

Influence of Tablet-Assisted Instruction on Learning Engagement and Numeracy Achievement of Preschool Pupils In Rivers State East Senatorial District

AKE, Vera Chimaobim (PhD)

Department of Early Childhood and Primary Education

Vera.ake@iaue.edu.ng

verachimaobim@gmail.com

+2348067070046

&

Anne Chidinma WILLIAMS (PhD)

Faculty of Education, Ignatius Ajuru University of Education

Port Harcourt, Rivers State, Nigeria.

Department of Educational Technology

anne.williams1@iaue.edu.ng,

+2349114574811

Abstract

This study investigated the influence of tablet-assisted instruction on learning engagement and numeracy achievement of preschool pupils in Rivers State, East Senatorial District. A quasi-experimental research design was employed, involving 220 preschool pupils drawn from intact classes in selected public preschools. The experimental group received tablet-assisted instruction, while the control group continued with conventional teacher-centered methods. Data were collected using a Learning Engagement Observation Checklist and a Numeracy Achievement Test, both validated for reliability. The experimental group participated of tablet-based instruction using educational applications and guided exercises aligned with the preschool numeracy curriculum. Pretests and posttests were administered to measure engagement and numeracy outcomes, and data were analyzed using descriptive and inferential techniques. Findings revealed that pupils exposed to tablet-assisted instruction demonstrated substantially higher gains in both learning engagement and numeracy achievement compared with those taught using teacher-centered methods. The results indicate that tablet-assisted instruction effectively promotes active participation, attention, and mastery of foundational numeracy concepts among preschool pupils. The study concludes that integrating tablet-assisted instructional strategies can significantly enhance early childhood learning outcomes. It recommends that teachers incorporate tablet-based activities into daily lessons, receive training on educational technology, and that schools ensure access to digital resources to optimize preschool education.

Keywords: Tablet-Assisted Instruction, Learning Engagement, Numeracy, Numeracy Achievement and Preschool Education

Introduction

It is crucial for preschoolers to learn certain skills in early childhood education, like language and literacy, as these will help them grow and make a seamless transition to primary school.

Early childhood represents a critical period during which children's curiosity, attention, and active participation shape the foundations of lifelong learning, particularly in numeracy development, where early competence is strongly associated with later academic achievement (Anggun et al., 2025). At this stage, children learn best through experiences that are concrete, interactive, and responsive to their developmental needs. In contemporary preschool environments, tablet-assisted instruction has emerged as a prominent instructional approach, offering interactive, play-based, and visually engaging learning experiences that align with how young children explore and make sense of their world. When appropriately guided by teachers, tablet use has the potential to enhance learning engagement and support numeracy achievement more effectively than traditional instructional approaches alone. As digital technologies increasingly permeate early childhood classrooms, examining their educational influence has become both timely and imperative (Onuegbu et al., 2025)

Learning engagement refers to the degree of attention, curiosity, interest, and active participation that learners demonstrate during the learning process (Bergdahl & Bond, 2022). In early childhood education, learning engagement is especially critical because it reflects how deeply preschool pupils are involved in learning activities, how long they sustain attention, and how positively they respond to instructional experiences. Engaged preschool pupils are more likely to develop foundational skills, including early numeracy, and to cultivate positive learning dispositions that extend into later schooling. Importantly, learning engagement does not reside solely within the child; rather, it emerges from the dynamic interaction between the learner and the learning environment (Wong & Liem, 2021). Instructional methods, learning materials, and teacher facilitation jointly shape the extent to which young learners are motivated, attentive, and actively involved in classroom activities.

Instructional approaches in preschool classrooms differ substantially in how they foster learning engagement. Teacher-centered instruction, which remains prevalent in many Nigerian preschools, including those in Rivers State, typically emphasizes direct teaching, repetition, and whole-class activities. While this approach may support classroom order and curriculum coverage, it often provides limited opportunities for exploration, interaction, and child-initiated learning, which are essential for sustaining engagement among young learners (Wong & Liem, 2021).

In contrast, tablet-assisted instruction introduces multimedia, interactive applications that allow preschool pupils to touch, manipulate, and respond to learning content in real time. Such features can stimulate interest, sustain attention, and promote active participation, key indicators of learning engagement in early childhood. Comparing the learning engagement level of preschool pupils taught using tablet-assisted instruction with those taught using teacher-centered instruction is therefore crucial for understanding how different pedagogical approaches shape children's involvement in learning activities.

Learning engagement is commonly conceptualized as a multidimensional construct encompassing behavioral, emotional, and cognitive dimensions (Xu et al., 2023). Behavioral engagement is reflected in pupils' on-task behavior, participation, and persistence in learning activities. Emotional engagement involves interest, enjoyment, and positive emotional responses during learning experiences, while cognitive engagement refers to pupils' willingness to think, explore, and invest effort in understanding learning tasks beyond surface participation. In the context of preschool education, these dimensions provide a robust framework for assessing how instructional approaches influence pupils' involvement in numeracy learning activities. Applying this framework allows for a nuanced examination of how tablet-assisted instruction and teacher-centered instruction differentially affect preschool pupils' engagement during classroom learning.

Empirical studies have increasingly demonstrated the potential of digital technologies to enhance engagement in early childhood settings. Miller (2018) found that although interactive mathematical applications on iPads did not produce statistically significant gains in number-sense achievement, they promoted collaboration and engagement in play-based kindergarten classrooms. Otterborn et al. (2019) reported high levels of engagement with digital tablets in preschools, particularly in activities involving problem-solving, design, construction, and creativity. Similarly, Rogowsky et al. (2017) observed that playful learning through educational software significantly enhanced literacy and numeracy outcomes among preschoolers. These findings suggest that while achievement gains may vary, tablet-based instruction consistently supports engagement, interaction, and active learning among young children.

Numeracy refers to the knowledge and understanding of numbers and their use. It encompasses number sense, operational skills, computation, measurement, and geometry (Umoh et al., 2023). Numeracy abilities lay the groundwork for future mathematical understanding, which will result in aptitude for scientific and technological growth (Adedigba, 2023). Numeracy achievement in preschool children refers to the acquisition of basic mathematical skills such as counting, number recognition, quantity discrimination, addition, and subtraction, which form the foundation for later mathematical learning (Juhaevah et al., 2025). Several studies have reported positive effects of technology-assisted instruction on early numeracy development. Umoh et al. (2023) revealed that pupils exposed to computer-assisted instruction performed better in numeracy skills than those taught using the traditional chalk-and-talk method. Papadakis et al. (2018) found that pupils taught using tablet-assisted instruction outperformed those taught with personal computers or conventional methods, with no significant gender differences. Lee and Choi (2020) further demonstrated that a tablet-based math game intervention significantly improved early numeracy skills among children, particularly in number identification, quantity discrimination, addition, and subtraction. At a broader level, Juhaevah et al. (2025) reported through a meta-analysis that educational media significantly improved early numeracy skills. However, computer-based instruction appeared more effective than tablet-based approaches in some contexts.

Despite the growing body of evidence on tablet-assisted instruction and early numeracy, notable gaps remain. Most existing studies have been conducted in developed countries or outside the Nigerian context, with limited attention to preschool settings in Rivers State, particularly within the East Senatorial District. Moreover, many studies focus primarily on achievement outcomes without simultaneously examining learning engagement as a complementary construct that mediates learning. There is also a scarcity of empirical research that directly compares tablet-assisted instruction with the teacher-centered instructional method commonly used in Nigerian preschools. This study, therefore, seeks to fill these gaps by empirically investigating the influence of tablet-assisted instruction on both learning engagement and numeracy achievement among preschool pupils in the East Senatorial District of Rivers State.

Statement of the problem

In early childhood education today, the use of technology in teaching and learning is becoming increasingly common. Tablet-assisted instruction (TAI) has emerged as a practical approach to making learning more interactive and engaging for preschool pupils. Using tablets in the classroom can help young children develop basic numeracy skills, encourage curiosity, and support learning that is tailored to each child's pace. Tablets also have the potential to improve focus and attention, which can contribute to better learning outcomes. However, the use of TAI in preschool classrooms is still inconsistent, and little is known about how it affects children's participation, engagement, and understanding of numeracy concepts compared to traditional teaching methods.

Understanding how TAI influences these aspects is important because preschool is a critical period for building foundational skills. Without effective engagement and teaching strategies, children may struggle with essential numeracy skills. This study, therefore, aims to explore how tablet-assisted instruction affects learning engagement and numeracy achievement among preschool pupils in Rivers State East Senatorial District.

Aim and Objective

This study aims to investigate the influence of tablet-assisted instruction on learning engagement and numeracy achievement of preschool pupils in Rivers State, East Senatorial District. Specifically, the objectives of this study are as follows: to

1. determine the learning engagement level of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions.
2. determine the numeracy achievement of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions.

Research Questions

The following research questions were used to guide this study

1. What is the learning engagement level of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instruction?
2. What is the numeracy achievement of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instruction?

Hypotheses

The following hypotheses were formulated and tested at a 0.05 level of significance:

1. There is no significant difference in the learning engagement level of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions.
2. There is no significant difference in the numeracy achievement of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions.

Methodology

This study adopted a quasi-experimental research design to examine the influence of tablet-assisted instruction on learning engagement and numeracy achievement of preschool pupils. The study population comprised 1,200 preschool pupils aged 4 to 6 years enrolled in 12 preschools across Rivers State East Senatorial District. The sample comprised two hundred and twenty (220) preschool pupils drawn from intact classes in selected public preschools within the Rivers State East Senatorial District. A purposive sampling technique was employed to select schools with similar class sizes, learning environments, and access to instructional resources. Within the selected schools, intact classes were used to form the study groups, with 103 pupils in the experimental group receiving tablet-assisted instruction and 118 pupils in the control group receiving conventional teaching. Using intact classes ensured that normal classroom dynamics were maintained and minimized disruption to regular school routines. Data were collected using a Learning Engagement Observation Checklist and a Numeracy Achievement Test (NAT). The observation checklist measured engagement in behavioral, cognitive, and emotional domains, while the NAT assessed foundational numeracy skills such as counting, addition, subtraction, and pattern recognition. Both instruments were validated by experts in early childhood education, and a pilot study involving 30 pupils outside the study sample was conducted to determine reliability. The Cronbach's alpha method was used to establish the internal consistency of the observation checklist, yielding a coefficient of 0.82, while the Kuder-Richardson 21 (KR-21) formula was used to determine the reliability of the Numeracy Achievement Test, yielding a coefficient of 0.88, indicating that both instruments were reliable for the study. The experimental group received tablet-assisted instruction for six weeks, using Lingokids, Endless Numbers, and guided digital exercises aligned with the preschool numeracy curriculum, while the control group continued with standard teaching practices. Pre-tests were administered to establish baseline engagement and numeracy performance, and post-tests were conducted to measure learning gains. Mean, standard deviation, and percentages were used to answer the research questions, and ANCOVA was used to determine significant differences between groups.

Results

Research Question 1: What is the learning engagement level of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instruction?

Table 1: Mean and standard deviation of learning engagement level of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions

Methods		Pre-Engagement	Post-Engagement	Mean Gain
tablet-assisted instruction	Mean	15.5534	29.6699	14.1165
	N	103	103	103
	Std. Deviation	1.80809	4.52745	4.65538
teacher-centered instruction.	Mean	14.5299	19.8120	5.2821
	N	117	117	117
	Std. Deviation	2.76547	5.61852	6.11082

Table 1 indicates that preschool pupils taught using tablet-assisted instruction recorded a mean gain in learning engagement of 14.1165 with a standard deviation of 4.65538, whereas those taught using teacher-centered instruction recorded a lower mean gain of 5.2821 with a standard deviation of 6.11082. The higher mean gain observed for the tablet-assisted instruction group shows a substantially greater improvement in learning engagement from pre-engagement to post-engagement compared with the teacher-centered instruction group. The large difference in mean gain scores suggests that tablet-assisted instruction was more effective in enhancing the learning engagement of preschool pupils than the teacher-centered instructional approach.

Research Question 2: What is the numeracy achievement of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instruction?

Table 2: Mean and standard deviation of numeracy achievement of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions

Methods		Pretest	Posttest	Mean Gain
tablet-assisted instruction	Mean	8.7476	15.5534	6.8058
	N	103	103	103
	Std. Deviation	1.36998	1.80809	2.40937
teacher-centered instruction.	Mean	8.6239	9.5299	.9060
	N	117	117	117
	Std. Deviation	1.42470	2.40536	2.68130

Table 2 indicates that preschool pupils taught using tablet-assisted instruction recorded a mean gain in numeracy achievement of 6.8058 with a standard deviation of 2.40937, whereas those taught using teacher-centered instruction recorded a much lower mean gain of 0.9060 with a standard deviation of 2.68130. The higher mean gain observed for the tablet-assisted instruction group shows a substantially greater improvement in numeracy achievement from pretest to posttest compared with the teacher-centered instruction group. The large difference in mean gain scores suggests that tablet-assisted instruction was more effective in enhancing numeracy achievement than the teacher-centered instructional approach.

Hypothesis 1: There is no significant difference in the learning engagement level of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions.

Table 3: ANCOVA Analysis of significant difference in the learning engagement level of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions

Tests of Between-Subjects Effects

Dependent Variable: Post Engagement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5361.234 ^a	2	2680.617	101.791	.000	.484
Intercept	2568.255	1	2568.255	97.524	.000	.310
Pre Engagement	38.038	1	38.038	1.444	.231	.007
Methods	4899.532	1	4899.532	186.049	.000	.462
Error	5714.602	217	26.335			
Total	142348.000	220				
Corrected Total	11075.836	219				

a. R Squared = .484 (Adjusted R Squared = .479)

Table 3 reveals an F value of $F(1, 217) = 186.049$, $p = .000$ ($p < .05$) for the effect of instructional method on the posttest learning engagement level of preschool pupils after controlling for pretest engagement scores. This result indicates a statistically significant difference in the learning engagement of pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions. The Partial Eta Squared value of .462 indicates that the instructional strategy had a large effect on preschool pupils' learning engagement.

Hypothesis 2: There is no significant difference in the numeracy achievement of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions.

Table 4: ANCOVA Analysis of significant difference in the numeracy achievement of preschool pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions

Tests of Between-Subjects Effects

Dependent Variable: Posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1987.466 ^a	2	993.733	214.656	.000	.664
Intercept	860.039	1	860.039	185.777	.000	.461
Pretest	.017	1	.017	.004	.952	.000
Methods	1983.042	1	1983.042	428.356	.000	.664
Error	1004.584	217	4.629			
Total	36547.000	220				
Corrected Total	2992.050	219				

a. R Squared = .664 (Adjusted R Squared = .661)

Table 4 reveals an F value of $F(1, 217) = 428.356, p = .000 (p < .05)$ for the effect of instructional method on the posttest numeracy achievement of preschool pupils after controlling for pretest scores. This result indicates a statistically significant difference in the numeracy achievement of pupils taught using tablet-assisted instruction and those taught using teacher-centered instructions. The Partial Eta Squared value of .664 indicates that the instructional strategy had a large effect on preschool pupils' numeracy achievement.

Discussion of Results

The findings of this study demonstrate that tablet-assisted instruction substantially enhanced the learning engagement of preschool pupils compared with the teacher-centered instructional approach. As shown in Table 1, pupils exposed to tablet-assisted instruction recorded a markedly higher mean gain in learning engagement than their counterparts taught using teacher-centered methods, indicating a greater improvement from pre-engagement to post-engagement. This descriptive result is further strengthened by the ANCOVA outcome in Table 3, which revealed a statistically significant effect of instructional method on post-engagement scores after controlling for pre-engagement levels. The large effect size (Partial Eta Squared = .462) suggests that the observed difference is not only statistically significant but also educationally meaningful, thereby confirming the effectiveness of tablet-assisted instruction in fostering active engagement among preschool pupils. These findings are consistent with prior empirical evidence emphasizing the role of digital technologies in promoting engagement in early childhood learning contexts. Miller (2018) reported that interactive tablet applications, while yielding mixed results in achievement, significantly supported collaboration and engagement in play-based classrooms. Similarly, Otterborn et al. (2019) observed high levels of learner engagement in preschool settings where tablets were used for problem-solving, creative design, and exploratory activities. Rogowsky et al. (2017) also found that playful learning supported by educational software enhanced active participation and learning outcomes among young children. The present study aligns with these findings by demonstrating that tablet-assisted instruction creates interactive and stimulating learning environments that sustain pupils' attention and involvement.

The findings of this study demonstrate that tablet-assisted instruction significantly enhanced the numeracy achievement of preschool pupils compared with the teacher-centered instructional approach. As indicated in Table 2, pupils taught using tablet-assisted instruction recorded a substantially higher mean gain in numeracy achievement than those taught through teacher-centered methods, reflecting a greater improvement from pretest to posttest. This descriptive evidence is further reinforced by the ANCOVA result presented in Table 4, which revealed a statistically significant effect of instructional method on posttest numeracy achievement after controlling for pretest scores. The large effect size (Partial Eta Squared = .664) indicates that the difference observed is not only statistically significant but also of considerable educational importance, confirming the effectiveness of tablet-assisted instruction in improving preschool pupils' numeracy outcomes. These findings are largely consistent with existing empirical studies that highlight the positive impact of digital and technology-based instruction on early numeracy development. Umoh et al. (2023) found that pupils exposed to computer-assisted instruction achieved significantly higher numeracy performance than those taught using traditional chalk-and-talk methods. Similarly, Papadakis et al. (2018) reported that tablet-assisted instruction produced superior numeracy outcomes compared with both personal computer-based and conventional instructional approaches. Lee and Choi (2020) also demonstrated that tablet-based mathematics games significantly improved early numeracy skills, particularly in core areas such as number identification, quantity discrimination, addition, and subtraction. At a broader level, the meta-analysis by Juhaevah et al. (2025) supports the general effectiveness of educational media in enhancing early numeracy skills, although it suggests that computer-based instruction may be more effective than tablet-based approaches in certain contexts. In contrast to this nuanced finding, the present study provides strong empirical evidence that tablet-assisted instruction, when appropriately integrated into preschool classrooms, can yield substantial gains in numeracy achievement beyond those achieved through teacher-centered instruction alone.

Conclusion

The results of this study show that tablet-assisted instruction is highly effective in improving both learning engagement and numeracy achievement among preschool pupils. Children who participated in tablet-based lessons demonstrated significantly higher gains in engagement and numeracy compared with those taught using traditional teacher-centered methods. The statistical analyses further confirmed that these differences were significant and meaningful, highlighting the strong impact of technology-enhanced learning in early childhood classrooms. In summary, the findings suggest that incorporating tablets into preschool teaching not only captures pupils' attention but also supports deeper understanding and mastery of basic numeracy concepts.

Recommendations

Based on the study's findings, the following recommendations are proposed:

1. Preschool teachers should incorporate tablet-based instructional activities into their daily lessons to boost engagement and learning outcomes.
2. Professional development programs should be provided to equip teachers with the skills needed to effectively use tablets and educational applications.
3. Schools should ensure that tablets, relevant educational software, and supporting materials are readily available for classroom use.
4. Tablet-assisted activities should be carefully aligned with preschool numeracy objectives to maximize learning relevance and effectiveness.

5. Teachers should regularly monitor pupils' engagement and numeracy performance to track progress and refine teaching strategies.
6. Education authorities should encourage and support the use of digital tools in early childhood education, recognizing their potential to enhance both engagement and foundational numeracy skills.

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