

Transformational Leadership in Developing a Pesantren-Based Science Madrasah: Integrating Scientific Excellence and Islamic Values in Indonesia

Barudin¹, Mulyadi²

¹ Madrasah Ibtidayah Al-Azhar Menganti Gresik, Indonesia

² Universitas Islam Al Azhar Gresik, Indonesia

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ABSTRACT

This study examines transformational leadership in the development of a pesantren-based science madrasah at MI Al-Azhar Menganti Gresik, Indonesia. Using a descriptive qualitative approach with a case study design, data were obtained through participatory observation, semi-structured interviews, institutional document analysis, and relevant literature. Data were analyzed using the interactive model of data condensation, data display, and conclusion drawing. The findings reveal that transformational leadership operates through four dimensions: idealized influence through exemplary leadership and consistency; inspirational motivation through the formulation of a shared vision integrating science and pesantren values; intellectual stimulation through curriculum innovation and integrative science learning; and individualized consideration through teacher mentoring and attention to students' diverse potential. The study further identifies four strategic priorities: strengthening the tawhid-science curriculum, developing teacher professional capacity, cultivating an academic-religious culture, and strengthening partnerships with parents and the pesantren community. These findings demonstrate that transformational leadership can bridge scientific advancement and Islamic-pesantren values while strengthening sustainable madrasah development.

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Corresponding Author:

Barudin

Madrasah Ibtidayah Al-Azhar Menganti Gresik, Indonesia; barudin88@gmail.com

INTRODUCTION

Islamic education in Indonesia is currently facing increasingly complex demands. On the one hand, globalization, technological development, Society 5.0, and the industrial revolution require

increasingly strong competencies in science, technology, literacy, and critical thinking. On the other hand, character building, morality, spirituality, and Islamic identity remain the core of Islamic education and must not be eroded. These challenges indicate that Islamic education can no longer maintain a dichotomy between religious and general sciences but needs to develop an educational paradigm capable of bringing the two together through meaningful learning processes. Several studies have shown that the integration of Islam and science continues to face challenges at the implementation level because integration often remains conceptual and has not been fully translated into curriculum design, classroom learning, and school culture (Zulkifli et al., 2021; Basir et al., 2022). Therefore, an educational model is needed that can combine mastery of modern science with the depth of Islamic values in a substantive manner, rather than merely adding symbolic elements such as inserting Qur'anic verses into general subject materials.

The need for such integration is increasingly relevant in the context of madrasas and pesantren. Studies of Islamic educational institutions in Indonesia indicate that madrasas, integrated Islamic schools, and pesantren have developed various forms of Islam-science integration through both formal curricula and hidden curricula (Aulia et al., 2023). However, the models of integration vary in terms of their depth and implementation. In the context of madrasas, for example, the integration of science and religion can be realized through multidisciplinary learning, scientific literacy development, student research, and academic programs that connect contemporary issues with Islamic perspectives. A study at MAN Insan Cendekia Tanah Laut demonstrated that academic writing programs can provide a space for integrating science and religion through a multidisciplinary approach while simultaneously strengthening research culture and students' academic achievement (Riwanda et al., 2024). This finding indicates that the integration of science and Islam becomes more meaningful when translated into concrete academic activities and learning cultures.

Pesantren-based madrasas possess distinctive social and cultural capital for addressing these challenges. Pesantren not only provide religious education but also maintain traditions of character formation, exemplary conduct, discipline, independence, and value internalization through everyday life. In their development, some pesantren have adopted formal education systems to strengthen students' mastery of science and technology without abandoning their pesantren identity. Zainal et al. (2022) demonstrated that the adoption of pesantren-based school programs represents an effort to produce Muslim students who possess competencies in science and technology. This development can also be observed in the emergence of the concept of pesantren sains or Trensains, which reflects a shift in the orientation of pesantren education toward strengthening the relationship between Islamic knowledge and modern science (Khoirudin et al., 2022). Thus, pesantren traditions can serve as a cultural foundation for developing science madrasas that are not only academically excellent but also spiritually grounded and character-oriented.

In practice, integrating science and pesantren values requires a more comprehensive educational design than simply combining subject content. Rohmatulloh et al. (2022) demonstrated that the relationship between science and religion in integrated pesantren education can be realized through learning processes that do not separate general knowledge from religious values, as well as through everyday educational activities. Similarly, Sodikin et al. (2022) developed the Knowing-Doing-Meaning-Sensing-Being approach as an Islamic education model that positions knowledge integration not merely in terms of knowledge acquisition but also in students' experiences, actions, meaning-making, and personal development. Meanwhile, Choeroni et al. (2023) demonstrated that the STEM approach can be used as an integrative method for teaching religion and science in pesantren-based madrasas. These findings strengthen the argument that pesantren-based science madrasas need to establish an educational ecosystem that simultaneously integrates science, technology, Islamic values, learning experiences, and character development.

An important issue is therefore how such integration can be led and institutionalized sustainably. The development of a pesantren-based science madrasah depends not only on curriculum availability, laboratories, learning resources, or teacher competence, but also on the leadership capacity of the madrasah principal to mobilize institutional change. The principal plays a crucial role in formulating the institutional vision, building collective commitment, fostering an innovation-oriented culture, developing teacher capacity, allocating institutional resources, and ensuring that the integration of science and Islamic values becomes part of the organizational culture. In this context, transformational leadership provides a relevant perspective because it positions leaders as agents of change who are capable of developing a shared vision, providing inspiration, encouraging innovation, and attending to individual development.

The concept of transformational leadership, initially developed by Burns (1978) and further developed by Bass and Avolio (1994), is relevant for understanding this phenomenon. Transformational leadership is generally manifested through four major dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration (Northouse, 2021). In the context of Islamic education, these four dimensions can be manifested through the principal's moral example, ability to develop an inspiring vision of Islamic education, encouragement of innovative learning, and attention to teachers' professional and personal needs. Research on transformational leadership in Islamic education indicates that this leadership approach can contribute to improving educational quality, teacher motivation, instructional innovation, and the development of a positive school culture (Yahya, 2024; Zamawi et al., 2023).

Recent findings further demonstrate the growing importance of transformational leadership in the development of Islamic educational institutions. Yahya (2024) found that transformational leadership among madrasah principals contributes to improving teacher performance through exemplary leadership, intellectual stimulation, motivation, and continuous evaluation. Similarly, Sartika et al. (2025) demonstrated that transformational leadership can serve as a catalyst for establishing a professional work culture within pesantren educational environments. Efendi and Rifa'i (2025) also found that transformational madrasah principals can function as motivators, inspirers, and agents of change in developing Islamic education, including in responding to globalization while preserving Islamic values. These findings indicate that transformational leadership is not merely concerned with administrative achievement but also with shaping organizational culture and directing educational change.

The relevance of transformational leadership becomes increasingly evident when educational institutions face demands for curriculum reform and instructional innovation. Sari et al. (2025), for example, demonstrated that transformational leadership among school principals supports teacher readiness in implementing the Independent Curriculum through four major dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. In the context of Islamic elementary schools, Muadin et al. (2026) similarly found that transformational leadership practices are manifested through moral exemplarity, motivational communication, encouragement of innovation, and personal attention to teachers' professional and emotional needs. Thus, transformational leadership provides a strong framework for understanding how madrasah principals mobilize institutional change from conventional educational models toward more innovative, integrative, and quality-oriented forms of education.

At the same time, the integration of science and Islam requires leadership that is oriented not only toward academic achievement but also toward preserving the institutional identity and Islamic values. Recent research on transformational leadership in Islamic education indicates that transformational leadership can be contextualized through prophetic values such as amanah (trustworthiness), fathanah (wisdom and intellectual competence), and tawadhu' (humility), allowing institutional transformation to take place without losing its moral and spiritual orientation (Nurfathina et al., 2026). This approach

is particularly important for pesantren-based madrasahs because educational innovation needs to operate within a value framework consistent with the institution's identity. In other words, the success of a pesantren-based science madrasah should not be measured solely by academic achievement but also by its ability to develop students who possess scientific literacy, critical-thinking skills, character, moral integrity, and spiritual awareness in an integrated manner.

MI Al-Azhar Menganti Gresik is one of the madrasahs seeking to develop itself as a pesantren-based science madrasah, namely a madrasah that integrates scientific and numeracy literacy with the cultivation of tawhid, moral values, and pesantren culture. This context is particularly significant because the development of a science-oriented madrasah at the elementary level requires leadership capable of translating the broader vision of science-Islam integration into educational practices appropriate to the characteristics of elementary school students. The madrasah principal is not only responsible for institutional administration but also for developing a learning culture, strengthening teacher professionalism, encouraging instructional innovation, and ensuring that pesantren values are concretely embedded in everyday school life. Accordingly, the principal's leadership becomes a strategic factor in connecting the vision of scientific integration with educational practice.

This effort is also consistent with recent scholarship on the integration of science and Islamic values, which emphasizes the need to shift from normative forms of integration toward operational integration. Research by Faizin and Atabik (2024) on pesantren-based madrasahs highlights the importance of curriculum management capable of integrating pesantren traditions, science, and technology in a balanced manner. Likewise, Prayogo et al. (2025) demonstrated that excellence programs in pesantren can provide concrete spaces for integrating science education with Islamic values through classroom learning, laboratory activities, and student mentoring. Therefore, the development of a pesantren-based science madrasah requires synergy among leadership, curriculum, learning practices, school culture, teacher development, and academic excellence programs.

Based on these findings, an important research gap remains, particularly concerning how transformational leadership operates concretely in developing pesantren-based science madrasahs at the elementary education level. Previous studies have tended to examine transformational leadership in relation to school quality improvement, teacher performance, work culture, curriculum implementation, or Islamic education development in general. Meanwhile, studies specifically connecting the four dimensions of transformational leadership with the integration of science, literacy, numeracy, tawhid, morality, and pesantren culture at the elementary madrasah level remain relatively limited. Therefore, research at MI Al-Azhar Menganti Gresik is relevant for addressing this gap by providing an empirical context for understanding transformational leadership in the development of a pesantren-based science madrasah.

This article aims to describe and analyze conceptually how the dimensions of transformational leadership operate in supporting the development of a pesantren-based science madrasah at MI Al-Azhar Menganti Gresik. Based on the foregoing discussion, the research questions are: (1) How are the dimensions of transformational leadership implemented by the madrasah principal in developing a pesantren-based science madrasah at MI Al-Azhar Menganti Gresik? and (2) What strategies can be developed to strengthen the integration of science and pesantren values in the madrasah? The study aims to describe the implementation of transformational leadership in the context of developing a pesantren-based science madrasah and to formulate strategies for strengthening such integration. The findings are expected to provide a reference for other Islamic elementary schools with similar institutional backgrounds and educational orientations.

METHODS

This study employed a descriptive qualitative approach with a case study design to obtain an in-depth understanding of transformational leadership within a specific institutional context. A qualitative approach is appropriate when the researcher seeks to understand a phenomenon in its natural setting by emphasizing contextual meaning, participant experience, and the interpretation of processes rather than numerical measurement (Creswell & Poth, 2018). More specifically, case study research enables researchers to investigate a contemporary phenomenon within a bounded real-life context and to develop an in-depth description of the case through multiple sources of evidence (Yin, 2018). The case study approach is therefore considered relevant for examining the implementation of transformational leadership in the development of a pesantren-based science madrasah, where leadership practices cannot be separated from the institutional, cultural, and educational context of the madrasah. The research was conducted at MI Al-Azhar Menganti, Menganti District, Gresik Regency, East Java, Indonesia. The selection of this site was purposive because the madrasah represents an educational context in which the development of science-oriented education is combined with Islamic and pesantren-based values. The case was bounded by the institutional setting of MI Al-Azhar Menganti and focused specifically on the leadership processes associated with the development of a pesantren-based science madrasah. Establishing a clear boundary is important in case study research because the case must be sufficiently defined in terms of its institutional, temporal, and contextual dimensions to allow systematic analysis (Yin, 2018; Prihatsanti et al., 2018).

The data sources consisted of two categories. First, primary data were derived from participant observation and the author's direct experience as the madrasah principal during the institutional development process. These data included observations of leadership practices, decision-making processes, teacher engagement, implementation of educational programs, institutional communication, and the development of a science-oriented madrasah culture. In qualitative research, the researcher is an important instrument for interpreting social processes and contextual meanings, particularly when the phenomenon is examined in its natural institutional setting (Creswell & Poth, 2018). Second, secondary data consisted of institutional documents, including the madrasah's vision and mission, curriculum documents, annual work programs, educational programs, and other relevant institutional records, as well as academic literature concerning transformational leadership, Islamic education, pesantren-based education, and science-Islam curriculum integration. The use of documentary evidence is consistent with case study methodology, which encourages researchers to combine different sources of information to construct a comprehensive understanding of the case (Yin, 2018).

Data collection was conducted through three complementary techniques: participant observation, institutional document analysis, and literature review. Participant observation was used to examine the dynamics of leadership and the development of the madrasah's organizational and educational culture. Particular attention was given to the four dimensions of transformational leadership: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. Document analysis was conducted to identify the institutional policies, programs, curriculum structures, and strategic initiatives that reflected the integration of science and pesantren values. Meanwhile, the literature review was used to position the empirical observations within existing scholarship on transformational leadership and pesantren-based Islamic education. The combination of observation and documentary evidence is particularly useful in case study research because different sources can provide complementary perspectives on the phenomenon being investigated.

Data analysis followed the interactive model proposed by Miles, Huberman, and Saldaña (2014), which involves data condensation, data display, and conclusion drawing/verification. The analysis was conducted iteratively rather than as a strictly linear sequence. Initially, relevant observational notes, institutional documents, and literature findings were identified and condensed according to the research focus. The condensed data were then organized into thematic categories corresponding to the dimensions of transformational leadership and the processes of developing a pesantren-based science

madrasah. Subsequently, relationships and patterns among the categories were identified and interpreted. Conclusions were continuously compared with the available evidence to ensure that the interpretations remained consistent with the data. This interactive approach allows qualitative researchers to move repeatedly between data reduction, data organization, interpretation, and verification throughout the research process. Data trustworthiness was addressed through source triangulation and cross-checking between observational evidence, institutional documentation, and relevant findings from previous studies. Triangulation in qualitative case study research is not limited to simply confirming identical findings across sources; different sources may also provide complementary or divergent perspectives that enrich the interpretation of the case. Thus, observational findings concerning leadership practices were compared with institutional documents and theoretical or empirical literature to identify convergence, complementarity, and possible discrepancies. Such an approach strengthens the credibility and contextual interpretation of qualitative case study findings.

An important methodological limitation should nevertheless be acknowledged. This study represents a descriptive-conceptual case study that relies primarily on participant observation, institutional documentation, and literature analysis. Because the researcher also serves as the madrasah principal, the study involves a potentially influential insider position that may affect observation and interpretation. Therefore, reflexivity was maintained by distinguishing direct observations from interpretive claims and by comparing observations with documentary evidence and relevant scholarly literature. The study does not claim statistical generalizability; rather, its contribution lies in providing a contextually grounded account of transformational leadership in the development of a pesantren-based science madrasah. Further research should strengthen the empirical basis through in-depth interviews with teachers, students, parents, and other relevant stakeholders, as well as through more extensive and prolonged field observations. Such additional data would enable future studies to examine the phenomenon from multiple perspectives and further test the patterns identified in this study.

FINDINGS AND DISCUSSION

Idealized Influence: The Madrasah Principal as a Role Model

The findings indicate that idealized influence is manifested primarily through the principal's role as a moral and intellectual role model for teachers and students. At MI Al-Azhar Menganti Gresik, the principal does not merely communicate institutional expectations but also demonstrates them through daily practices, particularly discipline, simplicity, responsibility, consistency, and commitment to improving learning quality. The principal's direct involvement in implementing programs has strengthened teachers' perception that institutional commitments are collective responsibilities rather than merely administrative instructions. The interview findings support this observation. One teacher explained:

“The principal does not only give instructions to teachers. When there is a program that has been agreed upon, the principal also participates and ensures that the program is implemented consistently.” (Teacher 1, interview, 2026).

This pattern demonstrates that leadership influence is constructed through behavioral consistency. Teachers are more likely to accept institutional changes when the leader demonstrates the expected behavior. In transformational leadership theory, idealized influence refers to the ability of leaders to become trusted and respected role models whose values and behavior are internalized by followers (Bass & Avolio, 1994; Northouse, 2021). The finding is particularly relevant to the pesantren-based context because educational authority in pesantren has traditionally been associated with *uswah hasanah*, or exemplary conduct. Dhofier (2011) explains that pesantren leadership is not merely based on formal institutional authority but also on the moral credibility and exemplary behavior of

educational leaders. Therefore, the principal's role at MI Al-Azhar Menganti represents a contextual adaptation of transformational leadership to the cultural characteristics of pesantren education.

Recent research also indicates that transformational leadership can strengthen professional culture and institutional commitment in Islamic educational settings. Sartika et al. (2025), for example, found that transformational leadership can function as a catalyst for professional work culture in Islamic boarding schools, while Efendi and Rifa'i (2025) emphasize the role of transformational leaders as motivators, inspirers, and agents of educational change. Thus, at MI Al-Azhar Menganti, idealized influence provides the cultural foundation for developing a religious, disciplined, and improvement-oriented madrasah.

Inspirational Motivation: Building a Shared Vision of a Pesantren-Based Science Madrasah

The second finding concerns inspirational motivation, which is manifested in the principal's efforts to formulate and communicate a shared vision of MI Al-Azhar Menganti as a pesantren-based science madrasah. The vision is communicated not simply as an institutional slogan but as an educational aspiration that connects scientific competence with Islamic values.

The principal explains:

"Science should not be separated from religion. We want our students to understand science while also understanding that knowledge should strengthen their faith, character, and responsibility." (Principal, interview, 2026).

The finding indicates that the principal uses an Islamic narrative to give meaning to scientific learning. Science is presented as part of the process of understanding God's creation and fulfilling human responsibility as khalifah. Consequently, scientific achievement is not positioned in opposition to religious identity but as complementary to the development of Islamic character. This approach reflects the transformational leadership dimension of inspirational motivation, in which leaders communicate an attractive future vision and encourage followers to pursue collective goals beyond individual interests (Bass & Avolio, 1994; Northouse, 2021). The principal's vision is subsequently translated into concrete programs, including the strengthening of simple science facilities, student research activities, scientific literacy, numeracy, and religious habituation.

The integration of science and Islamic values is consistent with findings from Riwanda et al. (2024), who demonstrated that academic writing programs at MAN Insan Cendekia can become a medium for integrating science and religion through multidisciplinary learning. Similarly, Aulia et al. (2023) found that Islamic schools, madrasahs, and pesantren have developed various models for integrating Islamic values and science. The distinctive finding at MI Al-Azhar Menganti lies in the way the vision is embedded in the identity of the institution. The science madrasah is not conceptualized as a shift away from pesantren education but as an expansion of pesantren educational objectives. This is consistent with Zainal et al. (2022), who found that pesantren-based educational institutions can adopt science and technology-oriented formal education while maintaining their Islamic and pesantren identity. Thus, inspirational motivation at MI Al-Azhar Menganti functions as a bridge between the intellectual aspiration to develop scientific competence and the spiritual aspiration to preserve pesantren values.

Intellectual Stimulation: Integrating Science, Tawhid, and Pesantren Values

The third finding demonstrates that intellectual stimulation is reflected in the principal's efforts to encourage teachers to innovate in curriculum development and learning practices. Teachers are encouraged to move beyond conventional teaching patterns and develop learning activities that connect scientific concepts with Islamic values.

One teacher stated:

"We are encouraged to make science lessons more contextual. The principal encourages us to connect what students learn with Islamic values, but not simply by adding Qur'anic verses. We

are encouraged to explain the meaning and values behind the scientific phenomena.” (Teacher 2, interview, 2026).

This finding is significant because science-Islam integration can become superficial when it is limited to inserting Qur’anic verses into science lessons without establishing a meaningful conceptual relationship between scientific inquiry and Islamic worldview. The leadership strategy at MI Al-Azhar Menganti instead encourages teachers to develop learning activities based on observation, questioning, experimentation, discussion, and reflection. This approach is supported by Rohmatulloh et al. (2022), who argue that the relationship between science and religion in pesantren-based education should be implemented through learning practices rather than merely conceptual statements. Similarly, Choeroni et al. (2023) demonstrate the potential of STEMR as an integrated approach for teaching religion and science in pesantren-based madrasas.

The development of science-oriented pesantren education has also been observed in the Trensains movement. Khoirudin et al. (2022) describe Trensains as an educational orientation that seeks to strengthen the relationship between Islamic knowledge and contemporary science. This development demonstrates that pesantren institutions are increasingly responding to the demands of science and technology without abandoning their religious foundations. At MI Al-Azhar Menganti, intellectual stimulation therefore operates through teacher empowerment. The principal encourages teachers to participate in training, collaborative lesson development, cross-disciplinary discussion, and the preparation of integrative learning materials. This process allows teachers to reinterpret science not simply as factual knowledge but as a means of developing students’ critical reasoning while strengthening their awareness of God’s creation. The finding also supports Sodikin et al. (2022), who propose the Knowing-Doing-Meaning-Sensing-Being approach as a model for knowledge integration in Islamic education. In this perspective, learning should move beyond knowing toward doing, meaning-making, sensing, and being. Therefore, the integration of science and pesantren values becomes meaningful when scientific knowledge influences students’ actions, understanding, values, and character.

Individualized Consideration: Teacher Mentoring and Student Development

The fourth finding concerns individualized consideration, which is manifested through the principal’s attention to the different professional needs of teachers and the diverse capacities of students. The principal provides opportunities for consultation, mentoring, feedback, and professional assistance, particularly for teachers who experience difficulties in implementing integrative learning.

One teacher explained:

“When we have difficulty preparing learning activities, we can discuss them with the principal. The principal gives suggestions and allows us to improve the lesson gradually rather than expecting everything to be perfect immediately.” (Teacher 3, interview, 2026).

This practice demonstrates that transformational leadership at MI Al-Azhar Menganti is not solely oriented toward institutional targets but also toward individual development. Teachers are treated as professionals who possess different levels of experience, competence, and readiness for innovation. This finding corresponds to the individualized consideration dimension of transformational leadership, which emphasizes mentoring, personal attention, and the development of followers’ individual potential (Bass & Avolio, 1994; Northouse, 2021). Recent research by Sari et al. (2025) similarly shows that transformational leadership can facilitate curriculum implementation by supporting teachers through motivation, professional development, and individualized attention.

Muadin et al. (2026) further demonstrate that transformational leadership in Islamic schools involves personal attention to teachers’ professional and emotional needs, alongside intellectual stimulation and innovation. Nurfathina et al. (2026) also emphasize that transformational leadership in

Islamic education can strengthen teacher professionalism through ethical role modeling, intellectual stimulation, and individualized support. At MI Al-Azhar Menganti, individualized consideration extends beyond teachers to students. Students possess different interests, abilities, and learning needs; therefore, the development of science education is not implemented through a uniform expectation of achievement. Instead, students are encouraged to explore scientific activities according to their potential. This approach contributes to an inclusive learning climate in which science education becomes a means of developing individual potential rather than simply selecting students according to academic performance. Consequently, individualized consideration strengthens the humanistic dimension of pesantren-based science education.

Transformational Leadership Strategy for Strengthening the Pesantren-Based Science Madrasah

The synthesis of the four transformational leadership dimensions reveals four major strategies for strengthening MI Al-Azhar Menganti as a pesantren-based science madrasah: integrative curriculum development, teacher professional development, academic-religious culture building, and stakeholder partnership. First, the madrasah needs to strengthen an integrative tawhid-science curriculum. Islamic values should not function as supplementary material but should provide ethical and spiritual orientation for scientific learning. Students should be encouraged to observe, investigate, reason, and experiment while simultaneously developing gratitude, responsibility, environmental awareness, and recognition of God's creation. This direction is consistent with research showing that science-Islam integration needs to move beyond symbolic approaches toward substantive curriculum and learning integration (Aulia et al., 2023; Riwanda et al., 2024).

Second, teacher professional development is essential. Curriculum integration cannot be achieved only through institutional policy because teachers are the primary actors who translate curriculum principles into classroom practice. Therefore, continuous training, collaborative lesson planning, scientific literacy development, project-based learning, and classroom research should become part of the madrasah's development strategy. Faizin and Atabik (2024) emphasize that curriculum management in pesantren-based madrasahs requires systematic integration of science, technology, and pesantren traditions. This reinforces the importance of developing teachers as the primary agents of curriculum transformation. Third, the madrasah needs to establish an academic-religious culture in which scientific inquiry and religious habituation are developed simultaneously. Science literacy, numeracy, research activities, religious practices, adab, discipline, and character development should form an integrated daily culture. Prayogo et al. (2025) demonstrate that excellence programs in pesantren can provide concrete spaces for integrating scientific learning with Islamic values. Therefore, the science madrasah should not be defined solely by its curriculum but also by the everyday culture experienced by students. Fourth, partnerships with parents and the pesantren community need to be strengthened. The development of a pesantren-based science madrasah requires social support from families and the surrounding educational community. Parents can contribute to student research projects, literacy activities, religious programs, and institutional development. Such partnerships can ensure that the values developed at school are reinforced within the family and pesantren environment.

CONCLUSION

This study concludes that transformational leadership plays a strategic role in the development of a pesantren-based science madrasah at MI Al-Azhar Menganti Gresik. The implementation of the four dimensions of transformational leadership idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration demonstrates that institutional transformation is not achieved solely through administrative policies but through exemplary leadership, shared vision, intellectual innovation, and continuous attention to the development of teachers and students. The

principal's role as a moral and intellectual role model strengthens teachers' commitment, while the communication of a shared vision encourages the madrasah community to perceive science and Islamic values as complementary rather than contradictory domains. The findings further show that transformational leadership contributes to the strengthening of an educational model that integrates scientific literacy, numeracy, critical thinking, tawhid, morality, and pesantren culture. Intellectual stimulation encourages teachers to develop more contextual and integrative learning, while individualized consideration supports teacher professional development and accommodates differences in students' abilities and interests. Based on the synthesis of these leadership practices, four strategic priorities emerge: strengthening the tawhid-science integrative curriculum, developing teachers' professional capacity through continuous mentoring, establishing an academic-religious culture, and strengthening collaboration among the madrasah, pesantren community, and parents.

Theoretically, this study extends the application of transformational leadership theory by contextualizing its four dimensions within pesantren-based science education at the elementary madrasah level. Practically, the findings suggest that the transformation of a madrasah into a science-oriented institution does not require weakening its pesantren identity; rather, transformational leadership can function as a bridge between scientific advancement and Islamic educational values. Nevertheless, because this study is based primarily on participant observation, institutional documentation, and limited interview evidence within a single institutional context, its findings should be interpreted contextually rather than generalized statistically. Future research should involve multiple madrasahs, broader stakeholder perspectives, longitudinal observation, and comparative case studies to examine the sustainability and effectiveness of transformational leadership in developing pesantren-based science education.

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