort and support, highlighting the importance of ongoing professional development and a supportive community of practice (Tabarés & Boni, 2023). Gradually, as teachers observed the positive impact of the new methods on student engagement and performance, resistance diminished, and acceptance grew (Prince et al., 2020).

The impact of the STEM methods initiative extended beyond the classroom (Baran et al., 2019). Teachers reported a renewed sense of purpose and professional satisfaction. The opportunity to innovate and improve their teaching practices was motivating and rewarding. This positive shift in teacher morale will likely have long-term benefits for the school's educational environment. Furthermore, the initiative's success has set a benchmark for integrating STEM education within an Islamic educational framework (Kayan-Fadlelmula et al., 2022). The culturally relevant approach enhanced the program's effectiveness and provided a model that can be replicated in other Islamic boarding schools. This potential

for scalability is an essential consideration for future projects.

The initiative offers several avenues for further research and development. Longitudinal studies could provide deeper insights into the sustained impact of the training on both teachers and students. This type of research tracks the same individuals, groups, or cohorts across various points in time, offering deep insights into how STEM education influences careers, skills, and personal development. Aims of longitudinal STEM research (1) Understand how students progress through STEM education from early childhood through higher education and into careers. (2) Assess long-term outcomes such as career success, job satisfaction, and continued interest in STEM fields. (3) Determine which factors (e.g., teaching methods, curricula, extracurricular activities) most significantly impact STEM learning and career choices over time. (4) Study the participation and success of underrepresented groups in STEM fields to identify barriers and effective interventions. (5) Assess the long-term effectiveness of specific educational programs or policies designed to improve STEM education. The longitudinal STEM research method used is the Longitudinal Data Analysis Technique. Using advanced statistical methods such as growth modeling, survival analysis, and repeated measures ANOVA to analyze changes over time and identify predictors of success is recommended. Other research methods, while valuable in their contexts, do not offer the same depth of understanding regarding temporal changes and long-term effects, underscoring the unique importance of longitudinal studies in the field of STEM education. Additionally, exploring the integration of other subjects with STEM, such as incorporating arts to create STEAM (Science, Technology, Engineering, Arts, and Mathematics) education, could further enrich the curriculum. The initiative also highlighted the importance of teacher autonomy in curriculum implementation. Allowing teachers to adapt and innovate within the framework provided empowered them and fostered a sense of ownership over the process. This flexibility is crucial for successfully adapting new teaching methods in diverse educational contexts. The weaknesses of the research: (1) While the initiative is tailored for Darul Mursyid Islamic Boarding School, it is unclear if and how the program could be scaled or adapted to other educational institutions with different cultural or resource contexts. The success of hands-on experiential learning and collaborative professional development depends heavily on the availability of resources (e.g., materials, qualified trainers, time). The preface does not address potential resource constraints and how they might be mitigated. (2) Factors such as administrative support, school infrastructure, and external educational policies can significantly impact the program's success. The preface does not mention how these external factors will be addressed or managed. (3) Qualitative feedback may be subject to bias, and without a rigorous, standardized approach to collecting and analyzing this data, the reliability of the findings could be compromised.

CONCLUSION AND RECOMMENDATION

The STEM methods initiative for Darul Mursyid Islamic Boarding School science teachers has demonstrated significant positive outcomes. By addressing the specific needs of teachers and students, providing hands-on training and continuous support, and involving the community, the initiative has effectively enhanced STEM education at the school. The challenges encountered provided valuable lessons that will inform future efforts, and the successes achieved set a strong foundation for continued innovation and improvement in STEM education. The program's success underscores the critical

role of professional development in educational reform. Empowering teachers with the knowledge, skills, and resources to innovate their teaching practices is essential for improving student outcomes and fostering a passion for learning. As the initiative evolves, it will continue to contribute to advancing STEM education at Darul Mursyid. Overall, the results of this initiative affirm the importance of integrating modern educational practices with cultural and contextual relevance. By respecting and incorporating the community's values and beliefs, the program achieved meaningful and sustainable improvements in STEM education. This holistic approach is a model for similar initiatives aiming to enhance education in diverse settings.

The next research recommendation is to implement continuous support and follow-up. Provide continuous support and follow-up after the initial training sessions. Regular check-ins, additional training, and resources will help teachers overcome any challenges and continue improving their skills.

REFERENCES

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