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Principals' Digital Leadership Competencies as Predictors of Teachers' Instructional Effectiveness in Public Secondary Schools in Osun State, Nigeria

Nuhu, Kehinde Muritala, Ph.D.[1], Akinyemi, Oluwafemi[2], Badmus, Anastasia Anuoluwapo[3], Suraju, Hussaini[3], Popoola, Khadijat Opeyemi[3] & Olumorin, Charles Olubode, Ph.D.[1]
[1]Department of Educational Technology, Faculty of Education, University of Ilorin, Ilorin, Nigeria
[2]Department of Educational Foundation and Management, Federal College of Education, Ilawe-Ekiti, Ekiti State, Nigeria
[3]Department of Educational Management, Faculty of Education, University of Ilorin, Ilorin, Nigeria

Contact:
Nuhu, K.M. — nuhu.km@unilorin.edu.ng, +234 803 388 3105
Akinyemi, O. — akinyemifemi333@gmail.com, +234 806 553 1960
Badmus, A.A. — anu.badmus@gmail.com, +234 803 436 4949
Suraju, H. — surajuhussaini17@gmail.com, +234 703 889 3667
Popoola, K.O. — khadijatpopoola2020@gmail.com, +234 903 236 0264
Olumorin, C.O. — bodeolumorin@unilorin.edu.ng, +234 806 649 4979

Abstract
This study examined principals' digital leadership competencies as predictors of teachers' instructional effectiveness in public secondary schools in Osun State, Nigeria. A descriptive survey research design of the correlational type was adopted. The population comprised teachers in public secondary schools, from which a sample of 367 respondents was selected using multistage sampling techniques. Data were collected using a structured questionnaire measuring dimensions of digital leadership competencies—such as vision for digital integration, professional development support, digital infrastructure, communication and collaboration, and monitoring and evaluation—as well as components of instructional effectiveness, including lesson delivery, use of instructional materials and technology, classroom management, student engagement, and assessment practices. Data were analyzed using descriptive statistics, Pearson correlation, and multiple regression analysis at the 0.05 level of significance. Findings revealed that both principals' digital leadership competencies M = 1.79 and teachers' instructional effectiveness (M = 1.46) were at low levels. However, a moderate, positive, and statistically significant relationship was found between the two variables. Digital leadership competencies significantly predicted teachers' instructional effectiveness, accounting for 16% of the variance (R^2=0.16). Among the dimensions, vision for digital integration, provision of infrastructure, and digital communication were significant positive predictors, while monitoring and evaluation showed a negative contribution. The study was grounded on the foundations of Transformational Leadership Theory, which explains how principals' leadership behaviours can enhance teachers' instructional

effectiveness. It concludes that enhancing principals' digital leadership competencies is essential for improving instructional effectiveness in schools. Recommendations were made to strengthen leadership capacity, improve infrastructure, and promote effective technology integration.

Keywords: Digital Leadership Competencies, Instructional Effectiveness, Public Secondary Schools.

Introduction

Education in the 21st century has been witnessing a high level of transformation with the integration of digital technologies into teaching, learning, and school administration, thereby redefining expectations of school leadership. In this context, principals are no longer limited to administrative functions but are required to lead digital transformation in ways that enhance instructional practices and learning outcomes. Karaköse et al. (2024) explained digital leadership as the set of competencies required for effective technology integration in education, while Syarip and Syarip (2025) emphasized its role in driving pedagogical innovation and improving teaching quality. These perspectives indicate the growing recognition that leadership capacity plays a central role in determining how effectively digital tools are utilized within schools.

Within the Nigerian education system, there have been intensive efforts to promote technology-driven teaching and learning, reflecting broader global trends toward digitalization. Empirical observations suggest that digital technologies can enhance classroom management, support instructional delivery, and expand access to educational resources (Akanimoh, 2025; Ekong, 2025). However, the translation of these potentials into improved instructional effectiveness remains inconsistent, particularly in public secondary schools where infrastructural deficits, limited teacher capacity, and uneven implementation of digital policies persist. This suggests that the presence of digital tools alone is insufficient; rather, their effectiveness depends largely on the ability of school leaders to guide their meaningful integration into instructional processes.

Principals' digital leadership competencies are therefore increasingly viewed as critical determinants of instructional effectiveness. According to Živković (2022), the articulation of a clear vision for digital integration enables school leaders to align technological initiatives with instructional goals and inspire stakeholder commitment. In a similar perspective, Prayoonvong and Limwongthong (2025) reiterated the importance of continuous professional development in enhancing teachers' digital competence, while Giovanni et al. (2024) stressed the role of adequate infrastructure in facilitating effective technology use in schools. Digital communication and collaboration further support information sharing and collective problem-solving among educators (Musid et al., 2023), whereas effective monitoring and evaluation ensure accountability and continuous improvement in instructional practices (Fauzi, 2025). Through these competencies, principals are able to influence how teachers plan, deliver, and evaluate instruction.

Instructional effectiveness, in turn, represents a key indicator of educational quality, reflecting the extent to which teachers successfully facilitate learning and achieve desired outcomes. Muruwei and Arazi (2025) explained that effective instruction involves clear lesson delivery, appropriate teaching strategies, and active student engagement, while Akinyemi (2024) established the importance of instructional materials and technology in enhancing teaching quality. These perspectives suggest that instructional effectiveness is not only a function of teacher competence but also of the broader leadership and institutional context within which teaching occurs.

Despite the increasing recognition of the importance of digital leadership, there have been limited empirical evidence on its role in shaping instructional effectiveness within localized Nigerian contexts. While existing studies have established general relationships between leadership and instructional outcomes, they have not sufficiently examined the multidimensional nature of digital leadership or its predictive influence at the level of specific competencies (Xin et al., 2025; Hasanah & Mohd Yusoff, 2024). This limitation shows the need for more context-specific investigations that move beyond general associations to provide a nuanced understanding of how principals' digital leadership competencies influence instructional effectiveness in public secondary schools.

Statement of the Problem

The integration of digital technologies into secondary school education in Nigeria does not appear to have translated into commensurate improvement in teachers' instructional effectiveness, particularly in public secondary schools. Classroom practices in many instances remain largely traditional, with limited use of digital tools, inadequate student engagement, and ineffective instructional delivery. This situation persists despite policy emphasis on technology-driven education and the recognized role of leadership in facilitating digital transformation in schools. For instance, Dogara and Anzaku (2025) examined factors hindering effective curriculum performance in Nigeria and identified issues such as inadequate funding, poor implementation, and insufficient teacher capacity; however, their study did not consider the role of principals' digital leadership competencies in addressing these instructional challenges. This omission leaves a gap in understanding how leadership-driven digital practices could enhance instructional effectiveness in the school system.

Furthermore, while some empirical studies have established a link between digital leadership and instructional effectiveness, they have not sufficiently addressed the predictive role of specific leadership competencies within localized contexts. Xin et al. (2025), for example, investigated the influence of principals' digital leadership on teachers' performance and found that it enhances instructional effectiveness through collaboration and the promotion of a digital culture; however, the study did not break down digital leadership into its core competencies or examine their individual predictive contributions. Additionally, the study was not conducted within the context of public secondary schools in Osun State, Nigeria, thereby limiting its applicability to the present study. These gaps indicate the need for a more context-specific and competency-based investigation, which this study seeks to address by examining how principals' digital leadership competencies predict teachers' instructional effectiveness in public secondary schools in Osun State.

Purpose of the Study

The main purpose of the study is to examine principals' digital leadership competencies as predictors of teachers' instructional effectiveness. More specifically, the study seeks to:

i. determine the level of principals' digital leadership competencies
ii. determine the level of teachers' instructional effectiveness
iii. determine the relationship between principals' digital leadership competencies and teachers' instructional effectiveness
iv. investigate the overall influence of principals' digital leadership competencies on teachers' instructional effectiveness

v. Explore the individual influence of the dimensions of principals' digital leadership competencies and teachers' instructional effectiveness

Research Questions

1. What is the level of principals' digital leadership competencies?
2. What is the level of teachers' instructional effectiveness?
3. Is there a significant relationship between principals' digital leadership competencies and teachers' instructional effectiveness?
4. Do Principals' digital leadership competencies significantly predict teachers' instructional effectiveness.
5. Do the dimensions of principals' digital leadership competencies do not significantly predict teachers' instructional effectiveness in public secondary schools in Osun State.

Research Hypotheses

1. There is no significant relationship between principals' digital leadership competencies and teachers' instructional effectiveness.
2. Principals' digital leadership competencies do not significantly predict teachers' instructional effectiveness.
3. The dimensions of principals' digital leadership competencies do not significantly predict teachers' instructional effectiveness in public secondary schools in Osun State.

Theoretical Review

A relevant theoretical framework for this study is the Transformational Leadership Theory, which provides a strong foundation for understanding principals' digital leadership competencies and their influence on teachers' instructional effectiveness. The theory was first introduced by James MacGregor Burns in 1978 and was later expanded by Bernard M. Bass in 1985. Burns (1978) conceptualized transformational leadership as a process in which leaders and followers elevate one another to higher levels of motivation and morality. Bass (1985) extended this idea by emphasizing the leader's role in inspiring followers to exceed expectations through vision, intellectual stimulation, and individualized consideration. Over time, the theory has been widely applied in educational settings to explain how school leaders influence teachers' attitudes, behaviors, and performance, particularly in contexts that require innovation and change.

The basic principles of Transformational Leadership Theory revolve around four key components: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. Idealized influence refers to the leader's ability to serve as a role model, while inspirational motivation involves articulating a compelling vision that motivates followers. Intellectual stimulation encourages creativity and critical thinking, and individualized consideration focuses on addressing the unique needs of each follower (Bass & Riggio, 2006). These components are grounded on the assumption that effective leadership goes beyond transactional exchanges and instead fosters intrinsic motivation, professional growth, and commitment among followers. In educational contexts, this implies that principals who exhibit transformational leadership behaviours are more likely to create supportive environments that encourage teachers to adopt innovative teaching practices and continuously improve their instructional methods.

Transformational Leadership Theory provides a relevant but not exclusive explanation for explaining the relationship between principals' digital leadership competencies and teachers' instructional effectiveness. While alternative frameworks such as the Technology Acceptance Model focus on individuals' adoption of digital tools, and distributed leadership emphasizes shared

responsibility in school management, these perspectives do not sufficiently capture the motivational and change-oriented dynamics required for leading digital transformation in schools. In contrast, Transformational Leadership Theory explains how principals, through vision, intellectual stimulation, and individualized support, can inspire teachers to adopt innovative practices and effectively integrate digital technologies into instruction (Bass, 1985; Burns, 1978). Specifically, competencies such as articulating a digital vision, supporting professional development, and fostering collaboration reflect the core elements of transformational leadership and provide mechanisms through which instructional practices are enhanced. Thus, the theory not only offers a conceptual foundation for understanding the influence of leadership behaviours on instructional effectiveness but also justifies the examination of digital leadership as a multidimensional construct with distinct yet interrelated components.

Literature Review

Concept of Digital Leadership in Education

Principals' digital leadership has increasingly been positioned as a critical driver of educational transformation in technology-mediated learning environments. Karaköse et al. (2024) conceptualized digital leadership as the competencies required for integrating digital technologies into educational practices, while Syarip and Syarip (2025) extended this view by emphasizing its role in promoting pedagogical innovation and improving teaching quality. Although these perspectives agree on the importance of leadership in technology integration, they differ in emphasis. This is because Karaköse et al. focus on structural and competency-based elements, whereas Syarip and Syarip foreground innovation and pedagogical outcomes. This difference suggests that digital leadership is not a uniform construct but one that operates across both managerial and instructional domains.

Similarly, Novković Cvetković et al. (2023) identified the role of digital leadership in facilitating knowledge transfer and organizational learning, thereby reinforcing its transformative potential. However, this perspective tends to assume the availability of enabling conditions such as infrastructure and teacher readiness, which may not hold in developing contexts. In contrast, studies such as Adeoye et al. (2024) and Termizi (2025) emphasized the role of digital leadership in driving systemic reforms and curriculum transformation, yet they provide limited empirical evidence on how such leadership translates into measurable instructional outcomes. This shows a perpetual limitation in the literature, where digital leadership is often discussed at a conceptual level without sufficient attention to how it is used and its impact.

Furthermore, while existing studies generally portray digital leadership as beneficial, there is limited engagement with contextual constraints that may moderate its effectiveness. For instance, although digital leadership is associated with improved collaboration and innovation (Sukmawati et al., 2024), little is known about the extent to which these outcomes are achievable in resource-constrained environments. This suggests a need for more contextual investigations that move beyond normative assumptions to examine how digital leadership functions under varying institutional conditions.

The multidimensional nature of principals' digital leadership competencies is widely acknowledged in scholarly works, yet there is little consensus on the relative importance or effectiveness of these dimensions. Živković (2022) argued that a clear vision for digital integration is central to aligning technological initiatives with educational goals, a position supported by Abdallah et al. (2024), who linked such vision to innovation and student-centred learning.

However, these studies largely rely on theoretical assertions, with limited empirical validation of how vision alone translates into improved instructional practices.

In contrast, Prayoonvong and Limwongthong (2025) emphasized the role of professional development in enhancing teachers' digital competence, suggesting that leadership effectiveness depends not only on vision but also on capacity-building efforts. Yet, this perspective assumes that training programmes are adequately designed and implemented, an assumption that may not hold in contexts where professional development is irregular or poorly resourced. Similarly, Giovanni et al. (2024) stressed the importance of digital infrastructure, but their findings suggest that infrastructure alone does not guarantee effective technology integration, thereby challenging technologically deterministic views of educational improvement.

The role of communication and collaboration has also been emphasized by Musid et al. (2023), who found that digital platforms enhance interaction and teamwork among stakeholders. While this aligns with Sukmawati et al. (2024), who linked collaboration to innovation, both studies provide limited insight into how communication practices influence actual classroom instruction. Furthermore, Fauzi (2025) argued that monitoring and evaluation are essential for ensuring accountability and continuous improvement; however, this perspective contrasts with emerging evidence suggesting that monitoring practices may not always yield positive outcomes, particularly when perceived as punitive rather than developmental. These inconsistencies collectively indicate that the effectiveness of digital leadership dimensions may vary depending on how they are implemented, indicating the need for empirical studies that examine their individual and combined effects.

Concept of Instructional Effectiveness

Instructional effectiveness is a central construct in educational research, reflecting the extent to which teachers facilitate meaningful learning and achieve desired educational outcomes. Awodiji (2023) conceptualized instructional effectiveness as a continuous process of evaluating teaching and learning to enhance school performance and professional growth, thereby emphasizing its developmental and systemic nature. In contrast, Muruwei and Arazi (2025) focused more on classroom-level practices, defining instructional effectiveness in terms of lesson delivery, appropriate teaching strategies, and active student engagement. While both perspectives acknowledge the importance of improving learning outcomes, they differ in scope in the sense that Awodiji's view situates instructional effectiveness within broader school improvement processes, whereas Muruwei and Arazi emphasize observable teaching behaviours. This difference suggests that instructional effectiveness is not a singular construct but one that operates across both instructional and organizational levels.

As a rider to this, Ezumah et al. (2025) linked instructional effectiveness to instructional leadership practices such as supervision and curriculum implementation, highlighting the role of leadership in shaping teachers' performance. Similarly, Omojemite (2025) associated instructional effectiveness with the use of interactive and student-centred teaching methods that enhance learners' academic outcomes. Although these studies agree on the importance of pedagogical quality, they place differing emphasis on leadership influence versus instructional strategy, indicating a lack of consensus on the primary drivers of effectiveness. Moreover, while these perspectives recognize the importance of improving teaching practices, they often treat instructional effectiveness as an outcome variable without sufficiently examining the mechanisms through which it is achieved, particularly in technology-mediated environments.

The dimensions of instructional effectiveness further illustrate its multidimensional nature, encompassing lesson delivery, use of instructional materials and technology, classroom

management, student engagement, and assessment practices. Muruwei and Arazi (2025) reiterated the importance of clear and structured lesson delivery, while Akinyemi (2024) emphasized the role of instructional materials and ICT facilities in enhancing teaching quality and student understanding. Arumuru and Toyo (2024) similarly argued that the availability and utilization of instructional resources significantly influence students' academic achievement. However, these studies tend to assume that the mere availability of resources translates into effective use, an assumption that may not hold in contexts where teachers lack the necessary skills or support to integrate such resources effectively.

In addition, classroom management and student engagement are widely recognized as critical components of instructional effectiveness. Bayefa-Asaowei (2024) defined classroom management as the organization of classroom activities to ensure order and facilitate learning, while Williams and Nwaokugha (2024) emphasized its role in creating inclusive and interactive learning environments. Similarly, Hikmah and Zubaidah (2024) highlighted student engagement as a key indicator of effective teaching, reflecting the extent to which learners actively participate in the instructional process. Although these studies establish the importance of learner-centred practices, they provide limited insight into how such practices are influenced by broader institutional or leadership factors, particularly in digitally evolving educational contexts.

Assessment and feedback also constitute essential dimensions of instructional effectiveness, as they guide both teaching and learning processes. Agbarakwe and Chibueze (2024) explained that assessment involves evaluating learning outcomes, while feedback provides information necessary for improvement. Despite this recognition, existing studies often treat assessment as a procedural activity rather than a strategic tool for enhancing instructional quality. Furthermore, not enough has been done to understand the integration of digital technologies into assessment practices, despite its growing relevance in contemporary education.

Despite the comprehensive conceptualization of instructional effectiveness, several challenges continue to hinder its realization in Nigerian secondary schools. Dogara and Anzaku (2025) identified systemic issues such as inadequate funding, poor policy implementation, and insufficient teacher capacity as major barriers to effective instruction. Similarly, Al-amin (2023) highlighted problems related to poor infrastructure and lack of qualified personnel, while Adeoye et al. (2023) pointed to outdated curricula and overreliance on traditional teaching methods as constraints to instructional quality. Birabil and Nwadibia (2023) further noted that shortages of instructional materials and large class sizes negatively affect teaching effectiveness. While these studies provide valuable insights into contextual challenges, they tend to focus on structural limitations without adequately examining how leadership practices, particularly digital leadership can mitigate these constraints.

The literature therefore indicates that instructional effectiveness is a complex and multifaceted construct influenced by a combination of teacher competence, resource availability, leadership practices, and systemic conditions. However, existing studies reveal important limitations, including fragmented conceptualizations, limited integration of digital dimensions, and insufficient attention to the role of leadership in shaping instructional practices. These gaps underscore the need for more integrative and context-specific research that examines instructional effectiveness within the framework of digital leadership, particularly in resource-constrained educational settings.

Relationship between Digital Leadership Competencies and Instructional Effectiveness

The relationship between digital leadership and instructional effectiveness has been widely examined, with most studies reporting positive associations between the two constructs. Syarip and Syarip (2025) and Karaköse et al. (2024) argued that digital leadership promotes innovative teaching practices and enhances instructional quality, while Hasanah and Mohd Yusoff (2024) emphasized its role in facilitating data-driven decision-making and improving pedagogical outcomes. Similarly, Dong and Tabajen (2024) found that digital leadership competencies enhance learning effectiveness through improved digital literacy and instructional practices. These studies collectively suggest a strong link between leadership and instructional outcomes.

However, despite this general consensus, important limitations remain. Many studies, including Xin et al. (2025), demonstrate the positive influence of digital leadership on teachers' performance but do not break leadership down into specific competencies, thereby limiting understanding of which aspects of leadership are most impactful. Similarly, Zeng et al. (2024) focused on teachers' digital competence as a mediating factor, but their study does not fully explain how leadership behaviours translate into competence development. This highlights a gap in the causal mechanisms underlying the relationship.

Also, while Villa-Sánchez and Pizarro-Fuentes (2025) reported that schools with strong digital leadership achieve better academic outcomes, the absence of a publication date and limited contextual detail raise concerns about the generalizability of their findings. In addition, most existing studies are conducted outside the Nigerian context, thereby limiting their applicability to public secondary schools where infrastructural and institutional challenges may alter the dynamics of digital leadership. These limitations suggest that, although the relationship between digital leadership and instructional effectiveness is well established, there is a need for context-specific and multidimensional analyses that move beyond general correlations to examine predictive relationships and underlying mechanisms.

Conceptual Framework of the Study

Drawing from the reviewed literature and the foundations of Transformational Leadership Theory, this study conceptualizes principals' digital leadership competencies as a multidimensional construct that influences teachers' instructional effectiveness. The framework assumes that leadership behaviours exhibited by school principals shape the conditions under which teaching and learning occur, particularly in technology-mediated environments. Specifically, principals' digital leadership competencies are operationalized into five key dimensions: vision for digital integration, support for professional development, provision of digital infrastructure, digital communication and collaboration, and monitoring and evaluation (Živković, 2022; Prayoonvong & Limwongthong, 2025; Giovanni et al., 2024; Musid et al., 2023; Fauzi, 2025). These dimensions reflect the core mechanisms through which principals influence instructional practices in schools.

Within this framework, teachers' instructional effectiveness is treated as the dependent variable and is conceptualized as a multidimensional outcome comprising lesson delivery, use of instructional materials and technology, classroom management, student engagement, and assessment practices (Muruwei & Arazi, 2025; Akinyemi, 2024; Bayefa-Asaowei, 2024; Agbarakwe & Chibueze, 2024). The framework posits that each dimension of digital leadership competency exerts both independent and collective influence on these components of instructional effectiveness. For instance, a clearly articulated digital vision is expected to guide instructional direction, while professional development enhances teachers' capacity to integrate technology effectively. Similarly, the availability of infrastructure enables the practical application of digital

tools, communication fosters collaboration and knowledge sharing, and monitoring and evaluation provide feedback mechanisms for continuous improvement.

The conceptual model underlying this study therefore assumes both direct and predictive relationships between principals' digital leadership competencies and teachers' instructional effectiveness. At a general level, overall digital leadership competency is expected to significantly predict instructional effectiveness. At a more specific level, each dimension of digital leadership competency is assumed to contribute differently to instructional effectiveness, reflecting the multidimensional nature of both constructs. This assumption provides the basis for the formulation of the study's hypotheses, which test the relationship, overall predictive influence, and individual contributions of the leadership dimensions.

Furthermore, this framework directly informed the construction of the research instrument, the Principals' Digital Leadership Competencies and Teachers' Instructional Effectiveness Questionnaire (PDLCTIEQ). Items in the questionnaire were developed to reflect each identified dimension of digital leadership and instructional effectiveness, ensuring alignment between the conceptual definitions, measurement scales, and analytical procedures. Thus, the framework not only guides the theoretical understanding of the study but also ensures coherence between the variables, the instrument design, and the statistical analyses employed.

Methodology

The study adopted a descriptive survey research design of the correlational type to examine principals' digital leadership competencies as predictors of teachers' instructional effectiveness in public secondary schools in Osun State, Nigeria. The population comprised all teachers in public secondary schools in the state, from which a sample of 367 respondents was drawn using a sample size determination formula to ensure adequate representativeness. A multistage sampling procedure was employed: schools were first stratified by senatorial districts, after which simple random sampling was used to select schools and participating teachers. This procedure ensured proportional representation and minimized sampling bias.

Data were collected using a structured instrument titled Principals' Digital Leadership Competencies and Teachers' Instructional Effectiveness Questionnaire (PDLCTIEQ). The questionnaire consisted of two sections measuring principals' digital leadership competencies (vision for digital integration, professional development support, provision of digital infrastructure, communication and collaboration, and monitoring and evaluation) and teachers' instructional effectiveness (lesson delivery, use of instructional materials and technology, classroom management, student engagement, and assessment practices). The instrument contained 50 items rated on a 4-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (4), with a decision rule of 2.50 as the cut-off point for determining high or low levels.

The instrument was validated through expert review to ensure content and face validity, while reliability was established using the Cronbach's alpha method, with coefficients indicating acceptable internal consistency. Data were analyzed using descriptive and inferential statistics, with mean and standard deviation used to answer research questions, and Pearson Product Moment Correlation and multiple regression analysis used to test the hypotheses at the 0.05 level of significance. Assumptions underlying regression analysis, including normality, linearity, multicollinearity, and homoscedasticity, were examined to ensure the robustness of the results.

Results

Research Question 1: What is the level of principals' digital leadership competencies?

Table 1: Mean and Standard Deviation showing the Level of Principals' Digital Leadership Competencies

S/N	ITEMS	Mean	SD
1	My principal clearly communicates a vision for digital learning in the school.	1.70	.62
2	My principal emphasizes the importance of technology in teaching and learning.	1.72	.75
3	Digital transformation goals are well defined in my school.	1.86	.87
4	My principal inspires teachers to adopt digital teaching practices.	1.75	.84
5	The school's digital vision aligns with instructional goals.	1.60	.83
6	My principal provides regular training on the use of digital tools.	1.86	.74
7	Teachers are encouraged to attend ICT-related workshops and seminars.	1.94	.82
8	My principal supports continuous development of teachers' digital skills.	1.48	.72
9	Training provided is relevant to classroom instructional needs.	1.88	.82
10	My principal ensures equal opportunities for digital skill development.	1.60	.83
11	My school is adequately equipped with digital teaching tools.	1.91	.77
12	Internet facilities in the school are reliable and accessible.	1.89	.83
13	My principal ensures availability of ICT resources for teachers.	2.04	.86
14	Teachers have access to digital instructional materials.	1.90	.97
15	Digital equipment in the school is properly maintained.	1.60	.83
16	My principal uses digital platforms to communicate with teachers.	1.70	.70
17	Information is effectively shared through digital channels.	1.78	.81
18	Teachers are encouraged to collaborate using online tools.	1.71	.82
19	Digital communication enhances interaction among staff.	1.81	.83
20	My principal models effective use of digital communication tools.	1.84	.98
21	My principal monitors teachers' use of technology in instruction.	2.10	.94
22	Feedback is provided on digital teaching practices.	1.90	.99
23	My principal evaluates the effectiveness of ICT integration.	2.08	.92
24	Teachers are guided to improve their use of technology in teaching.	1.90	.87
25	Data is used to improve digital teaching and learning outcomes.	1.19	.43
	Grand Mean	**1.79**	

Table 1 shows that the grand mean of 1.79, based on the decision rule of 2.50, indicates that principals' digital leadership competencies are low. This suggests that principals demonstrate limited effectiveness across key dimensions such as digital vision, professional development support, infrastructure provision, communication, and monitoring of digital instruction. The generally low item means further imply that digital leadership practices are not yet well established or systematically implemented in the schools.

Research Question 2: What is the level of teachers' instructional effectiveness?
Table 2: Mean and Standard Deviation showing the Level of Teachers' Instructional Effectiveness Competencies

S/N	ITEMS	Mean	SD
1	I present my lessons in a clear and understandable manner.	1.47	.70
2	My teaching methods enhance students' comprehension.	1.40	.60
3	I organize my lessons in a logical sequence.	1.45	.65
4	I use appropriate examples to explain concepts.	1.50	.70

5	I achieve the objectives of my lessons effectively.	1.52	.77
6	I effectively integrate digital tools into my teaching.	1.68	.83
7	I use multimedia resources to enhance lesson delivery.	1.58	.73
8	Technology improves the quality of my teaching.	1.69	.88
9	I select appropriate digital tools for different topics.	1.52	.78
10	I update my instructional materials using digital resources.	1.35	.60
11	I maintain discipline effectively during lessons.	1.47	.71
12	I create a conducive learning environment for students.	1.44	.75
13	I manage classroom activities efficiently.	1.50	.77
14	I handle disruptions promptly and effectively.	1.44	.72
15	I manage instructional time effectively.	1.30	.58
16	I encourage active participation of students during lessons.	1.44	.68
17	My teaching methods stimulate students' interest.	1.37	.67
18	I involve students in meaningful classroom discussions.	1.48	.73
19	I use strategies that promote collaborative learning.	1.37	.67
20	Students show enthusiasm during my lessons.	1.38	.62
21	I use different methods to assess students' learning.	1.43	.67
22	I provide timely feedback to students.	1.45	.71
23	My assessments align with instructional objectives.	1.51	.74
24	I use assessment results to improve my teaching.	1.44	.73
25	I help students understand their strengths and weaknesses.	1.44	.73
	Grand Mean	1.46	

Table 2 shows that the grand mean of 1.46, which falls below the cut-off point of 2.50, indicates that teachers' instructional effectiveness is low. This reflects weaknesses across major instructional domains, including lesson delivery, use of instructional materials and technology, classroom management, student engagement, and assessment practices. The pattern of low responses suggests that instructional challenges are widespread rather than isolated.

Research Hypothesis One: *There is no significant relationship between principals' digital leadership competencies and teachers' instructional effectiveness.*

Table 3: Pearson's Product Moment Correlation Analysis Showing the relationship between principals' digital leadership competencies and teachers' instructional effectiveness.

Variables	Correlations	PLC	TE
PLC	Pearson Correlation	1	.401**
	Sig. (2-tailed)		.000
	N	367	367
TE	Pearson Correlation	.401**	1
	Sig. (2-tailed)	.000	
	N	367	369

Table 3 shows that the Pearson Product Moment Correlation coefficient is r = .401 with a significance value of p = .000 (< .05), indicating a moderate, positive, and statistically significant relationship between principals' digital leadership competencies and teachers' instructional effectiveness. This implies that higher levels of digital leadership are associated with improved instructional effectiveness. The null hypothesis is therefore rejected, and the analysis is based on a consistent sample size of N = 367.

Research Hypothesis Two: *Principals' digital leadership competencies do not significantly predict teachers' instructional effectiveness.*

Table 4a: Analysis of Variance (ANOVA) showing the Influence of Digital Leadership Competencies on Teachers' Instructional Effectiveness

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	6302.358	1	6302.358	69.769	.000[b]
Residual	32970.983	365	90.331		
Total	**39273.341**	**366**			

Table 4a presents the ANOVA results, which show that the regression model is statistically significant ($F = 69.769$, $p = .000 < .05$). This indicates that principals' digital leadership competencies significantly influence teachers' instructional effectiveness, meaning the model provides a better explanation than one without predictors.

Table 4b: Model Summary Showing the Contribution of Digital Leadership Competencies on Teachers' Instructional Effectiveness

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.401[a]	.160	.158	9.50429

Table 4b shows that the R^2 value is 0.160, indicating that principals' digital leadership competencies explain 16% of the variance in teachers' instructional effectiveness. Although this contribution is statistically significant, it is relatively modest, suggesting that 84% of the variance is explained by other factors not included in the model.

Table 4c: Coefficients Table showing the Influence of Digital Leadership Competencies on Teachers' Instructional Effectiveness

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	**t**	**Sig.**
(Constant)	19.061	2.161		8.819	.000
PLC	.392	.047	.401	8.353	.000

Table 4c shows that principals' digital leadership competencies significantly predict teachers' instructional effectiveness (**β = .401, t = 8.353, p = .000 < .05**). This indicates that an increase in digital leadership competencies leads to a corresponding increase in instructional effectiveness, confirming the predictive strength of the variable.

Research Hypothesis Three: *The dimensions of principals' digital leadership competencies do not significantly predict teachers' instructional effectiveness in public secondary schools in Osun State.*

Table 5a: Analysis of Variance (ANOVA) showing the Influence of Digital Leadership Competencies on Teachers' Instructional Effectiveness

Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Regression	10129.934	5	2025.987	25.096	.000[b]
Residual	29143.407	361	80.730		
Total	39273.341	366			

Table 5a presents the ANOVA results, showing that the combined dimensions of digital leadership competencies significantly influence teachers' instructional effectiveness (F = 25.096, p = .000 < .05). This confirms that the model is statistically significant

Table 5b: Model Summary Showing the Joint Contribution of Dimensions of Digital Leadership Competencies on Teachers' Instructional Effectiveness

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.508[a]	.258	.248	8.98497

Table 5b shows that the R^2 value is 0.258, indicating that the dimensions of digital leadership competencies jointly explain 25.8% of the variance in instructional effectiveness. This reflects a stronger explanatory power compared to the overall composite model

Table 5c: Coefficients Table showing the Influence of Digital Leadership Competencies on Teachers' Instructional Effectiveness

	Unstandardized Coefficients		Standardized Coefficients		
Model	**B**	**Std. Error**	**Beta**	**T**	**Sig.**
(Constant)	16.965	2.087		8.128	.000
VD	.909	.262	.222	3.470	.001
SDP	-.346	.272	-.085	-1.269	.205
PDI	.876	.226	.242	3.873	.000
DCC	1.431	.249	.328	5.748	.000
MED	-.649	.226	-.180	-2.876	.004

Table 5c shows that vision for digital integration (β = .222, p < .01), provision of digital infrastructure (β = .242, p < .001), and digital communication and collaboration (β = .328, p < .001)

are significant positive predictors of instructional effectiveness. This indicates that these dimensions contribute meaningfully to improving teaching practices. However, monitoring and evaluation ($\beta = -.180$, $p < .01$) shows a significant negative effect, suggesting possible issues in its implementation, while support for professional development ($\beta = -.085$, $p > .05$) is not a significant predictor. This implies that not all leadership dimensions contribute equally to instructional effectiveness.

Discussion of Findings

The findings of this study revealed that principals' digital leadership competencies and teachers' instructional effectiveness in public secondary schools in Osun State were both at low levels (M = 1.79 and M = 1.46 respectively). This outcome aligns with earlier observations by Dogara and Anzaku (2025), who noted that inadequate funding, poor implementation, and insufficient teacher capacity continue to hinder instructional quality in Nigerian schools. Despite these limitations, the study established a moderate, positive, and statistically significant relationship between principals' digital leadership competencies and teachers' instructional effectiveness, thereby reinforcing the assertion of Syarip and Syarip (2025) that digital leadership plays a critical role in driving pedagogical innovation and improving teaching quality.

The regression analysis further showed that digital leadership competencies accounted for 16% of the variance in teachers' instructional effectiveness. This finding corroborates the position of Karaköse et al. (2024), who conceptualized digital leadership as a set of competencies essential for effective technology integration in education. Specifically, vision for digital integration, provision of infrastructure, and digital communication emerged as significant positive predictors of instructional effectiveness. This supports Živković (2022), who argued that a clear vision for digital integration enables school leaders to align technological initiatives with instructional goals, and Giovanni et al. (2024), who emphasized the importance of infrastructure in facilitating effective technology use. Similarly, Musid et al. (2023) highlighted the role of digital communication and collaboration in enhancing teamwork and information sharing among educators, which resonates with the present findings.

Interestingly, monitoring and evaluation showed a negative contribution to instructional effectiveness. This contrasts with Fauzi (2025), who argued that monitoring and evaluation are essential for accountability and continuous improvement. The negative influence observed in this study may be explained by the perception of monitoring practices as punitive rather than developmental, a concern echoed in emerging literature that cautions against overly rigid accountability mechanisms in resource-constrained environments.

The findings also validate the assumptions of Transformational Leadership Theory (Burns, 1978; Bass, 1985), which posits that leaders inspire followers through vision, intellectual stimulation, and individualized support. In this context, principals who articulated a digital vision and provided infrastructure demonstrated idealized influence and inspirational motivation, thereby enhancing teachers' instructional practices. However, the negative effect of monitoring and evaluation suggests that intellectual stimulation and individualized consideration may not be fully realized when evaluation is perceived as coercive rather than supportive.

The study therefore provides empirical evidence that principals' digital leadership competencies significantly influence teachers' instructional effectiveness, consistent with the conclusions of Xin et al. (2025) and Hasanah & Mohd Yusoff (2024), who found that digital leadership enhances instructional outcomes through collaboration and data-driven practices. However, the present study extends these findings by demonstrating the predictive contributions

of specific competencies within the Nigerian context, thereby addressing the gap identified by previous scholars who examined digital leadership only at a general level (Adeoye et al., 2024; Termizi, 2025).

Conclusion

The study concluded that principals' digital leadership competencies significantly influence teachers' instructional effectiveness in public secondary schools in Osun State, although both were found to be at low levels. The results indicate that while digital leadership contributes meaningfully to improving instructional practices, its current level of implementation is insufficient to drive optimal teaching outcomes. The findings further suggest that enhancing specific dimensions of digital leadership, alongside broader systemic support, is essential for improving instructional effectiveness and achieving better educational outcomes.

Recommendations

1. Since principals' digital leadership competencies were found to be low, the Ministry of Education and relevant agencies should organize regular capacity-building programmes focusing specifically on digital visioning, technology integration, data-informed decision-making, digital communication, and supportive instructional supervision. This recommendation aligns directly with the finding that stronger digital leadership significantly predicts improved instructional effectiveness.
2. Given that provision of digital infrastructure emerged as a significant positive predictor of teachers' instructional effectiveness, government should prioritize the supply of reliable internet connectivity, computers, smart devices, projectors, and maintenance support across schools. Without adequate infrastructure, principals and teachers may be unable to translate digital leadership efforts into effective classroom practice.
3. As digital communication and collaboration recorded a significant positive influence on instructional effectiveness, principals should institutionalize the use of official digital platforms for staff communication, resource sharing, lesson planning, peer mentoring, and collaborative problem-solving. This can enhance coordination, innovation, and timely instructional support.
4. Since vision for digital integration significantly predicted instructional effectiveness, principals should articulate clear, measurable, and context-relevant digital goals linked to teaching and learning outcomes. Such vision should be shared with teachers and stakeholders to create collective commitment and direction for sustainable innovation.
5. Because monitoring and evaluation showed a negative predictive contribution, school authorities should review current supervisory approaches and redesign them as supportive coaching systems. Monitoring should emphasize feedback, mentoring, problem-solving, and continuous improvement rather than fault-finding or excessive control, which may discourage teachers.
6. As support for digital professional development was not a significant predictor, training programmes for teachers should be needs-based, classroom-focused, and sustained over time rather than occasional theoretical workshops. Emphasis should be placed on practical digital pedagogy, subject-specific technology use, and follow-up mentoring.
7. Since principals' digital leadership explained only part of the variance in teachers' instructional effectiveness, policymakers should also improve teacher motivation, workload balance, curriculum quality, class size management, and availability of instructional materials. A multi-dimensional reform strategy is more likely to yield stronger outcomes.

8. Government should collaborate with private organizations, alumni associations, NGOs, and development partners to provide funding, technical expertise, and innovation support for schools. Such partnerships can accelerate progress, especially in resource-constrained public secondary schools.

Limitations of the Study

1. The study was limited to public secondary schools in Osun State, Nigeria; therefore, the findings may not be fully generalizable to private schools or other states.
2. The study adopted a descriptive survey design, which limits the ability to establish causal relationships among the variables.
3. Data were collected through self-reported questionnaire responses, which may be affected by response bias or social desirability bias.
4. The study focused mainly on selected dimensions of principals' digital leadership competencies and may not have captured all factors influencing teachers' instructional effectiveness.
5. The study explained only part of the variance in teachers' instructional effectiveness, indicating that other relevant variables were not included.

Suggestions for Further Studies

1. Future studies should replicate the research in other states of Nigeria or across regions to enhance generalizability of findings.
2. Comparative studies involving public and private secondary schools should be conducted to identify possible institutional differences.
3. Future researchers should employ longitudinal or experimental designs to better determine causal relationships between digital leadership and instructional effectiveness.
4. Additional variables such as teacher motivation, organizational climate, digital competence, and funding should be examined alongside digital leadership competencies.
5. Qualitative or mixed-method studies should be conducted to gain deeper insights into how principals' digital leadership practices influence classroom instruction.

References

Abdallah, A. K., Al Khanbooli, B., Al Kaabi, N. A. M., & Al Awadhi, M. A. (2024). *Bridging innovative technologies with progressive educational governance (pp. 84–99).* IGI Global. https://doi.org/10.4018/979-8-3693-0880-6.ch007

Adeoye, B. F. (2020). The era of digital technology in teaching and learning in Nigeria educational institutions. *In Handbook of digital education* (pp. 43–51). IGI Global. https://doi.org/10.4018/978-1-5225-9746-9.CH004

Adeoye, M. A., Oladimeji, R. M., & Paramole, O. C. (2024). 21st Century leadership as a catalyst for sustainable reform: *Transformative practices in digital education. 9*(2), 61–86. https://doi.org/10.47453/eduvis.v9i2.3264

Agbarakwe, H. A., & Chibueze, O. O. (2024). Leveraging artificial intelligence for enhanced assessment and feedback mechanisms in Nigeria higher education system. *International Journal of Research and Innovation in Social Science, 8*(9), 142–151. https://dx.doi.org/10.47772/IJRISS.2024.809012

Akanimoh, M. E. (2025). *Remodeling classroom management through technology.* https://doi.org/10.6084/m9.figshare.29127110.v1

Akinyemi, T. F. (2024). Instructional materials and ICT facilities situation as correlates of job performance of academic staff in Southwest Nigerian universities. *Commonwealth Journal of Academic Research,* 5(12), 1–15.

Akporuovo, H. O., Akporuovo, E., Fakolade, B. A., Usuolori, F. A., & Ebere, M. (2024). *The influence of instructional materials on effective implementation of Universal Basic Education programmes in public junior secondary schools of Lagos State.* Faculty of Education, Air Force Institute of Technology Kaduna.

Aldi, M. P. (2023). Manajemen kesiswaan di lembaga pendidikan pada tingkat madrasah. Al-Ihda': *Jurnal Pendidikan Dan Pemikiran,* 18(1), 881–894. https://doi.org/10.55558/alihda.v18i1.85

Arumuru, L., & Toyo, O. D. (2024). The impact of instructional resources on academic achievement: A study of library and information science postgraduates in Nigeria. *Asian Journal of Information Science and Technology,* 14(1), 54–60. https://doi.org/10.70112/ajist-2024.14.1.4259

Awodiji, O. A. (2023). Nexus between principals' instructional responsibilities and secondary school effectiveness. *International Journal of Theory and Application in Elementary and Secondary School Education (IJTAESE), 5*(1), 63–77. https://doi.org/10.31098/ijtaese.v5i1.1186

Bayefa-Asaowei, H. T. (2024). Classroom management practices for quality instructional delivery in secondary education in Nigeria. *International Journal of Institutional Leadership, Policy and Management, 6*(4), 506–517.

Dineshinie Prathees, D. P. (2025). Innovative digital leadership in education: Strategies for 21st century transformation. *International Journal of Research and Analytical Reviews, 7*(6), 325–338. https://doi.org/10.35629/5252-0706325338

Ekong, S. E. (2025). *Transforming Nigeria through educational technology: A nation building approach.* https://doi.org/10.5281/zenodo.15862737

Esse, N. L., Ogbaji, O. P., Edu, A. M., & Ornia, N. J. (2024). Remodeling classroom management through technology-driven curriculum in Nigeria: A sociological analysis. *Global Journal of Educational Research, 23*(4), 407–413. https://doi.org/10.4314/gjedr.v23i4.3

Ezumah, T. M., Ogbonna, R. N. O., & Afianmagbon, B. E. (2025). Instructional leadership and teachers' effectiveness in private secondary schools in southeast states, Nigeria. *Open Journal of Educational Development, 6*(1), 1–14. https://doi.org/10.52417/ojed.v6i1.848

Fauzi, F. (2025). Digital leadership in education: A systematic literature review. *Ta'lim, 8*(2), 215–237. https://doi.org/10.52166/talim.v8i2.9433

Giovanni, N., Ali, H., & Nurhaida, I. (2024). Fostering sustainable digital leadership in educational organization: Systematic literature review using NVIVO and PRISMA. *Dinasti International Journal of Economics, Finance and Accounting, 5*(3), 1204–1223. https://doi.org/10.38035/dijefa.v5i3.2853

Guanzon, R. S., Tan, G. P., Bagundol, M. C. F., Garcia, M. G., Salazar, M. I. H. D., & Uy, F. T. (n.d.). *Leading schools in the digital era: The evolving concept of digital leadership in education.* https://doi.org/10.5281/zenodo.14202476

Hikmah, F., & Zubaidah, Z. (2024). Students' management for developing students' potential and talent interests. *JUPE: Jurnal Pendidikan Mandala, 9*(4), 1321. https://doi.org/10.58258/jupe.v9i4.8110

Ismuni, M., Usman, M., & Choiriyah, S. (2024). Digital trends and 21st century competencies in educational transformation. Kontigensi: *Jurnal Ilmiah Manajemen, 12*(2), 930–939. https://doi.org/10.56457/jimk.v12i2.649

Karaköse, T., Polat, H., Tülübaş, T., & Demirkol, M. (2024). A review of the conceptual structure and evolution of digital leadership research in education. *Education Sciences, 14*(11), 1166. https://doi.org/10.3390/educsci14111166

Learning Rises Lab. (2024). Assessment practices in Nigeria: A baseline evaluation. Learning Rises.

Makinde, S. O., Sulyman, B. M., & Ibrahim, A. B. (2024). Beyond borders: Leveraging technology to achieve sustainable development goals in education. *International Journal of Universal Education, 2*(2), 90–100. https://doi.org/10.33084/ijue.v2i2.8586

Morales Henao, E. V. (2024). *Lesson delivery: A key component to ensure maximum benefit to the learner.* https://doi.org/10.60692/9f3gg-3kr32

Muruwei, M., & Arazi, T. S. (2025). Instructional and organizational skills of the teacher for effective teaching and learning in primary and secondary schools. *Global Journal of Humanities, Management & Educational Review, 1*(1), 58–67. https://doi.org/10.5281/zenodo.17055641

Musid, N. A., Matore, M. E. M. M., Hamid, A. H. A., & Hamid, A. A. (2023). Communication significance in digital leadership: Does it matter? *International Journal of Academic Research in Business & Social Sciences, 13*(5). https://doi.org/10.6007/ijarbss/v13-i5/16923

Niazi, A. (2025). Education is the foundation of individual growth and social progress. *Integrated Journal for Research in Arts and Humanities, 5*(4), 80–83. https://doi.org/10.55544/ijrah.5.4.11

Novković Cvetković, B., Spasić Stošić, A., & Tasić Mitić, I. (2023). *Leadership in education in the digital age.* https://doi.org/10.22190/futlte221115019n

Okeke, N. L., Ibe, V. T., & Nwogbo, M. O. (2025). Classroom management practices and 21st-century classroom in higher institutions in Nigeria. *International Academic Research Journal of Education and Digital Inclusion, 1*(1).

Omojemite, M. D. (2025). Effectiveness of interactive teaching methods on students' performance in social studies and civic education: An experimental study in Nigerian secondary schools. https://doi.org/10.71514/jssal/2025.171

Peng, Y., Alias, B. S., Mansor, A. N., & Ismail, M. J. (2024). Charting the evolving landscape of digital leadership in education: A systematic literature review. *Journal of Infrastructure, Policy and Development, 8*(8), 5925. https://doi.org/10.24294/jipd.v8i8.5925

Prathees, D. (2025). Innovative digital leadership in education: Strategies for 21st century transformation. *International Journal of Research and Analytical Reviews, 7*(6), 325–338. https://doi.org/10.35629/5252-0706325338

Prayoonvong, N., & Limwongthong, A. (2025). Digital leadership competencies for school administrators in Bangkok's educational transformation. International *Journal of Innovative Research and Scientific Studies, 8*(6), 2015–2021. https://doi.org/10.53894/ijirss.v8i6.10071

Ranggana, A., Wahyudin, W., Gunarso, G., & Permatasari, E. (2024). *21st century learning trends: What educators need to know.* https://doi.org/10.31004/edukatif.v6i1.6142

Ristianah, N. (2023). Review of the urgency of student management on learners' academic achievement. *Kartika, 3*(1), 1–15. https://doi.org/10.59240/kjsk.v3i1.28

Salazar Moreno, C. E., García Salazar, L. C., Nevárez Loza, R. F., Hurtado Santos, M. O., & Mora Quijije, M. K. (2025). Transformation of education in the 21st century: Innovation and sustainability in human development. *Revista Científica Multidisciplinar G-NER@NDO, 6*(2). https://doi.org/10.60100/rcmg.v6i2.806

Samijonov, A. I. (2025). Innovative digital tools for enhancing monitoring and evaluation in teacher education: Pedagogical perspectives. *International Journal of Pedagogics, 5*(09), 299–300. https://doi.org/10.37547/ijp/volume05issue09-78

Sukmawati, M., Giatman, M., & Maksum, H. (2024). E-leadership: Concept and influence of digital leadership. *Jurnal Teknologi Informasi dan Pendidikan, 17*(1), 87–97. https://doi.org/10.24036/jtip.v17i1.811

Syarip, D., & Syarip, D. (2025). Digital leadership in educational institutions: Media management strategies for 21st-century science education. *Jurnal Penelitian Pendidikan IPA (JPPIPA), 11*(9), 100–106. https://doi.org/10.29303/jppipa.v11i9.12567

Terania, L. (2023). A review on developing digital leadership: Assessing strategies and implications to generate links for promoting digital leadership in higher education institutions. *Journal of Innovative Practice, 1*(4). https://doi.org/10.69569/jip.2023.0028

Termizi, S. A. (2025). Digital leadership as a catalyst for curriculum transformation: The role of school leaders in the era of 21st-century education. *International Journal of Advanced Studies and Technology, 16*(4). https://doi.org/10.71097/ijsat.v16.i4.8678

Thahir, I. (2025). Digital leadership of school principals in enhancing technology-based learning quality. *International Journal of Studies in International Education, 2*(4), 33–42. https://doi.org/10.62951/ijsie.v2i4.417

Villa Sánchez, A., & Pizarro Fuentes, E. (2025). Digital leadership in education: A review of the last 50 years. *Revista d'Innovació Docent Universitària, 17*(2). https://doi.org/10.1344/ridu2025.17.2

Williams, C., & Nwaokugha, D. O. (2024). Achieving effective, inclusive and comprehensive classroom management in educational institutions in Nigeria. *Port Harcourt Journal of Educational Studies (PHAJOES), 8*(3).

Živković, S. (2022). Inspiring digital transformation: An integrative leadership competency framework. *Ekonomska Misao i Praksa, 31*(1), 237–254. https://doi.org/10.17818/emip/2022/1.11