



E-Leadership for Computer Engineering and Networking Teachers at Pekanbaru State Vocational Schools

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ABSTRACT

The purpose of this study is to describe and analyze the implementation of E-Leadership by Computer and Network Technology teachers at SMK Negeri 1 Pekanbaru City and SMK Negeri 7 Pekanbaru City, identify and analyze the factors that support or hinder the implementation process, and formulate effective strategies to optimize the application of E-Leadership by Computer and Network Technology teachers in the environment of State Vocational High Schools in Pekanbaru City.

The approach used in this study is descriptive qualitative to explore the phenomenon of E-Leadership among Computer and Network Technology teachers at two schools, namely State Vocational High School 1 Pekanbaru City and State Vocational High School 7 Pekanbaru City, in a natural and objective manner.

The results of the study show that SMKN 1 Pekanbaru has successfully integrated E-Leadership as part of its school strategy, with teachers playing a role as drivers of digital change. The main factors supporting success at SMKN 1 include a clear leadership vision, a collaborative culture, and management support, while challenges faced by both schools include a lack of devices, uneven teacher capabilities, and limited student access to technology. To enhance E-Leadership implementation, SMKN 1 adopts strategies such as teacher mentoring, exploratory learning, and industry collaboration, while SMKN 7 focuses on foundational development, including infrastructure improvements, needs-based training, and the formation of professional communities.

INTRODUCTION

Conventional leadership theories have traditionally emphasized individual heroism and charisma, portraying leaders as strong and unilateral figures who guide their followers through established hierarchical structures. This perspective stems from historical models, including the Great Man Theory and charismatic leadership theory, which suggest that effective leadership is rooted in the leader's personal traits and distinctive behaviors (Kim & Mauldin, 2022).

Digital leadership represents a vital construct in modern organizational theory, emphasizing the integration of digital technology and strategic leadership to drive innovation, engagement, and organizational growth. As organizations continue to navigate the complexities of digital transformation, the development and application of digital leadership skills become crucial for ensuring sustainability and competitive advantage in the digital era.

Principals play an essential role in instructional leadership, which involves strategic actions aimed at improving the quality of teaching and learning. Instructional leadership encompasses setting clear educational goals, supporting curriculum development, and facilitating professional development opportunities for teachers (Yumnah et al., 2024; Ulfa et al., 2023; Zakaria et al., 2023). Effective principals adopt leadership styles that not only focus on administrative tasks but also actively engage with teachers to support their professional needs and growth (Ulfa et al., 2023; Dian et al., 2021). For example, studies have shown that principals who implement instructional leadership practices tend to produce higher levels of teacher self-efficacy and job satisfaction, which in turn positively affect classroom learning outcomes (Karacabey, 2020; Alam et al., 2024).

The dual education system, which combines school-based learning with work experience in the industrial world (DUDI), is crucial in vocational education, particularly in Vocational High Schools (SMK). In this system, productive teachers play a dual and highly important role. In addition to teaching theoretical materials in schools, they must ensure that the learning content aligns with industry needs. Productive teachers serve as a bridge between classroom learning and the skills required in the workplace (Greinert, 2011). They must understand the dynamics of the professional world to better prepare students for the challenges of the labor market. Therefore, teachers need to continuously update their knowledge and adapt to technological advancements and evolving industrial trends.

Productive teachers also act as intermediaries between the school and the workplace by establishing strong collaborative relationships with companies or industries. Such collaboration is essential as it provides students with opportunities for hands-on experience. For instance, through internship or apprenticeship programs, students can gain real-world experience that cannot be achieved solely through theoretical classroom learning (Winch, 2013). Productive teachers in vocational schools play a crucial role in mentoring students during internships and ensuring they can apply their acquired knowledge in actual work settings.

Teacher leadership is not confined to formal roles but can manifest in various forms, such as mentoring novice teachers, leading professional development initiatives, and advocating for student needs (Mohammed, 2023). This is essential for building an environment that fosters innovation and responsiveness to diverse student needs (Santos et al., 2024). Research shows that teacher leaders who demonstrate advocacy and influence are better positioned to drive meaningful change in educational practice and policy (Journal, 2024).

The industry-based learning model (DUDI) in vocational schools is designed to create a strong linkage between education and the workforce so that students acquire skills aligned with industry requirements. In majors such as Computer and Network Engineering, DUDI-based learning includes several key components that ensure students not only understand theoretical knowledge but also possess practical skills relevant to industrial demands. One of the main aspects of DUDI-based learning is internship or practical work. Students are given opportunities to work in partner companies relevant to their field of study. During these internships, students can apply classroom knowledge to real-world situations—such as troubleshooting network issues, configuring hardware, or developing software. This experience also allows them to expand their professional network and enhance employability after graduation.

This study focuses on the implementation of E-Leadership in vocational schools (*SMK Negeri*) in Pekanbaru City to improve the quality of teaching in the field of Computer and Network Engineering. By adopting technology in leadership and instruction, it is expected that the teaching and learning process will become more efficient and effective, while also preparing students to face the rapid advancement of technology (Rini et al., 2019, p. 49).

LITERATURE REVIEW

School Leadership

Bernard M. Bass is one of the key figures in the development of modern leadership theory, particularly through his concept of transformational leadership. This theory originated from James MacGregor Burns, who distinguished between transactional and transformational leadership. Bass (1990) later expanded and deepened the concept by emphasizing that leadership is not merely an exchange relationship of rewards and punishments, but also the ability to inspire followers to commit to shared goals and transcend personal interests.

Teacher Leadership

Teacher leadership is an evolving and vital concept within educational systems worldwide. It highlights the influence exerted by teachers beyond their classrooms to improve overall teaching and learning practices. Understanding the mechanisms, frameworks, and impacts of teacher leadership is essential for fostering educational excellence. Broadly, teacher leadership is defined as a process in which teachers, individually or collectively, influence their peers and contribute to the overall improvement of the school.

E-Leadership in Education

E-Leadership, or electronic leadership, refers to a leader's ability to manage, direct, and motivate teams through information and communication technology (ICT). In this context, leaders do not only interact face-to-face but also use digital tools such as email, video conferencing applications, or project management platforms to lead and coordinate tasks. According to Avolio, Walumbwa, and Weber (2009), E-Leadership involves managing teams remotely through technology, enabling coordination and collaboration without geographical or temporal barriers. Effective digital leaders must possess strong communication skills and the ability to efficiently manage technological tools. E-Leadership is not only about managing teams physically but also about organizing communication and workflows virtually.

Models of E-Leadership

Various models of E-Leadership have been proposed by scholars, such as the Transformational Leadership model adapted by Avolio, Walumbwa, and Weber (2009) for virtual contexts. In this model, leaders not only motivate but also inspire and empower team members through technology. Conversely, models such as Transactional Leadership focus more on supervision and performance monitoring through digital platforms that allow quick feedback.

The Role of E-Leadership in Competency Development in Vocational Schools

In vocational education—particularly in Computer and Network Engineering programs—E-Leadership plays a crucial role in developing students' competencies. One essential aspect is the ability to work with tools and technologies used in industry. According to Tuomi (2013), technology-based learning supported by strong leadership can enhance students' practical skills, preparing them to face the ever-evolving industrial challenges.

Challenges and Opportunities of E-Leadership in Vocational Schools

Although E-Leadership offers many advantages in education management, challenges also arise—particularly in technology adaptation, teacher training, and infrastructure readiness. The use of technology in education requires the preparedness of all stakeholders, including principals, teachers, students, and parents. One of the major challenges is the digital divide that may exist among students and teachers, potentially hindering the optimal implementation of E-Leadership.

RESEARCH METHOD

This study employed a qualitative phenomenological approach to gain an in-depth understanding of teachers' lived experiences in implementing E-Leadership at public vocational high schools (*SMK Negeri*) in Pekanbaru City. This approach was chosen because it emphasizes understanding the meaning experienced by participants regarding a particular phenomenon (Creswell & Poth, 2018). In this context, E-Leadership is not viewed as something fixed and objective but rather as the result of interaction, experience, and personal interpretation constructed by each teacher.

RESEARCH RESULTS

Implementation of E-Leadership by Computer and Network Engineering Teachers at SMKN 1 Pekanbaru

The analysis revealed that E-Leadership among Computer and Network Engineering teachers at SMKN 1 Pekanbaru has evolved into a strong collective awareness. The leadership vision of the school principal and the head of the vocational program has been effectively internalized down to the teacher level. In this context, E-Leadership is no longer merely understood as a technical skill in operating digital applications but has shifted into a strategic paradigm for managing and leading technology-based learning.

Teachers at this school demonstrate complementary roles. Some position themselves as architects of digital learning experiences, designing interactive and adaptive instruction, while others act as bridges connecting the curriculum, technology, students, and parents. This implementation is evident in classroom practices through the use of Learning Management Systems (Google Classroom), specialized simulation tools such as Cisco Packet Tracer, and collaborative media like Google Docs, Quizizz, and Kahoot.

Furthermore, teaching practices are strengthened by tangible outputs such as students' digital portfolios and tutorial videos published via YouTube. Field observations showed that classroom interactions have become more participatory, where teachers no longer serve merely as content deliverers but also as facilitators and leaders of digital-based projects.

The implementation of E-Leadership at SMKN 1 Pekanbaru is supported by three key factors. First, top-down leadership from the principal provides a clear policy direction. Second, middle-out support from the head of the vocational program is realized through routine activities such as "*Jumat Berbagi*" (Friday Sharing), which serves as a knowledge-sharing platform among teachers. Third, a bottom-up collaborative culture has grown through teacher initiatives, including the "*Joint Question Bank*" program developed collectively.

Nevertheless, several obstacles remain. Outdated hardware has become a major technical constraint, while limited school funding restricts teachers' room for innovation. Additionally, there is a digital competence gap between senior and junior teachers, potentially hindering the consistency of E-Leadership implementation quality. However, these challenges are not viewed as insurmountable barriers but as motivators for optimizing digital learning efforts.

To overcome these obstacles, SMKN 1 Pekanbaru has adopted several strengthening strategies. First, developing internal learning communities through peer mentoring programs that enable natural knowledge transfer among teachers. Second, building partnerships with industry to align vocational competencies with labor market needs. Third, providing small-scale innovation funding to encourage teachers to experiment creatively with digital learning methods.

In addition, teachers emphasized the importance of integrating digital literacy and online ethics into the learning process. This effort focuses not only on mastering technical skills but also on equipping students to become responsible, ethical, and wise digital citizens. These strategies reinforce the

sustainability of E-Leadership at SMKN 1 Pekanbaru and ensure that digital learning transformation proceeds systematically and adaptively. The findings affirm that the success of E-Leadership is not determined solely by the presence of technology but rather depends on vision coherence, collaborative leadership, and a consistently supportive organizational culture.

Implementation of E-Leadership by Computer and Network Engineering Teachers at SMKN 7 Pekanbaru

Unlike the situation at SMKN 1, the condition at SMKN 7 Pekanbaru shows a more complex dynamic filled with various challenges. Although the school principal and the head of the vocational program understand the urgency of E-Leadership and acknowledge its importance, this concept has failed to transform into a collective understanding among teachers. Most teachers interpret E-Leadership merely as the use of Google Classroom for assigning tasks, while others openly reject it, arguing that conventional methods are already sufficient.

The implementation of E-Leadership in this school is sporadic and below expectations. Observations indicate that teaching activities remain dominated by lectures and the use of student worksheets (*Lembar Kerja Siswa*), while laboratory facilities are rarely utilized to their full potential. Digital innovations are driven by individual initiatives rather than coordinated efforts, resulting in limited impact.

Support within the school is minimal, sustained only by the enthusiasm of a small group of young teachers. Conversely, several challenges form a vicious cycle that is difficult to break – such as poor infrastructure (slow internet access and outdated computers), resistance from senior teachers, heavy administrative workloads, and the absence of internal mentors who can serve as role models. The strategies agreed upon by the leadership and teachers focus more on building foundational readiness rather than accelerating implementation. The main priorities include improving basic infrastructure, followed by enhancing human resource competence through practical training, and preparing potential teachers to serve as mentors. Additionally, there are proposals to reduce administrative burdens to allow teachers more time and space for experimenting with digital learning.

Interpretation of these findings indicates that the absence of a supportive ecosystem is the main barrier to digital innovation at SMKN 7 Pekanbaru. The simultaneous presence of multiple obstacles has caused E-Leadership to stagnate and even foster cultural resistance. Therefore, the most relevant strategy is not acceleration but rebuilding the foundation – through infrastructure improvement and human resource development – to cultivate pioneers who can serve as role models for driving change.

Comparison of E-Leadership among Computer and Network Engineering Teachers at SMK Negeri in Pekanbaru

Findings from SMKN 1 Pekanbaru indicate that E-Leadership has developed significantly within the leadership practices of Computer and Network Engineering teachers. It has become a strategic foundation for implementing technology-based vocational learning. Teachers in this

department act not merely as instructors but as digital change agents who actively create technology-driven learning ecosystems. They view technology not only as an instructional aid but as an instrument of instructional leadership that enables more contextual, adaptive, and collaborative learning.

In this regard, teachers function as digital designers who formulate, manage, and evaluate students' learning experiences through digital platforms. This strategy is evident in the use of tools such as Google Classroom, Cisco Packet Tracer, Quizizz, and digital portfolios via Google Sites.

These findings align with the concept of transformational E-Leadership proposed by Avolio & Kahai (2003), emphasizing that digital leaders do not merely direct but also inspire and cultivate a new learning culture through technology. This approach also resonates with the principle of participatory digital leadership highlighted by Laufer et al. (2021), in which teachers are no longer policy implementers but change agents in digital classrooms and learning environments. The transformational leadership model articulated by Baharuldin et al. (2020) is also reflected in how Computer and Network Engineering teachers at SMKN 1 inspire both students and colleagues through innovative learning practices using Google Classroom, Quizizz, and digital portfolios.

Conversely, at SMKN 7 Pekanbaru, the practice of E-Leadership has not yet been implemented optimally. Teachers remain passive in utilizing technology and continue to rely heavily on conventional methods. This strong dependence on traditional approaches has made them fail to perceive technology as a medium of leadership in the learning process.

This phenomenon reinforces the view of Da'as et al. (2021), who emphasized that the digital divide is not only related to the availability of devices but also involves pedagogical competence and orientation. This illustrates the limitations in applying the principles of instructional and collaborative leadership as expressed by Hu and Duyar (2024), who stated that leaders in schools should promote a collaborative learning environment.

This condition indicates a gap between teachers' leadership potential and its implementation in practice, which contradicts the concept of teacher leadership proposed by York-Barr and Duke, as cited in Alfin et al. (2020), namely the collective influence of teachers in improving instructional practices.

Supporting and Inhibiting Factors of E-Leadership

Several supporting factors have successfully strengthened the implementation of E-Leadership at SMKN 1 Pekanbaru. The role of the principal as a visionary leader and facilitator of change is reflected in policies that support digitalization in schools. One concrete form of this support can be seen in the allocation of BOS (School Operational Assistance) funds for training activities and the improvement of technological infrastructure.

In addition, the long-established collaborative work environment among Computer and Network Engineering teachers has been further strengthened through the Friday Sharing program and the establishment of a school digitalization team under the Principal's Decree. This condition reflects the practice of distributed leadership as explained by Laufer et al. (2021), who emphasized the importance of cooperation between school leaders and teachers

in developing learning technologies. In this context, the principal plays a facilitating role that enables E-Leadership to grow, as stated by Hidayat and Patras (2023), that principals who embrace the principles of a learning organization significantly enhance teachers' leadership capabilities.

This strategy is also consistent with the views of York-Barr and Duke (2004), who highlight the importance of teacher empowerment, involvement in decision-making, and professional collaboration as the main pillars of effective leadership.

In the context of vocational education, such collaboration not only fosters teachers' confidence in leading digital-based learning processes but also motivates them to continually improve their pedagogical competence in line with the demands of the times. Teachers are required not only to master vocational content but also to deliver it digitally and contextually.

Unlike SMKN 1 Pekanbaru, the implementation of E-Leadership at SMKN 7 Pekanbaru still faces significant challenges. The main problems arise from a lack of supporting facilities, weak collaboration among teachers, and the absence of a strong managerial support system. The lack of relevant training and the absence of professional communities further widen the technological adaptation gap among teachers. This shows that without a conducive environment and structural support, E-Leadership will be difficult to develop. This situation reinforces the view of Hidayat and Patras (2023) regarding the importance of the principal's role in creating a progressive learning environment that can adapt to technological changes.

At both SMKN 1 and SMKN 7, similar obstacles can still be found, such as differences in teacher competency levels, limited technological equipment, and students' minimal access to digital tools. These challenges reaffirm the findings of Nor et al. (2022), who emphasized that educational leadership must be adaptive and responsive to structural issues and access inequality, particularly within the framework of technology-based educational transformation.

Optimization Strategies for E-Leadership among Computer and Network Engineering Teachers at SMKNs in Pekanbaru

E-Leadership optimization strategies cannot be uniformly applied across all educational institutions; rather, they must be adjusted to each school's organizational culture, human resource readiness, and structural dynamics. A contextually responsive approach is key to ensuring that such strategies can be implemented effectively and sustainably.

At SMKN 1 Pekanbaru, the implementation of E-Leadership optimization strategies has shown positive results. One of the main approaches proven effective is strengthening a collaborative culture through a peer mentoring model. This model allows teachers to share experiences, enhance their digital competence, and increase confidence in applying technological innovations in teaching. This practice is highly consistent with the concept of collective teacher efficacy proposed by Da'as et al. (2021), which emphasizes that the success of innovation adoption is strongly influenced by collective beliefs and social support among educators.

In addition to peer mentoring, other strategies implemented include providing exploratory opportunities for teachers to experiment with new digital

methods and promoting professional development based on real and contextual needs. In this regard, the *distributed leadership* approach plays an important role, as it allows each teacher to become an agent of change and a leader on a micro scale. These strategies are also reinforced by the support of school principals who adopt the roles of facilitator and catalyst for innovation. This aligns with the perspective of Hidayat and Patras (2023), who emphasize the principal's role in shaping the school as a learning organization.

On the other hand, collaboration with industry also constitutes an integral part of the optimization strategy. Training that is tailored to the latest technological needs of the workplace provides practical relevance for classroom learning. This view is reinforced by Berkovich and Bogler (2020), who stress the importance of leadership that bridges academic theory and practical field demands. Such a flexible, contextual, and sustainable professional approach is also supported by Gentsoudi (2024), who suggests that teacher competence development must be adaptive to changes in the digital education environment.

Unlike SMKN 1, the optimization strategies at SMKN 7 Pekanbaru are still in their early stages and require systemic strengthening. Although there is an initial awareness among principals and teachers regarding the urgency of digital transformation, the implementation of E-Leadership has not yet been integrated into daily practices. The challenges faced include minimal technical assistance, lack of relevant training, and the absence of an active digital learning community.

Strategic steps recommended for SMKN 7 include building collective awareness about the importance of digitalization in learning and facilitating the establishment of technology-based professional communities. A more participatory and visionary principal leadership style is key to cultivating a school culture that supports digital change. Investment in continuous contextual training and intensive technical assistance is also essential to enhance teachers' readiness to adopt technology effectively.

Thus, the optimization strategies of E-Leadership in both schools demonstrate that digital transformation in vocational education cannot rely solely on the directives of the principal. Approaches that depend only on structural instructions must be complemented by active participation from all school elements. A comprehensive strategy grounded in community collaboration and strengthened by inclusive and participatory leadership is required. Such an approach will enable the development of E-Leadership practices that are not only responsive to technological dynamics but also have tangible relevance to teachers' ongoing professional development.

Table 4. Comparison of E-Leadership among Computer and Network Engineering Teachers at SMKN 1 and SMKN 7 Pekanbaru

Aspect	SMKN 1 Pekanbaru	SMKN 7 Pekanbaru	Theoretical Analysis
Understanding of E-Leadership	Holistic and contextual	Limited and technical	Aligned with Avolio and York-Barr's theory of transformative leadership
Implementation of E-Leadership	Practice- and collaboration-based	Still conventional	Based on Distributed Leadership and PLCs
Institutional Support	Strong and structured	Weak and sporadic	Supports the learning organization concept (Hidayat & Patras, 2023)
Optimization Strategies	Peer mentoring, contextual training	Still limited	Consistent with Da'as et al. (2021) and the collective efficacy approach
Challenges	Infrastructure and competency gap	Cultural resistance and lack of training	Demonstrates the importance of adaptive leadership

Implementation of E-Leadership in the Context of Teaching Factory

The implementation of E-Leadership by vocational school teachers, particularly in the context of the *Teaching Factory* and *TEFA (Teaching Factory)* programs, plays a crucial role in improving learning quality and preparing students for the industrial world. *Teaching Factory* focuses on creating innovative and effective learning experiences to ensure that students not only understand theoretical concepts but are also ready to face workplace challenges.

At SMKN 1 Pekanbaru, teachers who have integrated technology into their teaching actively use digital platforms such as Google Classroom, Microsoft Teams, and Zoom. Through these platforms, they can manage classes online, provide easily accessible materials for students, and facilitate digital collaboration between teachers and students. The use of these technologies allows students to be more active in learning, with teachers providing various industry-relevant educational applications such as graphic design software and programming tools.

This practice aligns with the principles of *Teaching Factory*, which aims to enhance student engagement with relevant learning materials while equipping them with practical skills needed in the workforce.

On the other hand, SMK Negeri 7 Pekanbaru faces greater challenges in implementing the *Teaching Factory* program. Although teachers at this school attempt to integrate technology into their teaching, limited infrastructure and inadequate technological understanding remain major obstacles. At SMK Negeri 7, teachers still rely more heavily on traditional teaching methods due to the lack of devices and unstable internet access. While simple applications such as Google Docs are used for group assignments, these limitations hinder the full implementation of technology-based learning that could otherwise enrich

students' learning experiences and better prepare them for an increasingly digitalized industrial world.

Regarding the TEFA (Teaching Factory) program, it aims to provide students with hands-on experience in a work environment that mirrors real industrial settings, supported by relevant technology. At SMK Negeri 1 Pekanbaru, the implementation of TEFA strongly supports E-Leadership, as the school possesses better facilities, such as Cisco and Mikrotik devices used for learning about network management and hardware configuration applied in the industry. Students at SMK Negeri 1 have the opportunity to learn directly using tools and technologies used in real-world industries, allowing them to develop practical skills that are highly valuable in the job market. This TEFA-based learning approach provides students with a more comprehensive and relevant experience, as they not only study theoretical concepts but also practice using the same devices employed by professionals in their fields.

However, at SMK Negeri 7 Pekanbaru, the implementation of TEFA is constrained by inadequate infrastructure. Although some digital learning tools such as computers and educational applications are available, unstable internet connectivity and limited device availability hinder the optimal execution of the program. Students at SMK Negeri 7 cannot participate in technology-based projects equivalent to those conducted at SMK Negeri 1, as these limitations prevent them from learning with the same software and hardware used in industry.

Overall, E-Leadership plays a crucial role in implementing the Teaching Factory concept. At SMK Negeri 1 Pekanbaru, the successful implementation of both concepts is strongly supported by adequate facilities and continuous teacher training. With technological support and consistent professional development, teachers are better equipped to facilitate students effectively and align learning with industrial demands. Conversely, at SMK Negeri 7 Pekanbaru, despite a genuine intention to implement the Teaching Factory approach, limited facilities and insufficient teacher training hinder optimal technology integration. Therefore, it is essential for SMK Negeri 7 to improve infrastructure, provide ongoing professional training for teachers, and strengthen institutional support for digital skills development so that E-Leadership can function more effectively and make a greater impact on learning quality and student competencies.

Research Limitations

This study on E-Leadership among Computer and Network Engineering teachers at vocational high schools (SMK) in Pekanbaru has several limitations. The research was conducted only at two public vocational schools in Pekanbaru, so the findings cannot be widely generalized. Consequently, the realities captured are more illustrative than representative of the broader context. The analysis focuses primarily on internal school dynamics, while the influence of local government policies, industry support, and community participation has not been explored in depth. In fact, these external factors often serve as crucial drivers or barriers in the technological adoption process within vocational schools. Therefore, the depiction provided in this study does not yet fully

represent the complex interaction between internal and external factors that shape the E-Leadership ecosystem.

CONCLUSION

Based on the results and discussion presented, the conclusions of this study can be formulated as follows:

1. The E-Leadership practices of Computer and Network Engineering teachers in vocational schools in Pekanbaru show significant differences between SMKN 1 and SMKN 7. At SMKN 1 Pekanbaru, E-Leadership has evolved into a strong collective awareness, with teachers acting as architects of digital learning experiences and as connectors between curriculum, technology, students, and parents. In contrast, the implementation of E-Leadership at SMKN 7 remains limited, sporadic, and has not yet been internalized at the teacher level.
2. The main supporting factors for the successful implementation of E-Leadership at SMKN 1 include visionary principal leadership, *middle-out* support from department heads, and a collaborative culture among teachers through various initiatives. Challenges such as limited hardware, constrained budgets, and competency gaps among teachers can still be addressed through optimization strategies. At SMKN 7, inhibiting factors are more dominant, including weak infrastructure, resistance from senior teachers, high administrative burdens, and limited managerial support.
3. The optimization strategies for E-Leadership implementation at SMKN 1 are directed toward strengthening internal learning communities, fostering collaboration with industry, and providing innovation funds for teacher experimentation. Furthermore, digital literacy and ethics are integrated so that students are not only technologically proficient but also ethically responsible as digital citizens. The optimization strategies at SMKN 7 Pekanbaru focus on infrastructure development, competence enhancement through training, and reducing administrative workloads to support digital learning experimentation.

RECOMMENDATIONS

Based on the findings of this study on E-Leadership among Computer and Network Engineering teachers at vocational schools in Pekanbaru, several recommendations are proposed for relevant stakeholders:

Recommendations for Practitioners and Stakeholders

- a. Computer and Network Engineering teachers should enhance their E-Leadership not only in technological use but also in designing strategic and collaborative learning experiences. They are encouraged to act as digital facilitators and role models through peer mentoring, digital student portfolios, and the utilization of Learning Management Systems (LMS).
- b. Schools – particularly principals and department heads – should provide continuous training based on actual needs and allocate budgets for digital infrastructure renewal. Programs such as “Friday Sharing” and “Shared

Question Bank” should be formalized into official policies to maintain a culture of collaboration.

- c. Educational policymakers at local and national levels should design adaptive programs that align with vocational needs, such as strengthening partnerships between vocational schools and industry. Furthermore, E-Leadership policies should incorporate digital literacy and technological ethics to ensure that students become both skilled and ethical digital citizens.

Recommendations for Academics and the Field of Educational Management

- a. This study highlights the importance of E-Leadership as a concept in educational leadership. Academics can further develop theoretical models suited to vocational education contexts that emphasize collaboration, teacher participation, and industry linkage.
- b. E-Leadership can also serve as a foundation for curriculum development in teacher education institutions (LPTK), ensuring that prospective teachers are equipped with digital leadership skills from the outset – not merely technical competencies.

Recommendations for Future Research

- a. Since this study only covers two schools, the findings cannot yet be generalized. Future research should involve a larger number of schools with diverse conditions.
- b. Amixed-methods approach could be employed to integrate qualitative and quantitative data, resulting in stronger and more comprehensive findings. Large-scale surveys could also be conducted to examine E-Leadership implementation more broadly.
- c. Future research topics could explore the impact of E-Leadership on student learning outcomes, parental engagement in the school’s digital ecosystem, and its relationship with students’ non-technical competencies such as creativity, collaboration, and digital ethics.

Suggestions for Addressing Research Limitations

The main limitation of this study lies in its narrow scope—covering only two schools and focusing on teacher perspectives. Future studies could:

- a. Involve more respondents, including students and parents.
- b. Employ a longitudinal approach to trace the development of teachers’ E-Leadership over time.
- c. Include evaluation instruments such as digital competence assessments and tests of technology-based learning effectiveness to produce more valid and generalizable findings.

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