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Original Article

Exploring the Role of Digital Leadership and Digital Competence in Enhancing Teacher Performance in Smart School Settings

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Abstract: *The smart school is an initiative designed to enhance educational quality by integrating technology in response to the Fourth Industrial Revolution. The establishment of a smart school in a vocational high school seeks to produce graduates equipped with skills aligned with industry demands, thereby enhancing their employability. Educators play a pivotal role in technology-driven learning activities within a smart school environment, guiding students toward their intended objectives, which necessitates the continuous enhancement of their performance as teachers. This study examines the principal's digital leadership, teachers' digital competence, and teacher performance, while also investigating the impact of digital leadership and digital competence on teacher performance within the context of a smart school. The innovation of this study lies in its application to the establishment of a smart school. Questionnaires were administered to all 110 teachers at SMK X (Vocational High School X) to collect comprehensive data using a quantitative research approach. The descriptive findings indicate that digital leadership is categorized as good, digital competence is categorized as competent, and teacher performance is categorized as good. The findings from hypothesis testing demonstrate that digital leadership and digital competence exert a positive and statistically significant influence on teacher performance.*

Keywords: *Digital Competence, Digital Leadership, Smart School, Teacher Performance.*

I. INTRODUCTION

Hamdani et al. (2020) claimed that the Fourth Industrial Revolution refers to an era of accelerating technological innovation and has far-reaching implications, most notably for employment. Industry workers are losing out to robots and machines, but new jobs are being created harnessing digital technology. This is a big problem for vocational high schools (SMK) in providing graduates suitable for and adaptable to industry. Vocational high school resurgence in Indonesia is a program that was created to help implement smart education that can improve the quality of education by employing technologies for implementation. This step could make vocational High School graduates have skills to meet industry needs (Hamdani et al., 2020).

According to www. phx. smartschool.com According to Chibuzor & Mkpa (2023), the smart school is an indispensable ingredient of smart education. It is a technology-driven school that uses technology to enrich every facet of the learning journey and activities, thereby revitalizing education. The intelligent school applies intelligent technologies which use modern educational techniques, i.e., flipped or blended learning; basic technologies such as LMS systems; enriching technologies with interactive content, and improving mobile technology and social networks (Demir, 2021).

The success of schools that implement the smart school concept depends heavily on teacher performance, as this has become an important part of educational moving forward in the dynamism of the digital era, which is able to bring about education that is relevant and oriented to an environment (Romadhoni et al., 2025). As posited by Hartiwi et al. (2020), the quality of education and its associated benefits are highly determined by the performance of teachers in discharging their duties to achieve maximum goals.

The performance of teachers at SMK X declined throughout 2021 to 2022. Educators' average score has dropped , and even more teachers earned below a passing score. This finding is consistent with the fact that the poor quality of teachers has been a long-standing problem in Indonesia (Huang et al., 2020). Therefore, improving teacher performance is important considering the education reformation in the digital age (Romadhoni et al., 2025).

Saeed & Kang (2024) maintained that the digital leadership of school principals has a significant impact on teacher performance and student readiness for the 21st century challenges. Besides digital leadership, a study by Palimbong et al.

(2022) found that a teacher's digital competence, connecting ICT in line with educational principles, will affect teaching and then enhance teacher performance in discharging his/her duties.

A) Problem Statement

Challenges of digital leadership, teacher digital capability, and efficacy of teacher performance based on previous research studies, and the figure can emerge in all types of educational institutions. This is also relevant to SMK X, which has implemented a smart school context. Additional studies are required to examine the matters of digital leadership, teachers' digital competency, and decreasing teacher efficiency due to smart schools.

B) Research Questions

Given the previously outlined problem, the researchers formulate the research questions as follows:

1. How is the principal's digital leadership in smart school settings at SMK X?
2. How is digital competence among teachers in smart school settings at SMK X?
3. How is the performance of teachers in smart school settings at SMK X?
4. How significant is the influence of digital leadership and teachers' digital competence on teacher performance in smart school settings at SMK X?

II. LITERATURE REVIEW

A) Digital Leadership

Leadership is the ability to improve employee work performance by guiding the team in achieving the vision and mission of the organization (Saputra & Wahyuningtyas, 2021). Digital leadership is less about change and more about optimizing what already exists to increase effectiveness and flexibility, instead of complexity (Sheninger, 2019). Digital leadership becomes a catalyst to bring about the transformation and becomes a cornerstone for the sustainable schools' smart implementation by mastering digital literacy, transforming change management skills, and cultivating collaborative and innovative school cultures (Chaidir et al., 2025).

Malhotra et al. (2020) have defined five dimensions of digital leadership, including equity and citizenship advocate, visionary planner, empowering leader, systems designer, and connected learner. These dimensions were based on the International Society for Technology in Education (ISTE) Standards for Education Leaders (2018).

B) Digital Competence

Competency is the basic characteristic of an individual that is causally related to criteria, a criterion-referenced measure, such as superior job performance (Pianda, 2018). Digital competence refers to strategies and skills required for educators to successfully incorporate information and communication technology into teaching practices (Sary et al., 2023). Smart digital literacy in education is a set of competencies, skills, knowledge, and conduct that allows an efficient use of new technology in various domains. This is enabled by embedding digital constructs and sustainability best practices within pedagogy to develop learning outcomes (Cao et al., 2023).

Research by Cabero-Almenara et al. (2023) discerned six dimensions of digital competence. These are professional engagement, digital resources, teaching and learning, assessment, empowering learners, and developing learners' digital competence (Redecker & Punie, 2017).

C) Teacher Performance

Performance consists of the activities, outputs, and outcomes of individuals and groups from any organization during a given period of time (Rohman et al., 2021). Teacher effectiveness has been defined in Pianda (2018) as the result attained by a teacher in performing his or her job over some period of time and in accordance with specified standards.

In the study of Rosida et al. (2024), teacher performance consists of the superior aspects, namely work quality, work accuracy, work initiative, work capability, and communication, that have been modified from Uno & Lamatenggo (2014).

D) Digital Leadership Relationship with Teacher Performance

Timan et al. (2022) realized that there is a direct influence on teacher performance by digital leadership at once. In this regard, the present study shows that providing appropriate digital leadership practices to teachers helps them fulfill expected performance. The work of Nawaz and his co-workers(researchers/script/bib) (2023) demonstrated that a positive relationship exists between digital leadership and the performance of educators. The research contributes to the improvement of the professional development of university teachers striving for digital leadership based on contemporary technology.

E) Digital Competence Relationship with Teacher Performance

Hizam et al. (2021) found a relationship between digital competence and performance. If educators are digitally competent, instruction is better, and performance increases. In a study of university lecturers, Waskito (2021) argues that

digital competence has an impact on performance. If teachers have received adequate digital literacy training, it is easier to solve performance tasks.

F) Relationship between Digital Leadership and Digital Competence

According to Lukman & Yune (2025), the research shows that there was a significant and positive relationship between digital leadership, on one hand, and teachers' digital competences on the other. The school leader plays a facilitating role, creating an environment that invites teachers to experiment with technology in their instruction. Digital leadership significantly increases teachers' digital competence as evidenced by Jogezai's (2023) study. Principals were found to have an expectation of teachers having digital competence, which was associated with the management of educational programs such as curriculum coordination, supervision, and evaluation of instruction, and creating a positive work environment conducive to teachers' development in digital literacy.

G) Framework

Scholars have gained insight regarding digital leadership, digital competence, and teacher effectiveness. This is supported by theories and empirical evidence provided in previous studies conducted by the referred experts. In this study, the framework is designed to explore digital leadership and teacher performance through the lens of digital competence.

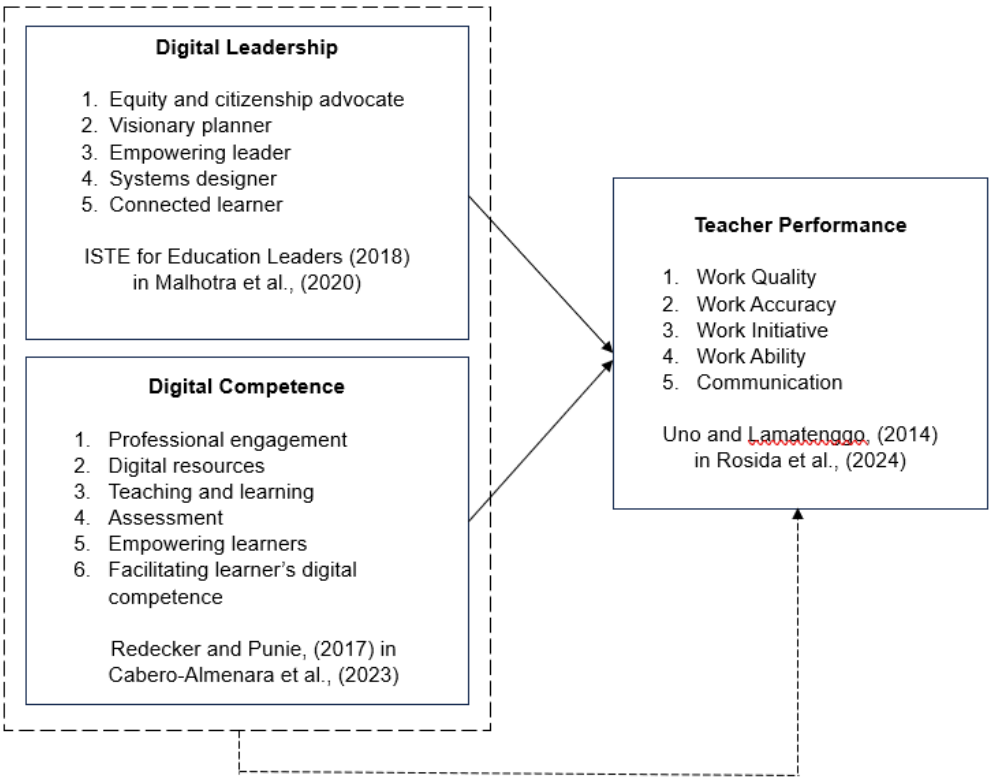

Fig. 1 Framework

III. METHODOLOGY

In this study, the research approach used was a descriptive causal verification approach to test the influence of digital leadership and digital competences on teachers' performance using both statistical and descriptive analysis. The research uses quantitative, confirmatory, and deductive approaches (Thomas, 2021). This study operationalized constructs of digital leadership (International Society for Technology in Education (ISTE) Standards for Education Leaders, 2018), digital competence (Redecker Punie, 2017), and teacher performance (Uno & Lamatenggo, 2014).

The present study uses a non-probability sampling method with the saturated sample technique. Saturated sampling is where the researcher opts for the entire population as their sample (Garaika & Darmanah, 2019). Hence, the population in this study is all teachers in SMK X, which amounted to 110 people. The first-hand information used for the purposes of this study is that obtained from questionnaires, and researchers applied the Likert scale as a measurement to measure the attitude or opinion of respondents (Hair et al., 2020). A 5-point Likert scale was used as follows in weight value measurement: strongly

disagree, disagree, quite agree, agree, and strongly agree. As is indicated in the following table, a score is given between 1 and 5, with a 5 being the most favorable.

Table 1: Likert Scale

Scale	Category
1	Strongly Disagree
2	Disagree
3	Quite Agree
4	Agree
5	Strongly Agree

In this study, data were analyzed using PLS-SEM with SmartPLS. SEM belongs to multivariate analysis, which is a statistical approach that permits investigating numerous variables simultaneously (Musyaffi et al., 2022). Hypothesis testing is a technique used to test whether or not there are any valid hypotheses that can be made about the patterns and relationships in the data (Hair et al., 2020). In PLS-SEM, it is tested using t-values (comparing with a t-table), the p-value, and path coefficient values. A p-value less than 0.05 means that the effect of the variable is important; if it is greater than 0.05, this indicates a non-significant effect (Hair et al., 2017).

IV. RESULTS AND DISCUSSION

A) Results

This section will evaluate each variable and delineate the elements associated with digital leadership, digital competence, and teacher performance, based on the responses from 110 teachers at SMK X to the administered questionnaire.

a. Respondents' Responses to Digital Leadership

The five dimensions of the independent variable digital leadership (X1) as presented in Malhotra et al. (2020) were informed by the International Society for Technology in Education (ISTE) Standards for Education Leaders (2018), which are equity and citizenship advocate, visionary planner, empowering leader, systems designer, and connected learner. Summary of the results for X1. The calculation of respondents' answers to all dimensions led us to the following results by dimension.

Table 2: Results of Digital Leadership Variable

Dimensions	Percentage	Category
Equity and Citizenship Advocate	77.21%	Good
Visionary Planner	77.06%	Good
Empowering Leader	78.09%	Good
Systems Designer	81.55%	Good
Connected Learner	77.27%	Good
Variable Percentage Average	**77.85%**	
Variable Category	**Good**	

Table 2 presents the characteristics of digital leadership in each dimension. And the percent of those for each dimension are respectively: ECA 77.21%, VP 77.06%, EL 78.09%, SD 81.55% and CL 77.27%. Across all dimensions, the summary statistics are good. In Table 3, the summary of grading shows the highest good percentage in the system designer, 81.55%, while the visionary planner has the lowest good rating, which is 77.06%. The conclusion of an extensive digital leadership summary (X1) is plotted in Figure 2 using one connected line.

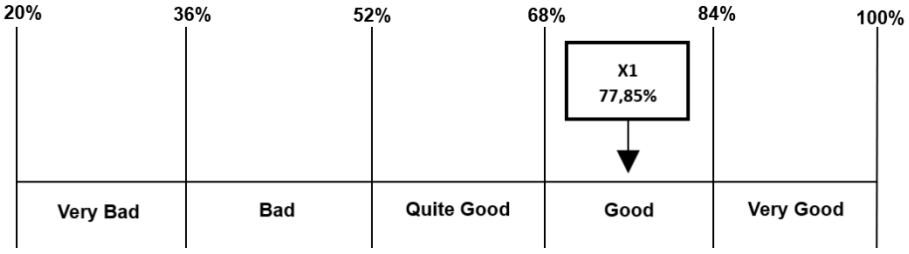

Fig. 2 Digital Leadership Variable Continuum Line Result

Based on the continuum presented, the digital leadership variable (X1) within the smart school environment at SMK X is classified as good, achieving a score of 77.85%, as depicted in Figure 2.

b. Respondents' Responses to Digital Competence

The six factors of the digital competence factor (X2) in Cabero-Almenara et al. (2023), according to Redecker & Punie (2017), are the professional involvement, the digital resources, as well as those pertaining to teaching and learning, assessment, empowerment of learners, and support for learners in their digital competence. Summary of Findings for Digital Competence as an independent variable (X2) from the computation of the responses to all items by respondents.

Table 3: Results of Digital Competence Variable

Dimensions	Percentage	Category
Professional Engagement	85.94%	Highly Competent
Digital Resource	85.27%	Highly Competent
Teaching and Learning	80.97%	Competent
Assessment	82.82%	Competent
Empowering Learners	79.52%	Competent
Facilitating Learners' Digital Competence	82.27%	Competent
Variable Percentage Average	**82,67%**	
Variable Category	**Competent**	

Table 3 overview of digital competence features in each dimension. The percentages are as follows for the dimensions: professional engagement (85.94%) in a highly competent category, digital resources (85.27%) in a highly competent category, teaching and learning (80.97%) in a competent category assessment (82.82%) in competency level empowering learners' levels of competence at 79.52% (competency level) facilitating learners' digital competence at 82.27% c) Level of self-efficacy (see Figure 5). The summary of data as presented in the table shows that professional engagement at 85.94% leads all other dimensions and is within the high competent category, while empowering learners at 79.52% trails all other dimensions and is within the competent category. Figure 3 makes visible the outcome of an integrative summary of digital competence (X2) in one continuous line.

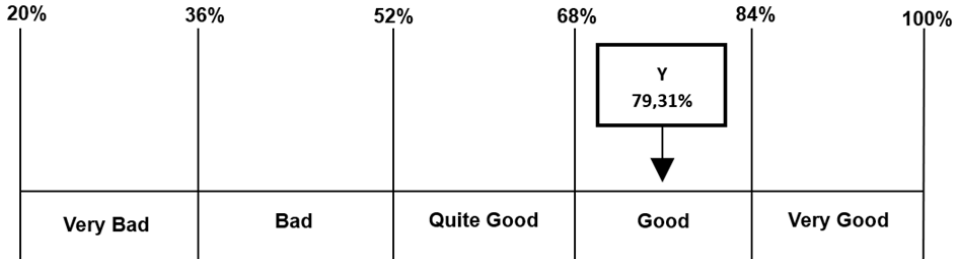

Fig. 3 Digital Competence Variable Continuum Line Result

Based on the continuum presented, the digital competence variable (X2) within the smart school environment at SMK X is classified as competent, achieving a score of 82.67%, as depicted in Figure 3.

c. Respondents' Responses to Teacher Performance

The five dimensions of the teacher performance variable (Y) in Rosida et al. (2024), adapted from Uno & Lamatenggo (2014), are work quality, work accuracy, work initiative, work ability, and communication. Here is a summary of the findings for the teacher performance variable (Y) based on the calculation of respondents' answers to all dimensions.

Table 4: Results of Teacher Performance Variable

Dimensions	Percentage	Category
Work Quality	78.64%	Good
Work Accuracy	82.09%	Good
Work Initiative	77.31%	Good
Work Ability	83.91%	Good
Communication	78.27%	Good
Variable Percentage Average	**79.31%**	
Variable Category	**Good**	

Table 4 summarizes the characteristics associated with teacher performance in each dimension. The percentages for the dimensions are as follows: work quality at 78.64%, work accuracy at 82.09%, work initiative at 77.31%, work ability at 83.91%, and communication at 78.27%. All dimensions fall into the good category, according to the summary statistics. The summary indicates that work ability has the highest percentage in the good category, at 83.91%, while work initiative

has the lowest percentage in the good category, at 77.31%. Figure 4 below illustrates the conclusion of a comprehensive summary of teacher performance (Y) in a continuous line.

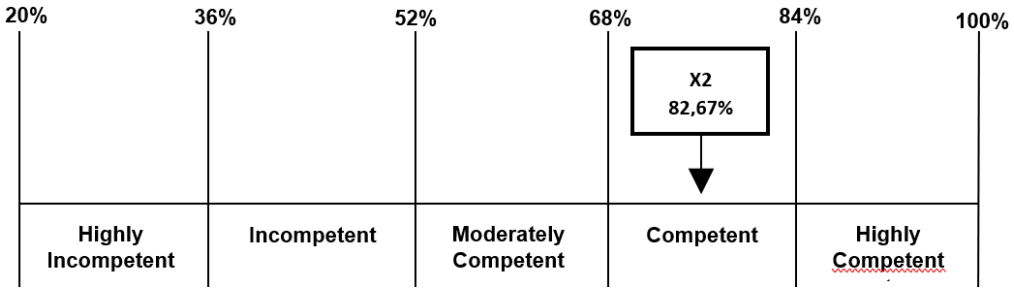

Fig. 4 Teacher Performance Variable Continuum Line Result

Based on the continuum presented, the teacher performance variable (Y) within the smart school environment at SMK X is classified as good, achieving a score of 79.31%, as depicted in Figure 4.

B) Discussion

The research findings yielded various test outcomes, encompassing internal and external model evaluations and hypothesis testing via path coefficients, derived from respondent questionnaire replies and SEM analysis. The criteria used in this study were digital leadership, digital competence, and teacher performance, which are the topics of discussion. Furthermore, to attain the previously established research aims, this discourse will examine the influence of digital leadership and digital competence on teacher performance within smart school environments.

a. Analysis of Digital Leadership at SMK X in Smart School Settings

This research employs the digital leadership variable as an exogenous factor. This survey involved 110 teachers from SMK X as responders. The analysis of the survey results from the respondents revealed that the digital leadership variable had an average value of 77.85%, with the good group positioned on a horizontal line.

Dimensions of digital leadership include equality and citizenship advocate, visionary planner, empowering leader, systems designer, and connected learner. The system designer dimension exhibits the highest percentage at 81.55%, whereas the visionary planner reflects the lowest percentage at 77.06%. The digital leadership variable comprises 15 statement items. Among the 15 distributed statement items, the one with the lowest value is "My principal has set a goal to stay up-to-date with more interactive technological developments in learning (such as AR/VR, robotics, and others)". The principal of SMK X has a low proactive attitude in keeping updated with current technology development applied to education. Hence, the principal needs to show a firm determination to continuously monitor these changes and gradually apply them in the school learning culture with persistence.

Digital leadership in the smart school principle represents the willingness of school leaders to be drivers of change and as a fundamental basis for the sustained embedding of technological transformation (Chaidir et al., 2025). Timotheou et al. (2023) describe a principal who weaves technology evolution into the essence of school. The school leader's ethos is a significant determining influence in the motivation that drives teachers and students towards sustainable digital transformation, which affects pedagogical practices and educational quality. Istamia (2019), "Rumah Belajar" portal created by the Ministry of Education and Culture of Indonesia is an e-learning portal that accommodates various materials and multimedia in every study level through its features. This system has eight main modules: Learning Resources, BSE (Electronic School Books), Question Bank, Virtual Laboratory, Culture Map, Spacecraft Rides, Online Professional Development, and Virtual Classroom, which the school principals can use to infuse the most recent up-to-date digital Wizard technology into his or her institution by providing high-quality learning.

b. Analysis of Digital Competence at SMK X in Smart School Settings

This research employs the digital competence variable as an exogenous factor. This survey involved 110 teachers from SMK X as responders. The analysis of the survey results from the respondents revealed that the digital competence variable had an average value of 82.67%, with the competent category on a horizontal line.

Dimensions of digital competence include professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence. Professional engagement has the highest percentage value of 85.94%, while empowering learners has the lowest percentage value of 79.52%. The digital

competence variable has 15 statement items. Of the 15 statement items that have been distributed, the item with the lowest value is "I use digital technology that allows students to engage in self-directed learning (such as using an LMS for self-directed learning)".

Some teachers were only familiar with using the LMS to send materials and assignments, based on observations and interviews. As a result, learning activities were primarily dominated by face-to-face interactions in the classroom, with no guidance or monitoring provided for self-directed learning activities conducted online outside of class hours. This finding was observed among Generation X educators, who demonstrated lower information technology skills.

According to Tomczyk (2024), digital competence encompasses not only the adept use of IT equipment, specialized software, and websites but also requires an awareness of the impact of new media on learner behavior, hence necessitating more sophisticated skills, such as the utilization of Learning Management Systems (LMS). Smart education as a whole idea is related to more interactive and self-directed learning at any time and location, which can be facilitated by LMS (Demir, 2021). Wirantaka et al. (2024) report that with an LMS, instructors can develop and deliver resources, tasks, responses, study plans, instructional media, and assessment instruments. This allows students to optimize self-determined learning and have more regular access to learning content, because students are enabled with the freedom to construct their studies in a pre-arranged sequence.

Maleesut (2019) argues that Generation X teachers themselves in the digital era find it odd teaching students who are quick to adapt to a digital learning environment, so these teachers of Gen X adjust their pedagogical ideas from traditional methods into those that suit students who demand education for audiences; they have sensitized interactivity and multimedia, online communication. That means the Generation X teachers must shore up their digital skills. Zhang et al. (2024), training activities, courses, and professional development in the form of webinars can improve teachers' digital competence.

c. Analysis of Teacher Performance at SMK X in Smart School Settings

In this study, teacher performance is adopted as an endogenous variable. This research will be conducted in SMK X with the number of respondents, which was 110 teachers. The average (mean) of the variable teacher performance was 79.31% based on respondents' responses and classified as "good" on the continuum.

The teacher performance variable contains five dimensions: work quality, work accuracy, work initiative, working ability, and communication. The percentage for the former is 83.91% and that for the latter is 77.31%. The teacher performance construct consists of 15 item statements. Of the 15 statement items presented, the second item, which commented as "I aspire to make my own digital learning media which is more interactive (eg, interactive multimedia and other interactive applications") garnered the lowest mean score.

The observations and interview findings showed that some teachers passively create interactive digital learning materials from PowerPoint presentations, e-books, or videos from social media without involving students' participation in the construction of material, and that also pose learning barriers to students: monotony generated boredom among students; loss of attention, and incomplete comprehension of what was learned. As such, teachers should be able to guide students with digital learning media that is more in touch and engaging for them.

Information and communication technology makes the school-type environment interactive, according to Demir (2021); thus, loading content developed for children in addition to related education-oriented tools will make the teaching and learning more vibrant with smart education. Hossain (2023) claimed that using interactive multimedia can improve teachers' teaching effectiveness. It can enable teachers to design more engaging and varied lesson plans to help explain complicated theories, and to monitor each student's progress in a quicker and more adaptive manner. Ramadhani et al. (2024) declared that interactive multimedia mediates the learning process and can engage and hold students' attention, as well as potentially diversify education to suit individual needs.

d. Analysis of the Effect of Digital Leadership on Teacher Performance at SMK X in Smart School Settings

The partial testing findings indicate that the t-statistic for the digital leadership variable in relation to teacher performance is 4.907, exceeding the t-table value of 1.96 in this study. The p-value was 0.000, which is below the significance threshold of 0.05. Therefore, the hypothesis is accepted. Consequently, digital leadership has a substantial impact on teacher performance.

The results of this study are compatible with other studies about digital leadership and teacher performance. According to Oredein and Obadimeji (2022), digital leadership has positive, significant effects on the job performance of

public primary school teachers. They also point out that the ongoing digitalisation of society is affecting leadership today and in the future, revealing that leaders with stronger digital competencies are better positioned to drive teacher performance. The results of Risanto et al. (2025) show that the principal's digital leadership has a positive and strong effect on teacher performance. Impact of Principal's Leadership on Teacher Performance in Secondary Schools. Widyaputri & Sary (2022) argue that digital leadership has a simultaneous and partially positive impact on employee performance. Digital leadership is not only influential to many but also relevant to digital problems. Hence, it is capable of improving the work performance of the employee.

e. Analysis of the Effect of Digital Competence on Teacher Performance at SMK X in Smart School Settings

The partial testing findings indicated that the t-statistic for the digital competence variable in relation to teacher performance was 6.748, exceeding the t-table value of 1.96 in this study. The hypothesis is accepted due to a p-value of 0.000, which is less than the significance level of 0.05. Consequently, digital competence has a substantial impact on teacher performance.

The results of this study are consistent with what has been previously shown concerning digital competence and teacher effectiveness. Adenekan & Jimoh (2021), however, conducted a study which evidence that digital competence influences job performance, because the skill allows an individual to choose and use technology in keeping with his or her task requirement to improve their job. Masias-Fernandez et al. (2023) demonstrated that the relationship between digital competence and job performance is of strong significance and positive direction. Digital literacy enhances teachers' methods in teaching and learning, I.e, it enables educators to achieve the best results of their teaching. Research by Sary et al. (2022) posits that digital competence positively and significantly affects teacher performance. The increasing pace of change in technology requires educators to achieve a level of digital literacy that enables them to operate productive TLPs and adhere to standards.

f. Analysis of the Effect of Digital Leadership and Digital Competence on Teacher Performance at SMK X in Smart School Settings

The assessment of the coefficient of determination for the variables of digital leadership and digital competence in relation to teacher performance produced an R-squared value of 0.55, or 55%, signifying that these factors collectively and significantly affect teacher performance by 55%. The remaining 45% is attributed to issues beyond the purview of this study. Musyaffi et al. (2022) assert that an R-squared value beyond 0.67 signifies a strong variable influence, a value between 0.33 and 0.67 denotes a moderate influence, and a value below 0.33 reflects a weak influence. Thus, this research is categorized as moderate.

This figure indicates that more than half of the variation in teacher performance can be explained by the principal's digital leadership and the teachers' digital competence. The result confirms the significant role of the digital component in the smart school ecosystem.

V. CONCLUSION

According to the previously presented background information, theory, research findings, and discussions, the application of descriptive statistical methods and structural equation modelling indicates that digital leadership in the smart school settings at SMK X falls into the good category, with a percentage of 77.85%. The teacher's digital competence in smart school settings at SMK X is in the competent category, with a percentage of 82.67%. Teacher performance in smart school settings at SMK X is in the good category, with a percentage of 79.31%. Digital leadership has a t-statistic of 4.907, exceeding 1.96, and a p-value of 0.000, which is less than 0.05, indicating a substantial positive impact on teacher performance. Digital competence, with a t-statistic of 6.748 exceeding 1.96 and a p-value of 0.000, which is less than 0.05, demonstrates a statistically significant positive impact on teacher performance. Digital leadership and digital competence substantially influence teacher performance in the execution of smart schools at SMK X, evidenced by an R-squared value of 55%.

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