

OPTIMIZING STUDENT LEADERSHIP AND SCIENTIFIC LITERACY THROUGH PARTICIPATORY AND PROJECT-BASED TRAINING

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ABSTRAK

Abstrak: Permasalahan umum dalam organisasi pelajar adalah lemahnya kapasitas kepemimpinan dan rendahnya literasi ilmiah di kalangan siswa. Penelitian ini bertujuan untuk meningkatkan dua aspek tersebut melalui pendekatan pelatihan terpadu berbasis praktik langsung dan pembelajaran kolaboratif. Metode pelaksanaan mencakup pelatihan kepemimpinan, workshop penulisan karya ilmiah, dan proyek sosial berbasis sekolah. Kegiatan ini melibatkan 60 siswa MAN Demak yang merupakan pengurus OSIS dan anggota Karya Ilmiah Remaja (KIR). Evaluasi dilakukan melalui observasi, wawancara, serta angket pre-test dan post-test sebanyak 15 pertanyaan, dengan skor rata-rata post-test meningkat 34% dibandingkan pre-test. Hasil penelitian menunjukkan peningkatan signifikan dalam tiga aspek utama: *pertama*, keterampilan kepemimpinan menunjukkan inisiatif lebih besar dalam berbicara di depan publik, perencanaan program, dan pemecahan masalah organisasi, *kedua*, kemampuan menulis ilmiah berhasil merancang proposal penelitian sederhana terkait isu lingkungan sekitar, dan *ketiga* kolaborasi tim menunjukkan kreativitas dan kemampuan mengintegrasikan nilai kepemimpinan dalam praktik nyata.

Kata Kunci: Pelatihan Kepemimpinan Siswa; Literasi Ilmiah Pelajar; Organisasi Pelajar; Proyek Sosial Sekolah; Madrasah Berbasis Kolaborasi.

Abstract: Common problems in student organizations are weak leadership capacity and low scientific literacy among students. This research aims to improve these two aspects through an integrated training approach based on hands-on practice and collaborative learning. The implementation methods included leadership training, scientific writing workshops, and school-based social projects. This activity involved 60 State Islamic Senior High School (MAN Demak) students who were student council administrators and Youth Scientific Work (KIR) members. The evaluation was conducted through observations, interviews, and pre-test and post-test questionnaires consisting of 15 questions. The average post-test score increased by 34% compared to the pre-test. The results of the study demonstrate significant improvement in three key areas: *first*, leadership skills, with students showing greater initiative in public speaking, program planning, and organizational problem-solving; *second*, scientific writing ability, with students successfully designing simple research proposals related to local environmental issues; and *third*, team collaboration, where students exhibited creativity and the ability to integrate leadership values into practical applications.

Keyword: Student Leadership Training; Student Scientific Literacy; Student Organization; School Social Project; Collaboration Based Madrasah.



Article History:

Received: 29-04-2025

Revised : 13-05-2025

Accepted: 26-05-2025

Online : 04-06-2025



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A. INTRODUCTION

Youth leadership and scientific literacy are two crucial aspects in developing the 21st-century young generation that demands adaptive, critical thinking, and collaborative skills (Alarcón-Orozco et al., 2024; Taufikin et al., 2021, 2024a; Vieira & Tenreiro-Vieira, 2016). Along with global dynamics that demand young people to be more active, creative, and solutive in facing social and environmental challenges, education at the secondary level, especially in madrasah, is required to integrate character strengthening with mastery of scientific literacy (Bicaj et al., 2024; Muzayanah et al., 2023; Syamsul et al., 2023; Taufik et al., 2021; Taufikin, 2021). In this context, student organizations such as student councils and Youth Scientific Work (KIR) groups are strategic platforms to foster leadership values, a spirit of innovation, and scientific thinking skills. However, the challenges faced by educational institutions, especially in regions such as Demak District, Central Java, are not simple.

MAN Demak, as one of the leading madrasahs in the region, already has an active student organization structure. However, preliminary observations show several problems hinder the optimization of the role of student organizations as a medium for youth capacity building. First, limited structured and sustainable leadership and scientific literacy training programs exist. Second is the lack of student involvement in designing and implementing programs contextual to their needs. Third, there is a lack of intensive assistance from outside parties who can provide new perspectives and methodologies in fostering student organizations. This impacts students' low confidence in taking initiative, the weak scientific culture among students, and the lack of real contribution of student organizations in developing the school community.

Several studies support these findings. (Dorasamy & Rampersad, 2014; Maryanah et al., 2022; Mulyaningsih et al., 2022; Nurhayati et al., 2025; Purba, 2024) Student council organizations can effectively build students' character and social responsibility if accompanied by directed and systematic coaching. (Muzayanah et al., 2023; Saparini & Sari, 2024; Seema, 2024; Sudirman et al., 2024) Emphasizing scientific literacy's importance in developing 21st-century competencies, he underlined that many KIR groups in madrasahs had not received adequate methodological support. (Astuti, 2020; Mahmud & Malik, 2024; Nasir, 2021; Setyowati et al., 2024) It is emphasized that the limitations of scientific development in madrasahs often stem from the lack of intensive training and collaboration with external parties, such as universities or research institutions. Therefore, strengthening students' leadership and scientific literacy capacity requires a contextualized, participatory, and sustainable training approach (Nafiah et al., 2020; Rissanen et al., 2023).

This community service activity is designed to address these problems by offering a training model based on active student participation. This approach

aligns with the paradigm of experiential learning and social-constructivist learning that emphasizes the involvement of students in the learning process through dialogue, reflection, and action (Balducci & Sultana, 2024; Bui & Yarsi, 2023; Lane & Grape, 2023; Patil & Powar, 2022; Taufikin et al., 2024b). In addition, this model aligns with national policies emphasizing the importance of strengthening student character through project-based education, as stated in the Merdeka Curriculum and the Directorate General of Islamic Education's policy on strengthening student organizations in madrasah (Solehuddin et al., 2024; Wardani et al., 2023).

The training program includes three main aspects that are integrated: first, training in the basics of leadership and organizational management to improve students' ability to design and manage activities (Taufikin et al., 2024b; Torrico et al., 2025); second, training in scientific writing and simple research methodology to foster scientific and systematic thinking skills (Gaber & Ali, 2022); third, the development of school community-based social innovation projects that aim to apply knowledge and skills in a real context (Banyan et al., 2023; Osland & Lester, 2020). These three aspects are designed to strengthen each other and positively transform students individually and collectively.

This activity was carried out through collaboration between a team of lecturers and students with the madrasah and involved 60 students as participants and research informants. The use of participatory methods ensures students' active involvement and opens up space for the emergence of creative ideas rooted in their own experiences and needs (Digout & Samra, 2023; Hanson & Clapp, 2020). Data were collected through observation, semi-structured interviews, focus group discussions (FGDs), and students' reflective journals (Meydan & Akkaş, 2024). These methods allowed the implementation team to comprehensively capture the dynamics of the training process and its impact.

The main objective of this service activity is to increase students' leadership capacity and scientific literacy through a structured and contextualized participatory training approach. More specifically, this activity aims to (1) increase students' confidence and ability to lead and work collaboratively, (2) equip students with scientific writing and critical thinking skills, and (3) encourage the birth of innovative and sustainable social initiatives in the madrasah environment. The results of this activity are expected to impact individual students' development and positively contribute to the organizational culture and academic atmosphere at MAN Demak.

By integrating the principles of participatory education and youth empowerment, this activity seeks to be an example of good practice that other madrasahs or schools in Indonesia can replicate. This article presents the process, findings, and reflections from the implementation of the training program, with the hope of enriching the discourse on student capacity

building through a community service approach based on collaboration and active participation.

B. IMPLEMENTATION METHOD

This study employed a qualitative descriptive design grounded in the principles of Participatory Action Research (PAR) (Mallory, 2024; Merçon, 2024; Nutton et al., 2020; Walker & Suter, 2025), which emphasizes collaborative engagement between researchers and participants to create knowledge and drive contextual transformation. The implementation method of this program includes a series of educative and participatory-based activities aimed at increasing students' leadership and scientific literacy capacity (Owen et al., 2020; Rissanen et al., 2023). The main activities include counseling, training, workshops, and intensive mentoring. Each activity was designed to encourage the active involvement of participants through experiential learning methods and contextual reflective approaches (Henderson et al., 2024).

1. Partner and Participant Profile

This service program was conducted at MAN Demak, Central Java, Indonesia, involving 60 student council members and the Youth Scientific Work (KIR) organization. This madrasah was chosen as a partner because it has excellent potential to develop student leadership and scientific literacy but does not yet have a structured and systematic coaching program. The participants were selected based on the recommendation of the mentor teacher and the head of the madrasah by considering their activeness and commitment to student organizations.

2. Stages of Implementation

The program implementation is divided into three main stages: pre-activity, core implementation, and monitoring and evaluation.

a. Pre-Activity Stage

The initial stage involved coordinating with the madrasah, preparing training modules, and selecting participants. At this stage, the implementation team also developed initial and final evaluation instruments to measure the program's effectiveness.

b. Implementation Stage

Training activities were carried out for two weeks (October 2024) with the following module division:

Table 1. Schedule for Training

Day/Date	Material	Presenter
Day 1	Leadership basics	Dedication Team from IAIN Kudus, Indonesia
Day 1	Student organization management	External facilitator and mentor teacher

Day/Date	Material	Presenter
Day 2	Writing scientific papers and mini-research	Lecturers and accompanying students
Day 2	Social innovation and community projects	Education practitioner and KIR mentor
Day 3	Group presentation and reflection	Program facilitator and evaluator team

Each session was designed to build a collaborative atmosphere through group discussions, simulations, and project work. Participants were also asked to write reflective journals collected at the end of each session to illustrate their understanding and development.

c. Monitoring and Evaluation

Monitoring is conducted periodically during the implementation of the activities through direct observation by the facilitator and process documentation (Idowu et al., 2024). Formative evaluation Cizek & Lim (2022) is conducted during the activity through quizzes, verbal feedback, and a review of student journals. Meanwhile, summative evaluation was conducted after the activity ended through satisfaction questionnaires, semi-structured interviews, and assessment of student outputs in scientific proposals and community project designs. This evaluation assesses the program's impact on improving students' leadership capacity and scientific literacy (Fattah et al., 2023).

3. Ethics and Validity

The principles of academic ethics and community service guided all activities. The madrasah approved the activity, and all participants agreed to participate voluntarily. The data obtained were analyzed thematically and kept confidential to ensure the validity of the field findings (Kiger & Varpio, 2020; Thompson, 2022).

C. RESULTS AND DISCUSSION

The results of this study show that organization-based participatory training and scientific literacy significantly improve madrasah students' leadership capacity, scientific writing skills, and collaborative abilities. This finding aligns with previous studies emphasizing soft skills development through experiential learning in secondary education (Henderson et al., 2024; Kolb, 1976; Lane & Grape, 2023).

1. Leadership Capacity Building through Organizational Training

The leadership training provided to 60 MAN Demak students, consisting of student council officers and KIR members, significantly improved their leadership skills. Students were trained to develop work programs, lead discussions, and make collective decisions in an organizational context. They were also given leadership simulations through role plays and case studies of student organizations, as shown in Figure 1.



Figure 1. Leadership Training

Observations showed that after the training, most participants improved their public speaking initiative, systematic delivery of ideas, and ability to resolve internal team conflicts. Some participants noted in their reflective journals that they felt more confident managing the organization's work program. Structured leadership training with simulation and case study methods increased speaking courage, decision making ability, and structural understanding of student organizations. These results support the transformational leadership theory (Blom, 2024; Burns et al., 2024; Mazurowski, 2024), which emphasizes the importance of training in fostering inspiration and confidence in the leadership process.

In addition, the increase in post-test scores on the leadership aspect by 24 points indicates that the integration of active training methods (role play, group discussion) has effectively fostered leadership competencies since adolescence (Bates et al., 2021; Cannon et al., 2024). This finding is also supported by (Jeldres & Volante, 2023; Volante et al., 2020)'s research, which confirms that leadership skills can be significantly developed through simulation based training at the high school level.

2. Strengthening Scientific Literacy through Writing Workshop

The second module of the workshop focused on scientific literacy, including the writing of scientific papers, an introduction to simple research methodologies, and data collection and analysis techniques. Each group of participants produced draft research proposals as outputs. Table 2 summarizes the research topics proposed by students after the training session.

Table 2. Research Topics Submitted by Participants

No.	Research Topic	Group
1	The Influence of Social Media on Achievement	A
2	Effectiveness of Online Learning in Madrasahs	B
3	Students' Environmentally Friendly Behavior	C

The students were trained to develop a framework and problem formulation and present the results of their studies in a systematic but straightforward manner. Observations showed that more than 80% of the

participants could understand the basic scientific writing structure after the training session, as shown in Figure 2.



Figure 2. Training in Writing of Scientific Paper

The scientific writing workshop made an important contribution to improving students' understanding of the structure of scientific papers. The post-test score increase of 26 points in this aspect indicates that the participatory and contextual approach can help students understand scientific logic in an applied manner. This aligns with the constructivist learning theory approach (Vygotsky, 1978), emphasizing learning through students' active involvement in knowledge construction (Mohammed et al., 2020; Wibowo et al., 2025).

The success of this training is also in line with the study by (Perdana et al., 2023; Seema, 2024), which found that strengthening scientific literacy among secondary school students is highly effective when combined with project based learning and reflective activities. On the other hand, the challenge of participants' lack of prior experience points to the need for adaptive training to students' backgrounds, as suggested by the study (Ankrum et al., 2020; Bove, 2019).

3. Collaborative Learning in Social Projects

The next step was implementing school-based social innovation projects, encouraging participants to apply the knowledge gained collaboratively (Banyan et al., 2023; Telemala et al., 2024). Some projects developed include a plastic waste reduction campaign in the school environment, a literacy movement through a mini library, and creating health-themed digital educational content. This activity builds a collaborative spirit and creates creativity in solving social problems in the surrounding environment. The accompanying teachers noted that students became more active and independent in designing group follow-up activities, as shown in Figure 3.



Figure 3. Training in teamwork collaboration

The social innovation projects run by the participants showed success in fostering students' collaborative spirit and social awareness. Projects like the anti-plastic campaign and digital educational content demonstrated students' ability to apply real-life training results. This supports the Service Learning approach integrating social activities with academic learning (Eakman et al., 2019; Marca & Martino, 2023). Improved team collaboration was reflected in the post-test score of 88, up from 65 in the pre-test. This improvement reflects the findings of (Porkodi et al., 2023; Setlhodi, 2018), who assert that collaborative projects designed with a clear structure can improve learners' communication skills and social responsibility.

4. Program Monitoring and Evaluation

The evaluation was conducted formatively and summatively (Elwy et al., 2020; Tsipianitis & Roumelioti, 2021). During the activity, monitoring was carried out through direct observation and short interviews with participants. The summative evaluation used pre-test and post-test questionnaires with 15 questions regarding the understanding of leadership material and scientific literacy. The questionnaire results showed a significant increase in concept understanding, positive attitude towards organizations, and research interest. The average post-test score increased by 34% compared to the pre-test.

Table 3. Average Pre-Test and Post-Test Questionnaire Scores

No.	Assessed Aspect	Pre-Test	Post-Test
1	Basic Leadership	62	86
2	Scientific Literacy	58	84
3	Team Collaboration	65	88

The formative and summative evaluations conducted through observations, interviews, and questionnaires provided quantitative and qualitative data that reinforced the program impact findings. The data triangulation method used in this evaluation allows for greater validity of the research findings (Creswell & Poth, 2018; Meydan & Akkaş, 2024; Nightingale, 2019). The increase in scores across all aspects indicates that the program was not only successful in terms of process but also in terms of learning outcomes. This finding reinforces the importance of continuous

assessment in community-based education programs, as (Balldridge, 2023) suggested.

5. Implementation Constraints and Solutions

Some obstacles encountered during the program's implementation include the limited time students spend due to conflicts with regular academic activities and participants' lack of initial experience in scientific writing. The solution was that the training schedule was arranged flexibly outside of school hours, and the writing materials were applicable and adapted to the student's context. In addition, there are obstacles in organizing time between group members to implement social projects. For this reason, time management training and team communication were strengthened through weekly reflective sessions and mentoring by the supervising teacher.

Time constraints and participants' minimal experience are common challenges in training programs in formal education settings. Adjusting schedules and simplifying materials is a practical solution found compelling in Asuquo et al. (2023); Johnson & Poore (2025) research on training management in secondary schools. Other solutions, such as weekly reflective mentoring and strengthening time management, demonstrate a flexible yet structured pedagogical approach. This aligns with the principle of adaptive teaching Cannon et al. (2024), which advocates developing learning strategies responsive to students' needs. Overall, this activity shows that structured participatory training can increase students' capacity for leadership, scientific literacy, and collaboration. The program also successfully strengthened the project-based learning ecosystem in the madrasah environment, as shown in Table 4.

Table 4. Novelty Analysis and Findings Comparison Table

Focus of Discussion	Findings of this Study	Previous Study Findings	Novelty
Student Leadership	Significant improvement through role play and discussion	Focus on formal training	Integration of simulations and case studies in the context of madrasah
Scientific Literacy	Understanding of scientific structure improved through workshops	Generally focused on teacher training	Direct student empowerment with research proposal output
Collaborative Social Project	Activation of social projects from training outcomes	Usually, it does not connect to real activities	Strengthening of student-based project learning ecosystem
Evaluation	Data triangulation (pre-post test, observation, interview)	Tends to be only descriptive or qualitative	Integration of formative and summative evaluation in training programs

Thus, this study confirms the effectiveness of participatory-based training for madrasah students and offers an integrative model that combines leadership training, scientific literacy, and project learning. This model can be replicated in madrasahs or other schools as an innovation in character education and strengthening adolescent scientific culture.

D. CONCLUSION AND SUGGESTION

This research demonstrates that participatory and contextually designed leadership and scientific literacy training can significantly enhance students' capacities in a madrasah environment. Through three stages of activities leadership training, scientific writing workshops, and collaborative project implementation participants showed improvements in both cognitive and affective aspects, along with enhanced social and teamwork skills. Evaluation data indicated a consistent increase in the ability to convey ideas, engage in critical thinking, and manage programs systematically. Specifically, the average post-test score increased by 34% compared to the pre-test. These findings confirm that project-based interventions and collective reflection are highly effective in fostering 21st-century competencies in religious secondary education.

The primary outcomes of this study highlight that training focused on active, experiential learning can address the challenges of low student involvement in organizations and insufficient scientific literacy. The study's implications underscore the importance of the teacher's role as a facilitator of change someone who not only imparts knowledge but also supports the development of independent and collaborative thinking processes. Additionally, the activity demonstrated that, despite challenges such as time constraints and students' limited prior experience, adaptive strategies like flexible scheduling and contextualized materials can effectively overcome these obstacles.

The main contribution of this study is its integration of organizational training and scientific literacy development into a sustainable model for enhancing the capacities of madrasah students. This research adds to the growing body of literature on project-based character education, particularly within the context of Islamic education in Indonesia, which has yet to be extensively explored in international publications. Future research could focus on longitudinal studies to assess the long-term impact of this training on students' academic and leadership success, as well as exploring similar approaches in other educational contexts or cultural settings. The limitations of this study include the short timeframe and the limited sample size from a single madrasah. However, the insights provided are valuable and warrant further replication and development.

ACKNOWLEDGMENTS

The author would like to express sincere gratitude to the Institut Agama Islam Negeri (IAIN) Kudus for their continuous support and facilitation throughout the implementation of this community service program as part of the university's Tri Dharma mandate. Special appreciation is also extended to the leadership, teachers, and students of MAN Demak for their enthusiastic participation, cooperation, and commitment, which were essential to the successful completion of the program. This collaboration not only enriched the practical outcomes of the training but also strengthened the bonds between higher education institutions and secondary schools in fostering leadership and scientific literacy among students.

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