World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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LECTURERS' DIGITAL READINESS AND INSTRUCTIONAL DESIGN COMPETENCY AS CORRELATES OF MATHEMATICS INSTRUCTIONAL QUALITY IN SOUTH-SOUTH NIGERIA

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World Journal of Advanced Research and Reviews, 2026, 32(01), 1564–1571

Publication history: Received on 13 September 2026; revised on 22 October 2026; accepted on 24 October 2026

Article DOI: https://doi.org/10.30574/wjarr.2026.32.1.2695

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ABSTRACT

This study examined lecturers' digital readiness and instructional design competency as correlates of Mathematics instructional quality in public tertiary institutions in South-South, Nigeria. The study adopted a descriptive survey design. The study was conducted in Rivers State, Bayelsa State, and Cross River State. The population comprised all the 187 Mathematics and Mathematics Education lecturers, consisting of 159 males and 28 females, from 14 public tertiary institutions in the selected states. Due to the manageable size of the population, census sampling technique was adopted to involve all the lecturers in the study. Two instruments were used for data collection, namely the 30-item Digital Readiness Questionnaire and the 10-item Digital Integration Checklist. The Digital Readiness Questionnaire was validated and tested for reliability using Cronbach's Alpha Reliability Coefficient, which yielded a reliability index of 0.70, indicating acceptable internal consistency while the Digital Integration Checklist was tested using inter-rater reliability method through Pearson Product Moment Correlation which produced a reliability coefficient of 0.86, indicating high reliability. Findings from the study revealed that Mathematics lecturers exhibited a generally low level of digital readiness. The study further revealed a strong and statistically significant positive relationship between lecturers' digital readiness and Mathematics instructional quality. The study concluded that lecturers' digital readiness, instructional design competency, and instructional quality are critical correlates in Mathematics education. The study recommended continuous ICT training, improved digital infrastructure, and professional development programmes for lecturers.

Keywords: Lecturers, Digital Readiness, Instructional Design and Correlates

1 INTRODUCTION

Mathematics is the study of measurements, properties, and relationship of quantities and sets, using numbers and symbols. It is also the part of science that deals with numbers, quantity and space. Odili (2006) expressed Mathematics

as a systematized, organized and exact branch of science which is a creation of the human mind, concerned primarily with ideas, processes and reasoning. Also, Mathematics is an intellectual subject which affects every facet of human activity that includes politics, economy, science and technology. Iji, Abakpa, Agbo-Egwu and Takor (2022) described it as a precursor of scientific discoveries and inventions.

According to Odo (2021), Mathematics is a group of related sciences, including geometry, calculus and algebra which focuses on the study of number, space, shape and quantity and how they interrelate using specialized notation.

Mathematics is the study of the measurement, relationships and properties of quantities and sets (Ekwueme, 2013). It is one of the core subjects taught in Nigerian primary and secondary schools. Mathematics provides the structure and methodology for the study of virtually all the important modern disciplines. It provides an important key to understanding the world in which we live. Everyday life would be quite difficult if one had no knowledge of Mathematics. It is the prime instrument for understanding and exploring the scientific, technological, economic, social and information world. Mathematics is an important subject as its knowledge enhances a person's reasoning, problem-solving skills, and in general the ability to think logically.

Mathematics include algebra, arithmetic, calculus, geometry, trigonometry, and statistics (Charles-Ogan & George, 2015; Charles-Ogan, George & Deme, 2016; Odili, 2006). Effective teaching of these branches requires lecturers to possess digital competence and instructional design skills that enhance students' understanding and engagement.

Mathematics Education plays a foundational role in developing critical thinking and problem-solving skills, making it essential across various disciplines and real-life applications. In the digital age, the effective integration of technology into teaching has become indispensable for enhancing learning outcomes especially in Mathematics, a subject that demands clarity, logical precision and active engagement. The digital readiness of lecturers is particularly crucial in Mathematics Education, as it influences how effectively they can adopt and utilize digital platforms to present abstract concepts, visualize problems and encourage active participation. This integration not only strengthens instructional delivery in Mathematics but also supports differentiated learning and fosters interactive classroom environments where students can collaboratively engage with complex problems. Such digital integration contributes directly to improved students' performance in Mathematics and aligns with Sustainable Development Goal 4, which emphasizes inclusive, equitable and quality education. Understanding the extent to which lecturers are digitally competent is therefore vital not only for promoting academic success in Mathematics, but also for driving systemic transformation toward a more digitally inclusive and globally competitive education system.

"Digital readiness" refers to the knowledge, skills, attitudes, access to infrastructure and institutional support that allow lecturers to integrate technology effectively into teaching (Mukuka & Alex, 2024). Lecturers' preparedness involves both the technical dimension (facility with tools, internet connectivity, hardware/software) and pedagogical dimension (beliefs, design of instruction, attitudes towards innovation).

Digital readiness involves more than mere familiarity with tools; it includes the capacity to design responsive, student-centred instruction through technology. According to Hong and Kim (2018), digital readiness includes a mix of knowledge, skills and attitudes that support the effective use of technology for academic purposes. Park, Kim, and Park (2021) add that it also reflects digital media literacy and the critical engagement with digital content. For Mathematics Instruction, which benefits from visualization tools, simulations and interactive problem-solving, a digitally competent lecturer is more likely to improve students' comprehension and outcomes. Digital readiness encompasses not only technical skills but also access to technology and a willingness to adopt it for pedagogical purposes. Pete, Coopasami, and Knight (2017), asserted that e-learning and other multimedia devices enhance learning opportunities and facilitate student's success in education. Efiuvwere and Avwiri (2025) further asserted that successful digital learning depends heavily on this preparedness.

Lecturers' digital readiness is a vital factor in achieving SDG-4, which advocates for lifelong learning opportunities and quality education at all levels. As change agents in education, lecturers serve as the bridge between policy and practice and lecturers' digital competence significantly influences students' learning experiences. Lecturers who are digitally ready can use various tools to create engaging lessons, communicate effectively and assess students' progress with greater accuracy. Conversely, insufficient readiness can result in fragmented instruction, negatively impacting learning outcomes. Assessing current digital readiness levels helps identify gaps and informs strategic professional development for lecturers.

In the context of tertiary education, digitally competent lecturers serve as vital agents in translating policy goals into impactful teaching practices that support students' success Dang, Phan, Vu, La, and Pham, (2024)). Mathematics Education, in particular, depends heavily on lecturers' ability to integrate technology into instruction to foster critical thinking and problem-solving skills (Dockendorff, 2020). The ongoing digital transformation in education underscores the need for lecturers to possess both technical proficiency and pedagogical agility to design and manage technology-

enhanced learning environments (Drijvers, 2020). Digital tools such as interactive simulations, collaborative platforms and real-time feedback systems can help bridge educational gaps and extend access to quality instruction. However, the effective use of these tools' hinges on lecturers' digital readiness. Where such readiness is lacking, opportunities to meet SDG-4 objectives especially around inclusion, equity and learning outcomes are diminished (Gamit, 2023).

1.1 Statement of the Problem

Face-to-face teaching and learning remain the dominant instructional approach in many higher institutions, particularly in Mathematics education. However, this mode of instruction has continued to experience several challenges that affect instructional quality and students' learning outcomes. Problems such as overcrowded classrooms, inadequate instructional materials, poor classroom interaction, irregular attendance during crises, and limited access to innovative teaching resources often reduce the effectiveness of traditional teaching methods. In periods of communal conflicts, bad weather conditions, health emergencies, or pandemic situations, face-to-face learning is usually disrupted, leading to interruption of academic activities, poor curriculum coverage, and decline in students' academic engagement and achievement in Mathematics.

Although digital technologies and effective instructional design strategies have the potential to support continuous learning during such disruptions. Many Mathematics lecturers in tertiary institutions are yet to take advantage of integrating technology in the teaching and learning of Mathematics. Consequently, the quality of Mathematics instruction and the realization of Sustainable Development Goal 4 (SDG-4), remain difficult to achieve. Therefore, this study seeks to examine lecturers' digital readiness and instructional design competency as correlates of Mathematics instructional quality in tertiary institutions.

Aim and Objectives of the Study

The aim of this study is to examine Lecturers' Digital Readiness and Instructional Design Competency as Correlates of Mathematics Instructional Quality. Specifically, the objectives of the study are;

- assess the level of digital readiness among Mathematics lecturers in the three South-South States;
- determine whether a difference exists in the digital readiness of male and female Mathematics lecturers;

1.2 Research Questions

Eight research questions were raised and answered in this study

- What is the level of digital readiness among Mathematics lecturers in the three South-South States?
- What difference exists in the digital readiness of male and female Mathematics lecturers?

1.3 Hypotheses

Two hypotheses guided the study and were tested at 0.05 level of significance.

- H_{01}: There is no significant level of digital readiness among Mathematics lecturers in the three South-South States.
- H_{02}: There is no significant difference in the digital readiness of male and female Mathematics lecturers

2 METHODOLOGY

The study adopted a descriptive survey research design. The design is appropriate because the study seeks to describe the level of digital readiness among Mathematics lecturers and examine differences and relationships among variables without manipulating them. The design allows for the examination of existing relationships and predictive effects among naturally occurring variables.

The population of this study consists of all 187 (159 males and 28 females) of the Mathematics and Mathematics Education lecturers from the 14 Public Tertiary Institutions in three randomly selected South-South States of Nigeria, consisting 7 Universities, 4 Polytechnics and 3 Colleges of Education. A Census Sampling technique was used for all the 187 Mathematics lecturers in the Mathematics and Mathematics Education departments from 14 public tertiary institutions were involved, Accordingly, questionnaires were distributed to the lecturers across the different institutions. The instrument for data collection was a structured 30 item Questionnaire titled, Digital Readiness Questionnaire (DRQ) and a 10-item Digital Integration Checklist (DIC). The DRQ is adapted from Howard et al. (2021). A 10 items Digital Readiness Level that measured access, skills, and attitudes, also a 10 items question that contain the ISTE Designer Role Scale (IDRS): Developed based on ISTE (2023) which measured instructional design competency, and another 10 items question that contained Mathematics Instructional Quality Scale (MIQS) which measured

Mathematics instructional quality, which covered lesson delivery methods, engagement and assessment practices. The questionnaire is in five levels indicating demography, level of readiness, application of ISTE standards and quality of mathematics instruction. DRQ was developed in line with the objectives of the study and consists of two sections. Section A elicited demographic information of the respondents such as institution, gender, department and highest academic qualification. Section B was structured in alignment with the four variables of the research. All the questionnaire items were structured on a four-point Likert scale with response options: Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1). Data was collected from the DRQ, using mean criterion cut off point of 2.50. while the Digital Integration Checklist (DIC) was used as an observation checklist which measured the usage of digital tools during class process. During classroom observation, the researcher with the help of some research assistants recorded the digital practices demonstrated by the lecturers during lesson delivery. The process of taking record with the checklist was done twice in each of the 14 tertiary institutions by the researcher with the help of research assistants. The DIC is a one section checklist with a simple rating scale with response options such as: Observed (2) and Not Observed (1), which implies high digital integration and low digital integration respectively. Data was collected from the DIC, using mean criterion cut off point of 1.50 The scores from the questionnaire and observation checklist were analysed together by computing the mean scores for both instruments separately. The checklist results were used to validate the authenticity of questionnaire responses.

The Digital Readiness Questionnaire DRQ was subjected to reliability testing using Cronbach's Alpha Reliability Coefficient to determine the internal consistency of the questionnaire items, the instrument was trial-tested on 20 Mathematics lecturers from two tertiary institutions in Abia State that was not part of the study population. The reliability coefficient obtained was 0.80, indicating the instrument was reliable for the study. While Digital Integration Checklist was tested using the inter-rater reliability method. Two independent observers used the checklist to observe the same teaching sessions, and the scores obtained were correlated using Pearson Product Moment Correlation (PPMC). The analysis produced a reliability coefficient of 0.86, showing that the checklist was reliable and capable of producing consistent observation results. The reliability coefficients obtained for both instruments were considered adequate and acceptable for educational research.

2.1 Results and Analysis

- **Research Question 1:** What is the level of digital readiness among Mathematics lecturers in South-South States?

Table 1: Mean and Standard Deviation of Level of Digital Readiness among Mathematics Lecturers

S/N		SA	A	D	SD	Mean	Std	Remark
1.	I possess adequate digital skills required for effective Mathematics instruction.	10 (5.3%)	23 (12.3%)	147 (78.6%)	7 (3.7%)	2.19	0.58	Disagree
2	I am confident in using Learning Management Systems (e.g., Google Classroom, Moodle).	6 (3.2%)	25 (13.4%)	133 (71.1%)	23 (12.3%)	2.07	0.62	Disagree
3	I can independently integrate digital tools into Mathematics lessons.	8 (4.3%)	21 (11.2%)	137 (73.3%)	21 (11.2%)	2.09	0.62	Disagree
4	I regularly use digital technologies to prepare instructional materials.	7 (3.7%)	18 (9.6%)	133 (71.1%)	29 (15.5%)	2.02	0.63	Disagree
5	I am comfortable troubleshooting basic technical challenges during instruction.	7 (3.7%)	16 (8.6%)	141 (75.4%)	23 (12.3%)	2.04	0.60	Disagree
6	I can effectively use data analytics from digital platforms to monitor student learning.	3 (1.6%)	19 (10.2%)	133 (71.1%)	32 (17.1%)	1.96	0.58	Disagree
7	I adapt easily to new educational technologies relevant to Mathematics teaching.	9 (4.8%)	14 (7.5%)	135 (72.2%)	29 (15.5%)	2.02	0.65	Disagree
8	I have sufficient access to digital resources for Mathematics instruction.	9 (4.8%)	20 (10.7%)	130 (69.5%)	28 (15.0%)	2.05	0.67	Disagree
9	I use digital tools to support diverse learners in Mathematics.	8 (4.3%)	13 (7.0%)	141 (75.4%)	25 (13.4%)	2.02	0.61	Disagree
10	I continuously update my digital competencies for instructional improvement.	8 (4.3%)	15 (8.0%)	139 7(4.3%)	25 (13.4%)	2.03	0.62	Disagree

	Grand Mean		2.05	0.62	Disagree

Table 1 shows that Mathematics lecturers demonstrated a low level of digital readiness, as reflected by the grand mean of 2.05 (SD = 0.62), which falls within the "Disagree" range. The findings indicate that most lecturers lacked adequate digital skills, confidence in using Learning Management Systems, and the ability to integrate digital tools effectively into Mathematics instruction.

The respondents also reported limited competence in troubleshooting technical issues, using digital analytics to monitor student learning, and adapting to emerging educational technologies. In addition, inadequate access to digital resources and insufficient efforts toward continuous digital skill development were identified. The low standard deviation values suggest consistency in respondents' opinions. The table indicates that mathematics lecturers lack sufficient digital preparedness for effective technology-driven instruction.

- **Research Question 2:** What difference exists in the digital readiness of male and female Mathematics lecturers in South-South States?

Table 2: Mean and Standard deviation of the digital readiness of male and female Mathematics lecturers

S/N	Item Statement	Male			Female		
		Mean	Std	Remarks	Mean	Std	Remarks
1	I possess adequate digital skills required for effective Mathematics instruction.	2.10	0.48	Disagree	2.65	0.80	Agree
2	I am confident in using Learning Management Systems (e.g., Google Classroom, Moodle).	1.99	0.54	Disagree	2.48	0.81	Disagree
3	I can independently integrate digital tools into Mathematics lessons.	2.01	0.55	Disagree	2.48	0.81	Disagree
4	I regularly use digital technologies to prepare instructional materials.	1.93	0.56	Disagree	2.45	0.81	Disagree
5	I am comfortable troubleshooting basic technical challenges during instruction.	1.95	0.53	Disagree	2.48	0.72	Disagree
6	I can effectively use data analytics from digital platforms to monitor student learning.	1.90	0.53	Disagree	2.29	0.69	Disagree
7	I adapt easily to new educational technologies relevant to Mathematics teaching.	1.94	0.60	Disagree	2.42	0.76	Disagree
8	I have sufficient access to digital resources for Mathematics instruction.	1.98	0.61	Disagree	2.42	0.85	Disagree
9	I use digital tools to support diverse learners in Mathematics.	1.93	0.53	Disagree	2.48	0.77	Disagree
10	I continuously update my digital competencies for instructional improvement.	1.96	0.58	Disagree	2.39	0.72	Disagree
	Aggregate mean	1.97	0.55	Disagree	2.45	0.77	Disagree

Table 2 presents the mean and standard deviation scores on the digital readiness of male and female Mathematics lecturers in the South-South Region. The results reveal noticeable differences in the level of digital readiness between male and female lecturers. The findings show that male Mathematics lecturers recorded an aggregate mean score of 1.97 (SD = 0.55), which falls below the criterion mean and is therefore interpreted as Disagree. This indicates that, on average, male lecturers perceived themselves as not being digitally ready for effective Mathematics instruction.

In contrast, female Mathematics lecturers obtained an aggregate mean score of 2.45 (SD = 0.77), which also falls below the acceptance criterion and is therefore interpreted as Disagree, indicating that they generally did not perceive themselves as digitally ready. However, female lecturers recorded higher mean scores than their male counterparts on all the measured indicators. They agreed only with the statement that they possess adequate digital skills required for effective Mathematics instruction (Mean = 2.65, SD = 0.80).

Overall, the descriptive statistics indicate that female Mathematics lecturers demonstrate relatively higher levels of digital readiness than male lecturers, as reflected in their consistently higher mean scores across all items. Nevertheless, the aggregate mean scores for both groups remain below the criterion mean, suggesting that both male and female Mathematics lecturers generally exhibit low levels of digital readiness. This finding implies that although female lecturers appear to be more digitally prepared than their male counterparts.

2.2 Hypotheses

- **Hypothesis 1:** There is no significant level of digital readiness among Mathematics lecturers in the three South-South Nigeria.

Table 3: One-Sample t-Test of Digital Readiness Against the Criterion Mean

Variables	N	Mean	Criterion Mean	SD	T	df	Sig. (2-tailed)	Decision
Digital Readiness	187	2.05	2.50	0.51	-12.005	186	.000	Reject H_{01}

The result in Table 3 shows that the mean digital-readiness score of 2.05 was significantly different from the criterion mean of 2.50, $t(186) = -12.005$, $p < .001$. Therefore, the null hypothesis is rejected. The lecturers' digital readiness was significantly below the expected criterion level, implying that Mathematics lecturers generally have a low level of digital readiness.

- **Hypothesis 2:** There is no significant difference in the digital readiness between male and female Mathematics lecturers in three South-South Nigeria.

Table 4: Z-test Analysis of the difference in the digital readiness between male and female Mathematics lecturers

Gender	N	Mean	SD	Z-value	P-value	Cohen's d	Level of Sig	Remark
Male	156	1.9686	0.44196	-5.133	0.000	-1.009	0.05	Significant
Female	31	2.4548	0.64953					

Table 4 shows a Z-value of $Z = -5.133$ with a significance value of $p = 0.000$ ($p < 0.05$), indicating that there is a significant difference in the digital readiness of male and female Mathematics lecturers. The result suggests that female lecturers (Mean = 2.4548, SD = 0.64953) have higher digital readiness compared to male lecturers (Mean = 1.9686, SD = 0.44196). Since the probability value of 0.000 is less than the 0.05 level of significance, the null hypothesis is rejected, which implies that there is a significant difference in the digital readiness between male and female Mathematics lecturers.

3 DISCUSSION OF FINDINGS

The findings showed that mathematics lecturers exhibited a generally low level of digital readiness, suggesting inadequate competence in the use of digital tools, limited confidence in learning management systems, and insufficient integration of technology into instructional practices. The results further reveal weaknesses in key areas such as troubleshooting technical issues, applying digital analytics for monitoring student learning, and adapting to emerging educational technologies. Collectively, these outcomes point to a systemic gap in lecturers' preparedness for technology-enhanced instruction, which has implications for the quality of mathematics teaching in higher education.

It also showed that both male and female mathematics lecturers demonstrated generally low levels of digital readiness, suggesting inadequate competence in the use of learning management systems, limited ability to integrate digital tools into instructional delivery, and weak proficiency in troubleshooting and applying digital analytics for teaching and learning. Although female lecturers recorded slightly higher mean scores than their male counterparts, both groups still fell within the same overall range of low digital preparedness. This suggests that while gender differences exist, they do not translate into adequate competence for effective technology-enhanced instruction in mathematics education.

3.1 Summary of findings

The findings are as follows:

- Digital readiness is an important component of effective technology-supported instruction. Lecturers who possess adequate digital knowledge, skills, confidence, and technological competence are better positioned to integrate digital technologies into teaching and learning.
- Digital competence alone does not guarantee high instructional quality. The study indicates that lecturers may possess knowledge of digital technologies without necessarily using them frequently or pedagogically effectively in their instructional practices.

4 CONCLUSION

The study concludes that lecturers' digital readiness, instructional design competency, and Mathematics instructional quality are important correlates of Mathematics instruction. Although digital readiness among lecturers is generally low, it remains essential for effective integration of technology in teaching and learning.

Instructional design competency emerged as the most influential factor in improving instructional quality. It plays a central role in how effectively Mathematics content is structured and delivered to students.

Recommendations

The following recommendations were be made

- Universities and other tertiary institutions should implement continuous digital-readiness training for lecturers. Such programmes should cover digital literacy, educational technologies, online learning platforms, digital assessment, digital communication, data management, and emerging technologies relevant to mathematics education.
- Institutions should provide systematic training in instructional design. Lecturers should be trained in learner analysis, instructional objectives, curriculum alignment, technology selection, digital content development, assessment design, learner engagement, and evaluation of technology-supported instruction.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Acknowledgments

My Profound gratitude goes to my Academic Supervisors, Dr. Gladys I. Charles-Ogan and Dr. Chris Iderima of the Department of Curriculum Studies and Educational Technology. University of Port Harcourt, for their support, contributions and scholarly guidance during this research work, I am greatly indebted to them. My gratitude also goes to the Dean of Faculty of Education University of Port Harcourt, Prof. N. M. Abraham and the Head of Department of Curriculum and Educational Technology, University of Port Harcourt, Prof. A. Oriji.

Disclosure of conflict of interest

The authors declare no conflicts of interest regarding this manuscript.

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