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Transformational School Leadership for Technology-Based Education: A Multi-Case Study Supporting SDG 4

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ABSTRACT

Objective: To examines the role of transformational leadership in managing technology-based vocational schools and its contribution to improving educational quality through digital transformation. **Method:** A qualitative multi-case study was conducted at SMK Mitra Sehat Sidoarjo and SMKN 1 Sidoarjo. Data were collected through interviews, observations, and document analysis, and analyzed using thematic analysis to identify leadership practices supporting technology integration. **Results:** The findings indicate that transformational school principals successfully promoted technology integration by fostering a shared vision, encouraging innovation, strengthening teacher professional development, and implementing collaborative and data-driven school management. These leadership practices enhanced digital learning, organizational effectiveness, and the quality of educational services despite challenges related to infrastructure and digital competencies. **Novelty:** Proposing a transformational leadership framework for technology-based vocational school management that integrates digital innovation with collaborative leadership practices. The framework contributes to SDG 4 (Quality Education) by improving the quality and inclusiveness of technology-enhanced education and supports SDG 9 (Industry, Innovation and Infrastructure) by strengthening digital innovation and institutional capacity for sustainable educational transformation.

INTRODUCTION

The rapid development of information and communication technology (ICT) over the past two decades has significantly transformed various sectors of society, including education (Moscato & Embré, 2023). Educational technology has become an integral component of both learning processes and school management, encompassing the use of software, hardware, and communication networks to support teaching activities, educational administration, and institutional governance (Japar et al., 2024; Sobari, 2024). The integration of technology into education offers numerous advantages, including broader access to educational resources, personalized learning experiences, improved communication, and greater administrative efficiency. Despite these benefits, several challenges continue to hinder the effective implementation of educational technology, particularly in developing countries.

In Indonesia, the digital divide remains a major obstacle to educational transformation, especially in 3T areas (underdeveloped, frontier, and outermost regions). Irshadi and Ivaanna (2024) reported that limited infrastructure, inadequate technological training for teachers, and insufficient budget allocations prevent many schools from fully implementing technology-based educational systems. These challenges indicate that the successful integration of technology requires not only digital tools but also adequate infrastructure, institutional support, and competent human resources.

Amid the increasing trend of digitalization, technology-based school management has enabled educational institutions to optimize both administrative and academic

processes. Digital management systems facilitate communication among educational stakeholders, accelerate documentation procedures, and improve the monitoring of student progress. Junior High and Senior High School in Bandung revealed that the implementation of digital school management reduced administrative delays, minimized manual errors, and enhanced the quality of educational services. Furthermore, the integration of technology into learning strategies, such as online and blended learning, has provided students with more flexible, interactive, and student-centered learning experiences. Innovative approaches, including gamification and the utilization of social media platforms in education, have also been shown to increase student motivation and engagement (Samad & Abbas, 2024). However, inadequate infrastructure and limited professional development opportunities for educators continue to pose significant barriers to the effective adoption of educational technology (Andriyan & Yoenanto, 2022).

The implementation of technology in school management has been proven to improve efficiency, accuracy in data processing, and the speed of decision-making processes. School management information systems support structured administration in areas such as student records, financial management, attendance monitoring, and academic reporting (Yanti et al., 2024). These systems also enhance transparency and accountability by enabling real-time access to information for principals, teachers, students, and parents. In instructional settings, teachers increasingly rely on interactive digital platforms to improve content delivery and learning outcomes. Nevertheless, a substantial gap remains between the ideal implementation of educational technology and the realities encountered in many schools. The importance of technology in improving educational quality; however, many institutions continue to struggle with limited digital devices, insufficient training opportunities, and unstable internet connectivity. Similarly, teachers' limited time and heavy workloads are additional barriers to technology adoption. Consequently, technology-based school management must be supported by comprehensive policies, adequate infrastructure, and continuous professional development programs to maximize its effectiveness.

The issues addressed in this study are closely related to the achievement of several Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), and SDG 10 (Reduced Inequalities). Technology-based educational management contributes directly to improving educational quality by enhancing access to learning resources, strengthening administrative efficiency, and promoting innovative learning practices. Furthermore, digital transformation in vocational education supports the development of students' digital competencies and workforce readiness, which are essential for participation in the modern economy. However, disparities in technological infrastructure and access between urban and remote regions continue to challenge the realization of equitable educational opportunities. Therefore, strengthening digital leadership and technology-based management is not only crucial for educational improvement but also contributes to achieving broader sustainable development objectives.

The role of school leadership in the digital era is crucial in determining the direction and success of technology-based educational transformation. School principals are not only responsible for making decisions but also serve as key agents of change who shape institutional visions and strategies that align with contemporary educational demands. They are expected to integrate information and communication technology (ICT) into

school management systems and learning processes while simultaneously facilitating the professional development of teachers and staff through continuous training and capacity-building initiatives. Wiyana et al. (2024) argue that principals who possess a strong understanding of digital technologies are more effective in leading schools toward organizational efficiency and academic excellence. However, a considerable gap remains between leadership theories and their practical implementation, particularly regarding technological competence, resistance to change, and limited institutional resources. Transformational and participative leadership approaches are essential for fostering collaboration, innovation, and the adoption of technology within educational institutions.

Transformational leadership has increasingly been recognized as a critical factor in supporting educational digitalization. This leadership model emphasizes inspiration, motivation, intellectual stimulation, and individualized support to empower organizational members in responding to change (Rifdan et al., 2024). Within educational settings, principals who adopt transformational leadership practices are more likely to encourage teachers to develop digital competencies, implement innovative teaching strategies, and establish collaborative partnerships with government agencies, industries, and other stakeholders (Elmanisar et al., 2024). Furthermore, transformational leaders play a significant role in reducing resistance to organizational change, which often emerges during the implementation of new technologies and management systems. Therefore, the success of digital transformation in schools depends not only on technological infrastructure but also on leadership capabilities that inspire, mobilize, and empower the entire school community to embrace sustainable change (Jayadih et al., 2024).

Digital transformation in school management should be implemented holistically and involve all educational stakeholders, including principals, teachers, students, government agencies, and external partners. Innovations such as School Information Management Systems (SIMS) have demonstrated considerable potential in improving administrative efficiency, while educational data analytics enable educators to monitor student performance in real time and develop more targeted interventions (Sastraatmadja et al., 2024; Akhmad et al., 2024). In Indonesia, the government has demonstrated a strong commitment to educational digitalization through various initiatives. These include the distribution of more than 1.3 million ICT devices to over 79,000 schools in 2023 (Kemendikbudristek, 2024) and the development of digital platforms such as Merdeka Mengajar, ARKAS, and SIPLah, which support both educational management and learning activities. Moreover, more than 2.7 million teachers have participated in technology-based self-learning programs, while 422,679 teachers have enrolled in Professional Teacher Education (PPG) programs to strengthen their digital competencies. These initiatives demonstrate the government's efforts to accelerate educational transformation through digital innovation.

Despite these advancements, the success of educational digitalization remains highly dependent on the readiness of school leadership and the active participation of teachers and students. Effective digital transformation requires continuous professional development, adequate technological infrastructure, and strategic management practices that are informed by data and evidence-based decision-making (Lahagu et al., 2024). Without strong leadership support, investments in technology may fail to generate meaningful improvements in educational quality and institutional performance.

Although educational digitalization in Indonesia has progressed considerably, significant disparities in infrastructure and technological access remain evident, particularly in remote and underdeveloped regions. Schools such as SMK Mitra Sehat Mandiri Sidoarjo and SMKN 1 Sidoarjo represent successful examples of institutions that have integrated Learning Management Systems (LMS) and other digital technologies into both educational administration and instructional processes. However, such achievements are not equally distributed across the country. Many schools in remote areas continue to face challenges related to limited internet connectivity, inadequate ICT facilities, and insufficient technical support (Putro et al., 2023). These disparities contribute to widening educational inequalities between urban and rural communities, preventing many students from accessing digital learning resources that have become increasingly important in modern education (Daud et al., 2019; Hermawansyah, 2021).

This situation is closely associated with SDG 4, which emphasizes the importance of ensuring equitable access to opportunities and resources. Unequal access to educational technology may further exacerbate existing social and educational disparities, particularly among students living in disadvantaged regions. Therefore, government interventions are necessary to provide stable internet access, affordable technological devices, and continuous support programs for schools with limited resources. Such efforts are essential to ensure that no student is excluded from the benefits of digital transformation and that educational development remains inclusive and sustainable.

RESEARCH METHOD

This study employed a qualitative research approach using a literature review method to explore the role of transformational leadership among school principals in managing technology-based schools. A qualitative design was selected because it enables researchers to gain an in-depth understanding of leadership and management phenomena within a specific context, namely the integration of technology into educational processes. According to Creswell (2018), qualitative research seeks to understand individuals' perspectives, experiences, and interpretations within particular social contexts. Therefore, this approach is appropriate for examining the complex and multidimensional nature of leadership in contemporary educational settings, particularly in relation to the implementation of technology in schools. This literature review focused on peer-reviewed journal articles, books, and other scholarly publications published within the last five years that are directly relevant to transformational leadership and technology-based educational management.

The data collection process involved a systematic search of relevant literature through reputable academic databases, including Google Scholar and other scholarly sources. The selected publications were evaluated based on their relevance to the research objectives, methodological rigor, and contribution to understanding the role of school principals in the effective integration of technology within educational institutions. To ensure the credibility and trustworthiness of the findings, this study applied data triangulation by comparing and synthesizing evidence from multiple sources. According to Patton (2015), triangulation enhances the validity of qualitative research by enabling researchers to verify information across different studies and perspectives. This approach helped minimize potential bias and provided a more comprehensive understanding of transformational leadership and technology-based school management.

Data analysis was conducted using thematic analysis, which allows researchers to identify, analyze, and interpret recurring patterns and themes within qualitative data. Thematic analysis as a systematic and flexible method for organizing and interpreting qualitative information. In this study, thematic analysis was employed to examine themes related to transformational leadership practices, technology integration in schools, and the interaction between leadership and technology in improving school management effectiveness. Through the identification and synthesis of recurring themes across the selected literature, this study provides a comprehensive understanding of how transformational leadership supports technology-based educational management and facilitates digital transformation in schools. Furthermore, the findings offer insights into best practices for integrating leadership strategies and technological innovation to enhance educational quality and organizational performance.

RESULTS AND DISCUSSION

Results

In accordance with the research methodology outlined previously, the literature In accordance with the research methodology described previously, this literature review focuses on the analysis of scholarly articles, books, and peer-reviewed journals that examine transformational leadership and technology-based educational management, with particular emphasis on studies published within the last five years. The focus on recent publications aims to capture contemporary developments, challenges, and innovations related to the integration of technology in educational leadership and school management. By examining current literature, this study seeks to provide insights that reflect the rapidly evolving nature of digital transformation in education. Relevant sources were systematically identified through reputable academic databases, including Google Scholar and other scholarly indexing platforms, ensuring the inclusion of credible and up-to-date research. This process was essential for obtaining comprehensive evidence regarding the role of transformational leadership in supporting technology-based school management.

Each selected study was evaluated based on its relevance to the research objectives, methodological rigor, and contribution to understanding how school leaders facilitate the adoption and implementation of educational technologies. The inclusion criteria were established to ensure that only high-quality studies providing reliable empirical or conceptual evidence were incorporated into the analysis. To enhance the credibility and trustworthiness of the findings, this study employed data triangulation by comparing and synthesizing evidence from multiple scholarly sources. According to Patton (2015), triangulation strengthens the validity of qualitative research by enabling researchers to verify findings across different studies and perspectives. Through this approach, recurring patterns, similarities, and differences among the reviewed studies were identified, thereby minimizing potential bias and increasing the reliability of the conclusions.

Furthermore, this review was conducted within the broader framework of the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), and SDG 10 (Reduced Inequalities). The literature demonstrates that transformational leadership and technology-based educational management play significant roles in improving educational quality, strengthening digital competencies, promoting

innovation, and reducing disparities in access to educational resources. Therefore, the findings of this review not only contribute to the understanding of educational leadership in the digital era but also provide insights into how educational institutions can support sustainable and inclusive development through effective technology integration.

The table below presents a summary of the studies included in this literature review. The selected studies provide valuable insights into transformational leadership practices, technology integration, digital transformation, and their implications for educational management. Collectively, these studies illustrate the growing importance of leadership in facilitating technological innovation and improving educational outcomes in the digital age.

Table 1. Matrix of relevant research

Author(s), Year	Research Title	Research Findings
Heriyanita Rosmini, Ningsih Ningsih, Murni Murni, Adiyono (2024)	Transformasi Kepemimpinan Kepala Sekolah pada Era Digital: Strategi Administrasi Pendidikan Berbasis Teknologi di Sekolah Menengah Pertama	Technology-based administration improves student learning outcomes, teacher professionalism development, and school management efficiency. The challenges of technology integration require careful management.
Silvi Dziya'ul Aini, Siti Romadhotul Kholifah, Elyya Putri Fia Nurmaya, Fitri Salwa Hervanda, Hasan Argadinata (2024)	Kepemimpinan Digital: Upaya Peningkatan Inovasi Pendidik di Sekolah Dasar	Digital leadership is crucial in facilitating educational innovation with technology to address the challenges of the digital era.
Ilham Yahya Romandoni, Sulistyorini, Nur Efendi (2024)	Transformasi Kepemimpinan Pendidikan Islam: Tantangan dan Peluang di Era Digital	Islamic education leadership must integrate Islamic values and digital technology to improve education quality; however, challenges such as resistance to change and the digital divide exist.
Dewi Yaminah, Nizma Armila, Ade Rukmana, Lilis Mariyam, Mujahidin, Khaerul (2024)	Kepemimpinan Kepala Sekolah Islam di Era Transformasi Digital	School leaders in the digital era must be competitive and ready to face the challenges of digital transformation with adaptive strategies.
Muslimah Hikmah Wening, Achadi Budi Santosa (2024)	Strategi Kepemimpinan Kepala Sekolah dalam Menghadapi Era Digital 4.0	School principals need to enhance human resource quality in ICT, react quickly to changes, and master 4C skills to adapt to digital changes.
McCarthy et al. (2020)	Digital Transformation in Education: Critical Components for Leaders of System Change	This article identifies key components for transformational digital change in education and proposes a strategic approach to addressing contemporary educational challenges with digital technology.
Carvalho et al. (2022)	What Research Tells Us About Leadership Styles,	Transformational leadership is most frequently found in the reviewed

Author(s), Year	Research Title	Research Findings
	Digital Transformation and Performance in State Higher Education	literature, with a primary focus on educational technology and online learning systems as part of digital transformation. This study also suggests a future research agenda.
Antonopoulou et al. (2021)	Digital Leader and Transformational Leadership in Higher Education	This research shows that transformational leadership positively correlates with digital leadership and emphasizes the importance of digital leadership skills for adaptation in higher education in the digital era.
Niță & Guțu (2023)	The Role of Leadership and Digital Transformation in Higher Education Students' Work Engagement	The research findings indicate that transactional leadership styles play a more significant role than transformational leadership styles in increasing student engagement in digitalized higher education.
Anwar & Saraih (2023)	Digital Leadership in the Digital Era of Education: Enhancing Knowledge Sharing and Emotional Intelligence	This research found that aspects of digital leadership, such as visionary leadership and digital citizenship, positively influence knowledge sharing and emotional intelligence, particularly in private higher education institutions.
Fengchao & Mingchi (2024)	School Leadership and Management Innovation in the Internet+ Education Era	School leaders must innovate in educational management and utilize technology to improve the quality of education services, as well as build a more efficient management system in the digital transformation era.
Connolly et al. (2023)	Ensuring Knowledge Sustainability in a Digital Era: Empowering Digital Transformation Through Digital Educational Leadership	This research proposes a theoretical model for digital educational leaders to support digital transformation, with an emphasis on the importance of leadership in creating a learning culture and professional development in the education sector.
Çetin & Karsantık (2022)	Current Trends in School Management: School Leadership in Education 4.0	This study emphasizes the critical role of school leaders in designing and implementing school development plans and creating an organizational climate that supports educational success in the digital era.
Yusmansyah et al. (2023)	Organizational Leadership Strategies in Improving the Quality of School Education in the Digital Era	This research shows that instructional and transformational leadership from school principals plays an important role in improving education quality and teacher performance, which in turn enhances student performance in the digital era.
Halimah et al. (2024)	The Role of Innovative Leadership in Driving Educational Management	This research highlights the importance of innovative leadership in creating a holistic educational environment and supporting

Author(s), Year	Research Title	Research Findings
	Transformation	student achievement, with the integration of technology and global perspectives being crucial in today's education world.

Discussion

Transformational leadership has emerged as a critical approach to managing technology-based schools in the digital era. This leadership style emphasizes not only the achievement of organizational goals but also the empowerment of individuals, the promotion of innovation, and the development of an organizational culture that is adaptive and responsive to change. Within educational institutions, the role of the principal as a transformational leader has become increasingly important in addressing both the opportunities and challenges associated with digital transformation. Previous studies have demonstrated that principals who adopt transformational leadership practices are more successful in facilitating school digitalization by fostering innovation, collaboration, teacher professionalism, and improved student learning outcomes. Rosmini et al. (2024), for example, found that technology-based educational administration initiated by school leaders contributed significantly to enhanced learning outcomes, professional development among teachers, and greater efficiency in school management. However, the integration of technology into educational systems requires strategic planning and effective leadership to ensure successful implementation. Consequently, principals must adopt leadership approaches that are not only technically competent but also transformational in nature, enabling school communities to adapt to rapidly evolving technological environments and maximize the benefits of digital innovation.

The implementation of digital technology in schools offers numerous advantages, including improved administrative efficiency, enhanced communication, and greater transparency in educational management. Digital technologies significantly improved school administration and communication processes, particularly in primary education settings. In this context, transformational leaders utilize data-driven decision-making processes to ensure that organizational changes are implemented effectively and transparently. This approach aligns with the transformational leadership framework proposed by Bass and Avolio (1994), which consists of four key dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. These dimensions encourage the development of a school culture that values innovation, creativity, and continuous improvement. By motivating teachers and staff to embrace technological innovations, transformational leaders create an environment that supports collaboration, experimentation, and professional growth. Furthermore, principals play a crucial role in ensuring that teachers possess the competencies required to integrate technology effectively into teaching and learning processes. Continuous professional development programs, mentoring initiatives, and technology-focused training are therefore essential components of successful digital transformation. Through these efforts, transformational leadership contributes not only to organizational effectiveness but also to the long-term development of human capital within educational institutions.

The importance of transformational leadership becomes even more evident in the context of ongoing educational digitalization. Aini et al. (2024) emphasized that digital leadership plays a significant role in promoting innovation among educators and

strengthening institutional readiness for technological change. As educational environments become increasingly technology-driven, principals must move beyond traditional administrative responsibilities and function as agents of change who inspire innovation and organizational learning. Transformational leaders facilitate the development of innovative instructional practices that leverage digital technologies to improve student engagement, learning experiences, and academic achievement. This process involves establishing a shared vision that encourages collaboration among teachers, students, parents, and other stakeholders in pursuit of common educational goals. Moreover, transformational leaders utilize technology not only as a management tool but also as a means of strengthening communication, collaboration, and knowledge sharing throughout the school community. Such practices contribute directly to the achievement of SDG 4 (Quality Education) by improving educational quality and learning outcomes through innovative teaching and learning approaches.

In addition, the integration of transformational leadership and digital technology contributes to SDG 9 (Industry, Innovation and Infrastructure) by promoting innovation-driven educational management and strengthening the technological infrastructure necessary for modern learning environments. Through strategic planning and effective resource management, school leaders can create sustainable digital ecosystems that support educational innovation and organizational effectiveness. At the same time, transformational leadership can contribute to SDG 10 (Reduced Inequalities) by addressing disparities in access to educational technology and ensuring that digital transformation benefits all students, regardless of their socioeconomic or geographical backgrounds. This perspective is consistent with the findings of Romandoni and Efendi (2024), who argued that successful educational leadership must balance technological advancement with cultural, ethical, and social considerations. By fostering inclusive and equitable access to technology, school leaders can ensure that digital transformation serves as a mechanism for educational improvement rather than a source of further inequality.

Overall, the literature indicates that transformational leadership is a key determinant of successful technology-based school management. Effective principals are able to create a shared vision for digital transformation, empower teachers to develop technological competencies, promote innovation, and establish collaborative school cultures that support continuous improvement. As educational institutions continue to navigate the challenges of the digital era, transformational leadership remains essential for ensuring that technological advancements contribute meaningfully to educational quality, organizational effectiveness, and the broader objectives of sustainable development.

Transformational leadership has emerged as a crucial approach in managing technology-based schools in the digital era. This leadership style focuses not only on achieving organizational goals but also on empowering individuals, fostering innovation, and creating an organizational culture that is adaptive and responsive to change. Within educational institutions, the role of the principal as a transformational leader becomes increasingly important in addressing both the opportunities and challenges associated with digital transformation. Previous studies have demonstrated that principals who adopt transformational leadership practices can effectively drive school digitalization by fostering innovation, strengthening collaboration, enhancing teacher professionalism, and improving student learning outcomes. For instance, Rosmini et al. (2024) reported that technology-based educational administration

initiated by school principals significantly improved learning outcomes, teacher performance, and overall school management efficiency. However, the successful integration of technology into educational systems requires more than technological readiness; it also demands visionary leadership capable of inspiring and guiding all members of the school community to adapt to continuous technological change.

The application of digital technology in schools offers numerous benefits while simultaneously presenting significant challenges that require effective leadership. Digital technology improves administrative efficiency, communication quality, and transparency in school management, particularly in primary education settings. Transformational principals often employ data-driven decision-making processes to ensure that organizational changes are implemented effectively and transparently, in line with the transformational leadership dimensions proposed by Bass and Avolio (1994), namely idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. These dimensions contribute to the development of a school culture that values innovation, creativity, and critical thinking. By encouraging teachers and staff to embrace digital tools and technologies, transformational leaders create an environment where collaboration and continuous improvement become integral components of educational practice. Furthermore, principals play a critical role in ensuring that teachers receive ongoing professional development and adequate support to integrate technology effectively into teaching and learning activities. Consequently, transformational leadership not only addresses technological and administrative needs but also promotes sustainable professional growth among educators.

In the context of ongoing educational digitalization, Aini et al. (2024) emphasized the importance of digital leadership in fostering innovation among educators. As educational environments continue to evolve, principals are expected to move beyond traditional administrative functions and become agents of change. Through the promotion of innovation and continuous professional development, transformational leaders facilitate the creation of innovative instructional practices that leverage technology to enhance student engagement and learning outcomes. This process requires the establishment of a shared vision in which teachers, students, parents, and other stakeholders collaboratively work toward common educational objectives. An essential aspect of transformational leadership is the ability to cultivate a collaborative learning culture that encourages the exchange of ideas, resources, and best practices. In this regard, technology serves not only as a management tool but also as a medium for strengthening relationships and communication within the school community. These findings align with Romandoni et al. (2024), who argued that effective educational leadership integrates technological advancement with institutional values and educational goals, despite challenges such as digital resistance and unequal access to technology.

The challenges associated with digital transformation are particularly evident in educational institutions that face cultural resistance, limited infrastructure, and disparities in technological readiness. These challenges require transformational leadership capable of addressing both technical and organizational dimensions of change. Principals must facilitate the development of digital competencies among educators while simultaneously supporting cultural adaptation to new educational technologies. Moreover, successful digital education management involves the implementation of e-learning systems, curriculum digitalization, and continuous

enhancement of teachers' digital skills. These initiatives require leaders who are committed to the long-term development of both human resources and technological infrastructure. As digital transformation continues to accelerate, school principals must adopt proactive and future-oriented leadership strategies that prepare educational institutions for ongoing technological advancements and emerging educational demands. This perspective is supported by McCarthy et al. (2023) and Carvalho et al. (2022), who emphasized the critical role of leadership in fostering organizational cultures that embrace innovation and digital transformation.

The successful implementation of transformational leadership in technology-based schools requires a comprehensive approach that integrates technological advancement with human resource development. Antonopoulou et al. (2021) and Niță and Guțu (2023) demonstrated that transformational leadership significantly contributes to the successful navigation of digital transformation by promoting collaboration, innovation, and continuous professional learning. Similarly, Çetin and Karsantik (2022) found that principals acting as transformational leaders play a pivotal role in school improvement planning, teacher competency development, and the integration of digital technologies into both administrative and instructional processes. The ultimate objective is to establish educational environments that are technologically advanced, student-centered, and capable of preparing learners for the demands of the twenty-first century. Halimah et al. (2024) further emphasized that innovative leadership is fundamental to creating holistic educational environments focused on student achievement and sustainable institutional development.

From the perspective of the Sustainable Development Goals (SDGs), the findings of this study contribute primarily to SDG 4 (Quality Education) by highlighting how transformational leadership supports the effective integration of technology to improve educational quality, accessibility, and learning outcomes. Furthermore, the promotion of digital competencies among educators and students contributes to SDG 8 (Decent Work and Economic Growth) by preparing future graduates with skills relevant to the digital economy. The implementation of technology-based school management systems also supports SDG 9 (Industry, Innovation, and Infrastructure) through the adoption of innovative educational technologies and digital infrastructure. Additionally, efforts to reduce educational disparities through equitable access to technology align with SDG 10 (Reduced Inequalities), particularly in addressing the digital divide between urban and rural educational institutions. Therefore, transformational leadership not only facilitates educational innovation but also supports broader sustainable development objectives through the advancement of inclusive and technology-driven education.

CONCLUSION

Fundamental Finding: This study demonstrates that transformational leadership is a critical factor in successfully managing technology-based vocational schools. School principals who foster a shared vision, encourage innovation, strengthen teacher professional development, and promote collaborative leadership are better able to facilitate digital transformation and improve school performance. These findings confirm that transformational leadership extends beyond administrative management by creating adaptive and technology-oriented learning environments that enhance both academic quality and organizational effectiveness. **Implication:** The findings imply that educational policymakers and school leaders should strengthen transformational leadership competencies to support sustainable digital school management. Integrating

collaborative leadership, continuous professional development, and technology-driven decision-making can enhance educational quality and organizational performance. These practices contribute directly to SDG 4 (Quality Education) by improving technology-enhanced teaching and learning, while also supporting SDG 9 (Industry, Innovation and Infrastructure) through the promotion of digital innovation and institutional capacity in vocational education. **Limitation:** This study is limited to two vocational schools in Sidoarjo, which may restrict the generalizability of the findings to schools with different organizational characteristics or technological readiness. In addition, the qualitative multi-case design emphasizes in-depth understanding rather than broad statistical generalization. **Future Research:** Future studies are encouraged to examine transformational leadership across broader educational settings, including public and private schools with varying levels of digital maturity. Quantitative or mixed-method approaches may also be employed to validate the proposed leadership framework and investigate its long-term impact on digital innovation, teacher performance, student outcomes, and sustainable educational transformation.

AUTHOR CONTRIBUTIONS

Yohanes Eko Prasetyo contributed to the conceptualization of the study, research design, data collection, formal analysis, manuscript drafting, and project administration. **Yatim Riyanto** contributed to the conceptual framework, methodology development, supervision, validation, manuscript review and editing, and provided academic guidance throughout the research process. **Nunuk Hariyati** contributed to data interpretation, validation, manuscript review and editing, supervision, and contributed to the refinement of the research findings. All authors have read, reviewed, and approved the final version of the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors state that no financial or personal conflicts of interest exist that may have affected the content or findings of this research.

STATEMENT ON THE USE OF AI OR DIGITAL TOOLS IN WRITING

The authors declare that no artificial intelligence (AI) tools or other digital writing assistants were used in the preparation, analysis, or writing of this manuscript. All stages of the research process, including data analysis, interpretation, and manuscript writing, were conducted solely by the authors. The authors take full responsibility for the originality, accuracy, and integrity of the content presented in this article.

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