VOL. 13 NO. 8,
AUGUST, 2026
E-ISSN 3026-8893
P-ISSN 3027-1061

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Education Research and Library Practice (JERLP)

Digital Competence, Assistive Technology Utilization and Innovative Teaching Practices among Early Childhood Educators in Government-Owned Primary Schools in Oyo State, Nigeria

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DOI: https://doi.org/10.70382/ajerlp.v13i8.0103

Abstract

Although early childhood educators' teaching is required to be digitally mediated and inclusive, there is limited evidence of the capabilities that underpin innovative practice in sub-Saharan Africa. The present research focused on the effect of digital competence and assistive technology use on innovative teaching methods by ECEs in government owned primary schools in Oyo State of Nigeria. A descriptive survey design with the correlational type has been used. Table was used for proportional allocation and simple random sampling methods to identify 412 early childhood educators from a population of 28,509 teachers in 2,411 state-operated public schools of the three senatorial districts in the state. The Questionnaire on Digital Competence (19 items, $\alpha = .95$), Assistive Technology Utilization Scale (14 items, $\alpha = .88$) and Innovative Teaching Practices Scale for Early Childhood Educators (20 items, $\alpha = .92$) were used to collect the data. Content validity was determined by expert review (S-CVI/Ave = .93). Descriptive statistics, Pearson product moment correlation and multiple linear regression were used to analyse the data at the .05 level of significance. The scores for digital competence ($M = 3.19$, $SD = 0.70$) and assistive technology utilization ($M = 3.42$, $SD = 0.63$) were both found to be at a moderate level, with reflective and inclusive applications lagging behind procedural applications. The two predictors combined explained 34.3% of the variance in innovative teaching practices, $F(2, 409) = 106.97$, $p < .001$. The null hypothesis was rejected for digital competence ($\beta = .38$, $p < .001$) as well as assistive technology utilization ($\beta = .30$, $p < .001$) as independent variables. Results show that innovation in early years' classrooms is not influenced by the availability of devices but by educator

capability; and that support for practice-informed professional learning should be seen as learning about inclusive and digital pedagogy as one competence domain.

Keywords: digital competence; assistive technology utilization; innovative teaching practices; early childhood education; teacher professional development; inclusive pedagogy; Nigeria

Introduction

There is a rapid change in technology in the early years of schooling, but little evidence of what teachers can do in the technology. Young children are now faced with digital media even before they are introduced to formal schooling, and the pedagogical responsibility of brokering this encounter for them is now falling on teachers who have been trained for analogue curricula. Worldwide, devices are distributed in early childhood contexts at a much higher rate than teachers are able to use them for developmentally appropriate goals, resulting in classrooms that are technologically "full" but pedagogically "empty" (Blackwell et al., 2014; Dore & Dynia, 2020; Konca & Erden, 2021).

Two capacities are involved in solving this paradox. The general enabling condition for digital competence is the technical, critical, ethical, and pedagogical ability to select and use digital technologies for learning (Durán Cuartero et al., 2016; Masoumi & Bourbour, 2023; Van Laar et al., 2018). Assistive technology utilization is the inclusive condition because it determines if children with disabilities and developmental differences engage in the same learning activities as their peers and is crucial for mobility, communication, and access to the classroom environment (Johnston & Thompson, 2015; Plunkett et al., 2010; Sadao & Robinson, 2010). Neither of these diminishes to "ownership" of a device. Both refer to the use of available resources by an educator.

International evidence links both capabilities to innovation in practice. Teachers' digital competencies predict innovative work behaviour, partly through informal digital learning, and operate as an enabler of institutional educational innovation (Astuti & Setiawan, 2023; Bustos López & Gómez Zermeño, 2018; Jekabsone & Anohina-Naumeca, 2024). Digital competence has also been found to have an impact on attitudes toward new technologies, even when age and experience are controlled for, and structured competence development based on theory has been found to bring about measurable changes in pedagogical competencies (Galindo-Domínguez et al., 2024; Knezek et al., 2023; Kyza & Georgiou, 2025). Evidence regarding assistive technology is similar: AT is used to support critical thinking, multimodal learning and motivation; and to enhance teaching and learning outcomes when used with purposeful pedagogical design and intentional use, as opposed to as a standalone tool (Adebayo & Ayorinde, 2022; Burne et al., 2011; Felicia & Sharif, 2014).

The early childhood subsector in Nigeria suggests circumstances in which such relationships are not automatically assumed. The National Policy on Education situates pre-primary provision in the framework of basic education and requires it to be inclusive, while primary schools are government-owned, and despite various recommendations on improving the technologies they use for learning, they are constrained by infrastructure, lack of power supply, high pupil-teacher ratios, and professional development programs that rarely include early years technology integration (Federal Republic of Nigeria, 2014). A competence deficit would be felt at scale as evident in Oyo State where 22,909 teachers were deployed in 2,411 public schools in the 3 senatorial districts as at 2023 and a further 5,600

were recruited in 2024. In the cases where devices are available, a similar pattern emerges in the international literature: conceptual knowledge of AT is generally high with limited technical skill and AT facilities (Lesar, 1998; Yoyon & Hermanto, 2025).

Three gaps follow. The empirical evidence that connects digital competence with innovative practice is limited to higher and secondary education and is mainly found in European or East Asian contexts, but it does not include the experiences of early childhood educators in sub-Saharan Africa (Astuti & Setiawan, 2023; Guillén-Gámez et al., 2021; Martínez-Rico et al., 2021). Where early childhood technology is the focus of a study, prevalence, attitudes and barriers have been documented but not a modelling of the predictive relationship between educator capability and innovative practice (Blackwell et al., 2013; Dore & Dynia, 2020; Murcia et al., 2018). In theory, the adoption of technology in education continues to be dominated by models that focus on acceptance and reach the stage of behavioural intention and/or self-reported use, with the pedagogical impact of adoption research remaining unexplored (Davis, 1989; Lau & Greer, 2022; Naseri & Abdullah, 2024; Venkatesh et al., 2003; Scherer et al., 2019). While the constructs of acceptance have been incorporated into the same predictive model as the framework of what competent technology use looks like in classroom practice, notably Technological Pedagogical Content Knowledge (TPCK) and Universal Design for Learning (UDL), this pathway has not been sufficiently researched, and so the line from acceptance to pedagogical innovation is often assumed rather than estimated (CAST, 2018; Mishra & Koehler, 2009). Conceptually, the use of digital competence and AT is conventionally studied separately and their relative contribution to innovative practice is not quantified. The same applies to the issue of whether or not teachers who innovate technologically also innovate inclusively, which is still not measured as a dimension of innovation in education, but rather as a construct separate from innovation in education (Burne et al, 2011; Lesar, 1998; Yoyon & Hermanto, 2025).

To fill these gaps, this study models the use of digital competence and assistive technology as concurrent predictors of innovative teaching within a single regression model, operationalises the outcome variable as pedagogical, technological and inclusive, and situates the analysis in the government-owned early childhood subsector of a Nigerian state. It takes the acceptance-centered adoption research one step further to pedagogical outcomes and provides effect estimates from a setting that does not exist in the international evidence base.

The study set to identify the level of Digital competence and extent of assistive technology use by early childhood educators in government owned primary schools in Oyo state, and the joint and relative influence of these variables on innovative teaching practices.

Research Questions

1. What is the level of digital competence among early childhood educators in government-owned primary schools in Oyo State?
2. What is the extent of assistive technology utilization among early childhood educators in government-owned primary schools in Oyo State?
3. To what extent do digital competence and assistive technology utilization jointly and relatively influence innovative teaching practices among early childhood educators in government-owned primary schools in Oyo State?

Research Hypotheses

The following null hypotheses were tested at the .05 level of significance.

H01: Digital competence does not significantly predict innovative teaching practices among early childhood educators in government-owned primary schools in Oyo State.
H02: Assistive technology utilization does not significantly predict innovative teaching practices among early childhood educators in government-owned primary schools in Oyo State.

Research Design

The descriptive survey design with correlational type was used. The appropriateness of the design was justified because the study employed a structured questionnaire to collect data from a large, geographically dispersed group that was not manipulated to measure naturally occurring associations between ATU, DC, and innovative practices (Fraenkel et al., 2019; Kerlinger & Lee, 2000; Pallant, 2020). Predictor variables were digital competence and utilization of assistive technology, while the criterion variable was innovative teaching practices.

Population

The target population were ECEs in government owned primary schools in Oyo state, Nigeria. An early childhood educator was a qualified teacher working as an early childhood educator while the study was conducted in a state owned school in their respective crèche, nursery or pre-primary, kindergarten or lower primary class. The Oyo State Ministry of Education, Science and Technology field survey in 2023 revealed a total of 22,909 teachers in 2,411 public schools with 8,469, 7,123 and 7,317 teachers in 873, 931 and 607 schools in Oyo Central, Oyo North and Oyo South local government areas respectively. The state government recruited an additional 5,600 teachers in 2024 and had an estimated population frame of 28,509.

Sample and Sampling Procedure

Using Krejcie and Morgan's (1970) table and applying it to a population of 28,509, a minimum sample size of 379 was determined. In order to compensate for the poor response rate and incomplete questionnaires, 450 questionnaires were sent and 412 valid questionnaires were kept for analysis, giving a valid return rate of 91.6%. A multi-stage process was used. The three senatorial constituencies in the State were treated as strata and the sample size allocated accordingly to the teaching strength per district in the State, that is, 152 for Oyo Central, 128 for Oyo North and 132 for Oyo South senatorial constituencies. Local Government areas and then schools were selected using simple random sampling within each district and the balloting method was used to the register of qualified ECDs in each school. All teachers in the sampling frame were thus given the same and independent likelihood of being selected, reducing selection bias and generalising to the larger population (Fraenkel et al., 2019; Kerlinger & Lee, 2000).

Instrumentation

The data were gathered through a structured self-report instrument, the Questionnaire on Digital Competence, Assistive Technology Utilization and Innovative Teaching Practices among Early Childhood Educators consisting of 59 items organized into four sections. The bio-data items in section A included six items: sex, age, highest qualification, years of teaching, class level taught and senatorial district. There were 53 Likert-type items on Sections B, C and D, with each section being developed from a previously validated instrument and, for the areas where there were validated instruments addressing preferred constructs, the researchers opted to modify existing instruments rather than creating new ones (DeVellis & Thorpe, 2022).

Section B – Digital Competence Scale contained 19 items that were developed and validated by Ergül and Taşar (2023), which returned a Kaiser-Meyer-Olkin value of .930, the confirmatory fit indices of the items were acceptable (comparative fit index = .98) and the internal consistency coefficient was .949. Items were modified in accordance with early years practice by replacing student references with references to children, rephrasing examples to refer to developmentally appropriate activities (including those in picture stories and digital portfolios), and restating one item about copyright instruction as a statement of the early years educator's ethical practice. The original frequency response format was used, with a fifth response category for Non-Use due to unfamiliarity, and a separate one for Non-Use due to familiarity of a technology.

Section C: Assistive Technology Utilization Scale consisted of 14 items adapted from the four factor structure of Interactivity, Objectives, Relevance and Efficacy, and Clarity of Guimarães et al., (2015) that explained 57.37% of the cumulative variance with an alpha coefficient of .822. Given the focus of the present study on how educators use assistive technology and not the evaluation of a single artefact, all 14 items were reformulated as first-person statements about the actual behaviour of the educator in selecting, implementing and adapting AT, and the original groupings of attributes were maintained. To ensure consistency across sections, the three-point scale of the source instrument was changed to a five-point Strongly Disagree to Strongly Agree scale.

The Innovative Teaching Practices Scale for Early Childhood Educators was comprised of 20 positively worded items that were synthesized from Technological Pedagogical Content Knowledge, Universal Design for Learning, and the Teaching-Innovate capacity-building framework (CAST, 2018; Dwivedi, 2024; Mishra & Koehler, 2009). There are three domains of innovative practice: Pedagogical Innovation (7 items), Technological Innovation (7 items) and Inclusive or Assistive Technology-Supported Innovation (6 items), each measured using the same five-point agreement scale, with no reversed-scored items. Scale and subscale scores were computed as item means and interpreted against a five-band framework: very low (1.00 to 1.49), low (1.50 to 2.49), moderate (2.50 to 3.49), high (3.50 to 4.49) and very high (4.50 to 5.00).

Validity

Face and content validity were determined by experts. Content validity index procedure of Lynn (1986) and Polit and Beck (2006) was used to determine the degree of relevance, clarity, simplicity and freedom from ambiguity of each item in Sections B, C and D by a panel of five experts from the fields of Early Childhood Education, Educational Technology, and Measurement and Evaluation, using a four point scale. The item-level content validity index was determined by dividing the number of experts who marked an item as "relevant" (codes 3 or 4) by the total number of experts. Items with a CIV < .78 were revised in accordance with the comments of the experts and re-rated. The scale-level content validity index, calculated by averaging, was .93 which is above the suggested CVI value of .90. The exercise is a continuation of the factorial evidence that already exists for the source instruments (Ergül & Taşar, 2023; Guimarães et al., 2015).

Reliability

To ensure that there was no contamination, ECEs were recruited from outside the main sampling frame and took part in a pilot to establish internal consistency (Nunnally & Bernstein, 1994). To calculate the Cronbach's alpha for each scale and subscale, IBM SPSS Statistics Version 26 was used. Table 2 gives the main administration's coefficient values. All values were equal or higher than .70, the criterion

recommended for adapted instruments (Field, 2018; Nunnally & Bernstein, 1994) and align with coefficients reported for the source instruments.

Data Collection Procedure

Questionnaires were conducted by the researcher using four trained research assistants for 6 weeks. Selected teachers were approached using a letter of introduction and following their consent, they were asked to nominate a suitable period for the administration. The instrument was completed by the respondents on the spot and copies were collected on the same day to increase the response rate. At screening, 450 scripts were given out with 38 of those being excluded because they had over 10% items unanswered.

Ethical Considerations

The study was conducted with the approval of the Federal College of Education (Special), Oyo. Permission was requested for both Oyo State Universal Basic Education Board and head teacher of each school involved. Participants were briefed on the purpose of the study, told that their participation was voluntary, that they could stop at any time without loss of their data and that responses would be anonymous and used only for academic research. Identifying data was not gathered and completed instruments were kept securely and only looked at by the research team.

Data Analysis

The data were checked for completeness, coded and analysed with IBM SPSS Statistics Version 26. Means and standard deviations were used to answer Research Questions 1 and 2 and interpreted in relation to the five bands. Multiple linear regression was used to test the Research Question 3 and the two null hypotheses, and Pearson product moment correlation was used to determine the bivariate structure of the variable and to check for multicollinearity. Benchmarks for the interpretation of the correlation magnitudes were those of Cohen (1988). Normal probability plots and scatterplots of standardised residuals were checked for regression assumptions, and tolerance and variance inflation factors (VIF) were examined to check, Field (2018); Pallant (2020). All inferential tests were carried out at the .05 alpha level. Responses of "Not Applicable" on the Digital Competence Scale were not scored and were substituted with the respondent's mean score on the other items scaled for the computation of scale scores and reliability coefficients.

Preliminary Analysis

Of the 450 questionnaires distributed, 412 were retained for analysis. Demographic characteristics are presented in Table 1. Reliability coefficients for the main administration are presented in Table 2.

Table 1: Demographic Characteristics of Respondents (n = 412)

Characteristic	Category	F	%
Sex	Male	79	19.2
	Female	333	80.8
Age (years)	Below 25	21	5.1
	25–34	114	27.7
	35–44	141	34.2
	45–54	103	25.0
	55 and above	33	8.0

Highest qualification	NCE	198	48.1
	B.Ed./B.A.(Ed.)/B.Sc.(Ed.)	161	39.1
	PGDE	21	5.1
	M.Ed./M.A.(Ed.)/M.Sc.(Ed.)	26	6.3
	Ph.D.	2	0.5
	Other	4	1.0
Teaching experience	1–5 years	74	18.0
	6–10 years	99	24.0
	11–15 years	95	23.1
	16–20 years	78	18.9
	21 years and above	66	16.0
Class level taught	Crèche/daycare	24	5.8
	Nursery/pre-primary	128	31.1
	Kindergarten	91	22.1
	Lower primary (Basic 1–3)	169	41.0
Senatorial district	Oyo Central	152	36.9
	Oyo North	128	31.1
	Oyo South	132	32.0

Note. All respondents were employed in government-owned primary schools. Percentages are rounded to one decimal place and may not total 100.

Table 2: Internal Consistency Reliability Coefficients for the Study Instrument

Scale and subscale	No. of items	α	Interpretation
Digital Competence Scale	19	.95	Excellent
Assistive Technology Utilization Scale	14	.88	Good
Interactivity	4	.80	Good
Objectives	4	.81	Good
Relevance and Efficacy	4	.80	Good
Clarity	2	.78	Acceptable
Innovative Teaching Practices Scale	20	.92	Excellent
Pedagogical Innovation	7	.85	Good
Technological Innovation	7	.86	Good
Inclusive/AT-Supported Innovation	6	.84	Good

Note. n = 412. Interpretation bands follow Field (2018).

Research Question 1: Level of Digital Competence

The item and scale statistics of the Digital Competence Scale are given in Table 3. The mean value for the overall scale was 3.19 (standard deviation = 0.70), in the moderate range. It was distributed symmetrically and platykurtic (skewness = 0.06, kurtosis = -0.54) and the scores ranged between 1.56 and 4.89. There was a lack of uniformity within the construct of competence. The educators rated themselves as most competent with the items that reflect the goal-directed selection and documentation of technology, such as aligning technology choice with the children's learning outcomes (M = 3.90), documenting and evaluating children's learning with technology (M = 3.72), and accommodating

individual differences in technology choice (M = 3.71). Reflective and generative uses, such as reflecting on or evaluating one's own learning using digital tools, were the other rating items with the lowest mean rating (M = 2.43) as well as the lowest item mean score (M = 2.72) for using digital technologies to develop creative thinking and implementing digital technologies in lesson planning. In this scale 601 out of the total responses (7.7%) were Not Applicable, meaning that a significant number of teachers had no familiarity with the technologies mentioned.

Table 3: Descriptive Statistics for the Digital Competence Scale

Item	N	M	SD	Level
1. Selects digital technologies suited to the topic or theme taught	390	3.30	1.02	Moderate
2. Uses digital technologies to develop children's creative thinking	386	2.72	1.03	Moderate
3. Ensures ethical and responsible use of digital materials	384	2.92	1.01	Moderate
4. Creates learning environments suited to individual differences	377	2.88	1.02	Moderate
5. Learns to use new digital technologies supporting development	377	3.20	1.02	Moderate
6. Joins online communities to learn innovative digital practices	383	3.50	0.98	High
7. Enables children to reflect on their learning using digital tools	386	2.43	1.00	Low
8. Creates digital learning materials for children	383	3.26	1.02	Moderate
9. Designs rich learning environments using digital technologies	377	3.01	1.00	Moderate
10. Uses different digital technologies in complementary ways	379	3.32	1.00	Moderate
11. Documents and evaluates learning using digital tools	379	3.72	0.97	High
12. Follows new digital technologies supporting children's learning	381	3.19	1.00	Moderate
13. Evaluates reliability of internet information sources	377	3.07	1.02	Moderate
14. Considers the learning outcome when choosing technologies	383	3.90	0.89	High
15. Uses digital technologies to ensure active participation	378	3.56	0.98	High
16. Considers individual differences when choosing technologies	384	3.71	0.96	High
17. Incorporates digital technologies into lesson or activity plans	376	2.72	1.04	Moderate
18. Provides instant feedback using digital technologies	373	2.98	1.01	Moderate
19. Uses digital technology to enhance collaboration among children	374	3.29	1.02	Moderate
Overall Digital Competence Scale	412	3.19	0.70	Moderate

Note. Item wording is abbreviated. Not Applicable responses were excluded from item-level scoring, so item n values vary. Bands: very low 1.00–1.49; low 1.50–2.49; moderate 2.50–3.49; high 3.50–4.49; very high 4.50–5.00.

Research Question 2: Extent of Assistive Technology Utilization

The Assistive Technology Utilization Scale item, subscale, and scale statistics are reported in Table 4. Overall utilization was 3.42 (SD = 0.63) which fell in the moderate range, and was distributed symmetrically (skewness = -0.09, kurtosis = -0.69). The attribute profile was helpful. Clarity returned

the highest subscale mean (M = 3.69, SD = 0.89), followed by Objectives (M = 3.50, SD = 0.80), both in the high band, while Interactivity (M = 3.33, SD = 0.79) and Relevance and Efficacy (M = 3.29, SD = 0.81) remained moderate. The pattern suggests that one can be more certain about what assistive technology will offer to children, than what they will do with it. The greatest single item was the use of assistive technology to encourage learning of taught content (M = 3.85); this was the only item in the scale to touch the low end of the scale (M = 2.92).

Table 4: *Descriptive Statistics for the Assistive Technology Utilization Scale*

Item and attribute	N	M	SD	Level
Interactivity				
1. Selects AT adequate to individual needs of children	412	3.31	1.01	Moderate
2. Uses AT to encourage active interaction and involvement	412	3.08	1.04	Moderate
3. Ensures easy access to content through AT provided	412	3.54	0.97	High
4. Uses AT to promote independence in operating the tool	412	3.38	0.99	Moderate
Subscale mean	412	3.33	0.79	Moderate
Objectives				
5. Uses AT to stimulate learning of content taught	412	3.85	0.97	High
6. Uses AT to help children learn new concepts	412	3.54	1.00	High
7. Uses AT allowing children to access information easily	412	3.31	1.03	Moderate
8. Selects AT with attractive and engaging presentation	412	3.31	1.03	Moderate
Subscale mean	412	3.50	0.80	High
Relevance and Efficacy				
9. Provides adequate AT resources for classroom use	412	3.31	1.04	Moderate
10. Uses AT to arouse children's interest in learning	412	3.31	1.03	Moderate
11. Uses AT to stimulate positive behaviour change	412	3.62	0.99	High
12. Uses AT to help children apply learning in new contexts	412	2.92	1.05	Moderate
Subscale mean	412	3.29	0.81	Moderate
Clarity				
13. Uses AT presenting information simply and understandably	412	3.77	0.95	High
14. Uses AT allowing children to reflect on content presented	412	3.62	1.02	High
Subscale mean	412	3.69	0.89	High
Overall ATUS	**412**	**3.42**	**0.63**	**Moderate**

Note. Item wording is abbreviated. AT = assistive technology. Attribute headings follow the four-factor structure of Guimarães et al. (2015). Bands as in Table 3.

Research Question 3 and Hypothesis Testing

The descriptive data and inter-correlation of study variables are shown in Table 5. The overall mean score for innovative teaching practices was 3.44 (SD = 0.62) which is in the moderate range, with Pedagogical Innovation highest (M = 3.50, SD = 0.71), followed by Inclusive or Assistive Technology-Supported Innovation (M = 3.46, SD = 0.75) and lowest on Technological Innovation (M = 3.36, SD = 0.74). There were significant and positive intercorrelations between all three variables at $p < .001$. The largest correlation (r = .52) occurred between digital competence and innovative teaching practices by the standards of Cohen (1988) and was followed by the utilization of assistive technology (r = .49).

Multicollinearity was not a problem because the predictors were only moderately correlated (r = .49), which is far below the level where multicollinearity can affect the regression estimates.

Table 5: *Descriptive Statistics and Intercorrelations among Study Variables*

Variable	M	SD	1	2	3
1. Digital competence	3.19	0.70	1.00		
2. Assistive technology utilization	3.42	0.63	.49**	1.00	
3. Innovative teaching practices	3.44	0.62	.52**	.49**	1.00
Pedagogical Innovation	3.50	0.71			
Technological Innovation	3.36	0.74			
Inclusive/AT-Supported Innovation	3.46	0.75			

Note. n = 412. AT = assistive technology. Diagonal entries are unities. Subscale means are reported for descriptive purposes and were not entered into the regression model. ** p < .001 (two-tailed).

To see the joint and relative effects of the predictors on innovative teaching practices, multiple linear regression was performed using enter method. Assumption checks were met: on visual inspection the standardised residuals were normally distributed and homoscedastic, with tolerance values and variance inflation factors of .76 and 1.32 respectively both within acceptable limits, and the Durbin-Watson statistic was of 1.97, which is within the acceptable range of 1.5 to 2.5; this confirms that the residuals were independent (Field, 2018).

Table 6: Model Summary and Analysis of Variance for the Regression of Innovative Teaching Practices on Digital Competence and Assistive Technology Utilization

Source	SS	Df	MS	F	p
Regression	54.15	2	27.08	106.97	< .001
Residual	103.53	409	0.25		
Total	157.68	411			

Note. R = .59; R^2 = .343; adjusted R^2 = .340; standard error of the estimate = 0.50; Durbin-Watson = 1.97. SS = sum of squares; MS = mean square.

The model was statistically significant, F(2, 409) = 106.97, p < .001, and the overall explained variance was 34.3% (R^2 = .343, adjusted R^2 = .340) for innovative teaching practices, which was explained by the model of digital competence and assistive technology utilization. This would leave about 65.7% of the variance unexplained by the model.

Table 7: Regression Coefficients for the Prediction of Innovative Teaching Practices

Predictor	B	SE B	B	T	P	Tolerance
(Constant)	1.38	0.15		9.45	< .001	
Digital competence	0.33	0.04	.38	8.14	< .001	.76
Assistive technology utilization	0.29	0.05	.30	6.54	< .001	.76

Note. n = 412. Criterion variable: innovative teaching practices. Variance inflation factor = 1.32 for both predictors.

Both predictors had statistically significant independent contributions. The larger standardized regression coefficient (β) was for digital competence (β = .38, t = 8.14, p < .001), followed by assistive

technology utilization ($\beta = .30$, $t = 6.54$, $p < .001$). Digital competence explained around 57.2% of variance and the use of assistive technology explained around 42.8% of variance. The unstandardised coefficients show that the four measures of digital competence are positively associated with innovative teaching practices when the level of assistive technology was held constant, while the four measures of assistive technology were positively associated with innovative teaching practices when the level of digital competence was held constant.

Thus, the hypothesis 1 (no significant differences between the digital competence and innovative teaching practices was rejected ($\beta = .38$, $p < .001$). Hypothesis 2 was also rejected ($\beta = .30$, $p < .001$) that the use of assistive technology was not significantly predictive of innovative teaching practices.

Discussion

While overall education sample participants' digital competence was not low, it is important to recognize that its internal profile is more relevant to the digital competence than the overall level. However, teachers did rate themselves relatively high in procedural/preparatory dimensions, including connecting technology to learning outcomes and keeping records of children's progress, and relatively poor in dimensions that involve giving the technology to the child, such as communicating with the child and inviting them to use the technology. It is the poorest performing item - allowing children to think back on or to assess their own learning using digital technologies - that is exactly what makes technology a delivery vehicle and technology a learning vehicle.

This is typical of the way professional exposure is structured and not necessarily a lack of ability. Digital skills acquired informally are often tied to tasks similar to those performed by adults in their productivity processes, and are generally weak in pedagogical translation zones (Astuti & Setiawan, 2023; Knezek et al., 2023). The results align with evidence that classrooms with digital technologies are often used for basic consumption activities rather than for integrated learning (Blackwell et al., 2014; Konca & Erden, 2021), and with the multidimensional conceptualisation of digital competence, in which technical competency and critical or generative competency are distinguishable rather than confused (Durán Cuartero et al., 2016; Masoumi & Bourbour, 2023; Van Laar et al., 2018). The 7.7% of Not Applicable responses brings a reminder of Blackwell et al.'s (2013) documented barriers to extrinsic access to technology for a measurable minority of educators: whether they have encountered the technology or not is the question.

The use of AT was also moderate and its attribute profile is similar to that for digital competence. Clarity and Objectives, the attributes related to the way content is presented using assistive technology, were rated higher than Interactivity and Relevance and Efficacy, which are related to what children do with it and whether or not that activity is transferable. Utilisation is focused at point of delivery rather than generalisation, as evidenced by the lowest rating attributed to the use of assistive technology to enable children to apply their learning in other contexts.

This may be read as a sign that AT is beginning to be seen as a way of accommodating rather than as a pedagogy. This is in line with what Lesar (1998) and Yoyon & Hermanto (2025) found, that educators' conceptual understanding of AT is often higher than the technical and applied skill and that the availability of the facilities is also a constraint. It also differs from those in which AT is used as a problem-solving device which fosters critical thinking and multimodal engagement (Felicia & Sharif, 2014), and from where measurable gains have been recorded when AT is used deliberately (Adebayo & Ayorinde, 2022; Burne et al., 2011). The difference is not that AT cannot have a positive impact but that it is in the implementation that it has its greatest impact, and this divergence serves to highlight this point (Johnston & Thompson, 2015; Plunkett et al., 2010; Sadao & Robinson, 2010).

The two predictors together explained 34.3% of the variance in innovative teaching practices. This is a significant effect for a model with just two predictors in a complex behavioral outcome. The finding shows that educator capability, rather than simply having devices, determines if innovation happens. It expands acceptance-oriented research by proving that the relationship applies not just to reported use but also to actual teaching practices. Technology acceptance research has found that perceived usefulness and self-efficacy predict adoption in various educational settings (Holden & Rada, 2011; Scherer et al., 2019; Siddiq & Scherer, 2016). The current result builds on this logic by looking at what educators do after they adopt technology (Davis, 1989; Venkatesh et al., 2003).

The fact that digital competence was a stronger predictor than assistive technology use makes sense. In the Technological Pedagogical Content Knowledge framework, digital competence reflects the overall intersection of technology and pedagogy that influences all technology-based practices. In contrast, assistive technology use is a narrower subset. Thus, digital competence is more likely to play a significant role in measures that include pedagogical, technological, and inclusive factors. This finding supports evidence that digital competence helps foster innovation in various institutions (Astuti & Setiawan, 2023; Bustos López & Gómez Zermeño, 2018; Jekabsone & Anohina-Naumeca, 2024) and shows that competence influences technology-related orientation largely regardless of demographic factors (Galindo-Domínguez et al., 2024).

Two additional observations deserve attention. First, the predictors were moderately correlated ($r = .49$). This suggests that digital and assistive competence are not the same but do overlap to some extent. Therefore, it's reasonable to consider them as part of a single area for professional development instead of separate training streams. Second, 65.7% of variance was left unexplained. Innovative practice is influenced by institutional and contextual factors that individual capability does not account for. These include leadership support, organizational climate, and access to resources—all identified by literature as critical factors in adoption (Awang et al., 2025; Lund & Stains, 2015; Riedner & Pischetola, 2021). In Nigerian public schools, for instance, infrastructure challenges likely limit the practices even competent educators can implement.

Contribution

The study provides evidence from a context that is underrepresented in the international literature on early childhood technology integration, which is mainly from European, North American and East Asian contexts (Dore & Dynia, 2020; Guillén-Gámez et al., 2021; Martínez-Rico et al., 2021; Murcia et al., 2018). It also makes a methodological contribution by modelling general and inclusive technology capability simultaneously; and by including inclusive innovation as a measurable dimension of innovative teaching practice, rather than a separate construct, thus enabling direct comparison of the weights of this capacity.

Implications

The results suggest that the marginal return on training may be greatest when teachers are trained to reflectively and generatively use technology, and least when they are trained to operate technology. In contrast, one-off workshops are less suitable for this purpose since they only provide limited and insufficient support for building agency (Kyza & Georgiou, 2025; Knezek et al., 2023).

Observations on assistive technology policy lead to the conclusion that presentation-oriented practice does not produce participation-oriented practice – and thus procurement will not produce inclusive innovation. Provision should be accompanied by implementation support for transfer of learning to new

contexts, alongside consideration of the limits of implementation that create non-use (Lesar, 1998; Yoyon & Hermanto, 2025).

A moderate correlation between the two capabilities makes it more feasible to consider digital and inclusive pedagogy together within a single competence framework in ECE teacher preparation to plan the curriculum (CAST, 2018; Mishra & Koehler, 2009).

The large unexplained variance is for school leadership to recognize that individual capability is within institutional boundaries. Some factors that facilitate innovation are created by leadership, such as collaborative structures, protected planning time and the fair allocation of resources (Awang et al., 2025; Riedner & Pischetola, 2021).

For implementing educational technology more generally, the findings warn against using the deployment of devices as an intervention. When competence is the limiting factor, capability investment can produce more pedagogical change at lower costs than investment in equipment (Blackwell et al., 2013; Donohue & Schomburg, 2014).

Limitations

These findings are subject to four limitations. Firstly, all constructs were self-reported with potential to bias against social desirability and/or between perceived and demonstrated competence, and would improve future estimates. Second, the cross-sectional design does not allow for conclusion as to causality, and the fact that innovative educators become competent, and not the other way around, must not be ruled out at this time. Second, the research was done in the government owned subsector of a single state and thus results from this study cannot be generalized to private and faith based subsector, or to other states in Nigeria, although probability sampling was used across the three senatorial districts. Fourth, institutional-level factors like leadership support and infrastructure quality and professional development were not included in the model and were found to be important by the unexplained variance.

Conclusion

The evidence suggests that creative teaching is dependent on the things that teachers can do, not what they are handed. Both measures of digital competence and the use of assistive technology alone and together accounted for a large proportion of the variance in innovative practice, with digital competence being more predictive than the inclusive one. The overall level of each capability was not as diagnostic as the internal structure of the capabilities: even though the educators' over-all level was generally higher in the preparatory and presentational dimensions of technology use, than in the reflective, generative and transfer-oriented dimensions of technology as a learning tool rather than a means of delivery, their level of competence in the former dimensions was more consistent than their level of competence in the latter. This asymmetry is found in general and inclusive, and it serves to pinpoint the developmental task. The study demonstrates that there is a measurable pedagogical return in a context where evidence of such return is lacking, and that the variation that cannot be explained involves conditions that are beyond the capacity of an individual to change.

Recommendations

1. The Oyo State Universal Basic Education Board should redesign in-service technology training of early childhood educators on the reflective and generative competencies that recorded the lowest ratings in the survey such as using technology to assess children's learning, use of

technology to develop creative thinking, embedding technology in lesson plan, etc., rather than adding on at the end of the lesson.

2. Implementation support for AT provision needs to include AT on transfer, where use was least, as this will be crucial to utilization. The allocation of training should be linked to a procurement decision, and not be considered a separate initiative.
3. Digital and inclusive pedagogy should be included in a competence strand in early childhood teacher preparation, without making the competence in assistive technology a choice for specialisation, consistent with the moderate association found between the two competencies.
5. School leaders should set up collaborative structures, including peer observation and professional learning communities focused on technology, since research has shown that non-formal exchange is instrumental to the development of competence, and that there is variance in competence development that can be explained by the school's institutional climate.
6. In public early childhood settings, a significant number of educators indicated that they were not familiar with any of the technologies described, suggesting access (but not skills) was the limiting factor for that group;
7. State and local education authorities should conduct an audit of assistive technology availability across all public early childhood settings to assess what is available in terms of access, and to determine if that is the limiting factor, or if it is not, to determine if the limiting factor is skills.

Future research needs to expand the model to include institutional predictors, use observational or performance-based assessments of competence, and use a longitudinal or quasi-experimental design that would allow for the establishment of directionality.

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