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Effect Of Age On Engagement, Academic Performance, And Retention Of Students Taught Computer-In-Education Concepts In South-South Nigeria

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ABSTRACT
This study investigated the effect of age on various aspects of student engagement, academic performance, and retention of knowledge when taught Computer-in-Education concepts in universities within South-South Nigeria. This study adopted pretest, posttest, non-randomized quasi-experimental and descriptive design. Three research questions and three hypotheses guided the study. The population of this study was 2,873 undergraduate students (200, 400L). The sample consists of 235 undergraduate students obtained using a multi-stage sampling technique. The instruments, used for data collection were Learning Platform Self-Engagement Scale (LPSES), Computer-in-Education Performance Test (CPT), and Computer-in-Education Retention Test (CRT). Cronbach Alpha formula was used to obtain a reliability coefficient of 0.87 for the LPSES, while Kudar Richardson 21 formula was used to obtain reliability coefficients of 0.86 for CPT and 0.84 for CRT. Data collected were analysed using descriptive statistics of mean and standard deviation, while Analysis of Covariance (ANCOVA) was used to test hypotheses at 0.05 level of significance. Findings revealed that students with an age range of 30-33 had the highest level of engagement in the teaching modes. It further revealed that students in the age range 26-29 had the highest academic performance. Similarly, students in the age range 34 & above had higher retention when compared to other age ranges. The study, therefore, recommended amongst other e-tutors, lecturers should design engagement strategies that are universally effective across all age groups, as age does not significantly influence students' engagement levels, ensuring inclusive participation and interaction for all learners.

Keywords: Engagement, Academic Performance, Retention, Age, Computer-in-Education, e-learning

INTRODUCTION

According to Heilporn, Lakhal, and Belisie (2021), students' engagement necessitates interactive and participatory learning experiences that enhance motivation and involvement. Similarly, Oreta (2020) posits that student engagement in an online Learning Management System (LMS) environment is facilitated through teaching presence, social presence, and cognitive presence. Students are particularly engaged with LMS features, notably on platforms like Canvas and Moodle because these tools are designed to foster engagement through various functionalities such as announcements, quizzes, discussion boards, and conferences. This increased engagement can potentially translate to improved academic performance.

Wentling (2015) defined academic performance as the achievement of an individual's objectives for various types of knowledge and skills. In this contest, objectives are established based on the age, prior learning and capacity of individuals in education, socialization and qualification. Presenting evidence of learning should be

an important landmark in the journey towards lifelong learning and capabilities. Academic performance is widely recognized as a critical indicator for assessing the effectiveness of educational programs. In evaluating education systems, researchers frequently focus on academic outcomes to gauge success and identify factors that influence student achievement. Performance in examinations, for instance, serves as tangible evidence of learning. Academic performance also encompasses learners' overall fulfilment of institutional academic standards, reflecting their ability to retain and apply the knowledge acquired through instruction. This measure underscores the expectation that students demonstrate mastery of taught content, aligning their achievements with the objectives set by educational institutions. Retention is the ability for someone to retain information in their long-term memory for easy recall. Repetition of learning resources and activities such as test questions is another key to mastery of the subject or what is being taught. When instructors employ diverse instructional channels—such as video-based, audio-based, or blended approaches—they cater to the varied learning preferences of students. Learning is demonstrated through improved performance, which arises as students engage in tasks, acquire new skills, and repeatedly practice them, thereby strengthening retention. This aligns with the understanding that behavioural changes are driven by learning to enable students to perform more effectively over time. Increased involvement in tasks enhances retention levels for both male and female students, emphasizing the role of active participation in reinforcing knowledge and skills.

Gender is usually seen to have a reasonable influence on students' academic performance in STEM subjects. Gender is the range of physical, biological, mental, and behavioural characteristics in differentiating males from females (boys and girls). Gender may have an impact on the students' engagement, academic performance, and retention especially in STEM subjects such as Information and Communication Technology (ICT) in Computer Science (Computer-in-Education), this course is a compulsory course for all students in the Faculty of Education in all Federal University where they have Faculty of Education, it is to enhance and broaden the IT skills and how they in return become digital natives to find relevance in the 21st century

The use of digital technology has influenced every facet of human life; more especially, the educational sector; observable impact has been made on how business ventures are imagined and brought to reality due to regular digital tools in the market. Various technological tools were used for instructional purposes such as; smart devices, mobile computing, cloud computing, and usage of social media platforms. The diffusion of technology has created avenues for developing entrepreneurial projects by leveraging collaboration and collective intelligence (Elia, Margherita, & Passiante, 2020). The advancements of digital technology facilitated more innovative ways for learning to continue irrespective of physical school closure.

Higher Education constitutes the post-secondary level of a national education system, encompassing institutions such as universities, polytechnics, colleges of technology, and colleges of education. The objectives of universities in Nigerian Higher Education are the acquisition of both physical and intellectual skills which will enable individuals to develop into useful members of the society; and to develop intellectual capacities of individuals to understand and appreciate the environment. Higher education plays a critical role in every economy due to knowledge explosion. How can Higher Education, especially the university students, which is the interest of the researcher, acquire skills that will aid them to transform their immediate environment without engaging in best global practices thereby creating a paradigm shift from what used to be (traditional) to what is now and the future (e-learning/ blended learning), with the hope of adoption and implementation of LMS? Higher education through e-learning mode of teaching and learning to meet the demands and competition of students especially in Nigeria.

Computer-in-Education course is the same terminology as Information, Communication and Technology in Education (ICT) in various universities in the South-South region. This course is designed to acquaint students with the fundamentals and usage of computers, its functionalities, and interactions with online activities: and also, how students can be digitalized to interact globally with online platforms for self-development. This course is compulsory for all Faculty of Education students in Federal universities, especially in the South-South region.

Statement of the Problem

Traditional teaching methods may not cater to the diverse needs of different age groups, leading to varying levels of success and engagement among students. In South-South Nigeria, this challenge is particularly

pronounced, as the region continues to embrace digital education. Despite the growing importance of computer-based learning, there is a lack of comprehensive research on how age impacts students' interaction with and mastery of these concepts. This gap in knowledge hinders the development of effective, age-appropriate teaching strategies that can enhance learning outcomes for all students. The persistent disparities in engagement, academic performance, and retention across age groups underscore the need for a deeper understanding of these dynamics. The study aims to investigate the extent to which age influences student engagement, academic performance, and retention in Computer-in-Education courses. By examining these factors, the research seeks to provide insights that can inform the design and implementation of more effective, tailored teaching methods. Ultimately, the goal is to improve educational outcomes and ensure that students of all ages can thrive in the digital learning environment.

Aim and Objectives of the Study

The study aimed to investigate the effect of age on various aspects of student engagement, academic performance, and retention of knowledge when taught Computer-in-Education concepts in universities within South-South Nigeria. Specifically, the objectives of the study were to:

1. investigate the influence of age on the engagement level of students taught Computer-in-Education concepts in South-South Nigeria.
2. Examine the influence of age on the academic performance of students taught Computer-in-Education concepts in South-South Nigeria.
3. Investigate the influence of age on the retention of students taught Computer-in-Education concepts in universities in South-South Nigeria.

Research Questions

The following research questions guided the study based on the stated objectives:

1. What is the difference among engagement levels of students of different age ranges in Computer-in-Education concepts in South-south Nigeria?

2. What is the difference in academic performance of students of different age ranges in Computer-in-Education concepts in South-South Nigeria?

3. What is the difference among retention of students of different age ranges in Computer-in-Education concepts in South-South Nigeria?

Hypotheses

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

H_{01}. Age does not significantly influence the engagement level of students taught Computer-in-education concepts in South-South Nigeria.

H_{02}. Age does not significantly influence the academic performance of students taught Computer-in-Education concepts in South-South Nigeria.

H_{03}. Age does not significantly influence the retention of students taught Computer-in-education concepts in South-South Nigeria.

METHODS AND MATERIALS

This study adopted Pretest, Post-test, non-randomized quasi-experimental design. The population for this study comprised 2,873 undergraduate students, (200, 400 Level), who offered the course Computer-in-Education for the 2023/2024 academic session in the three selected Federal Universities in South-South Nigeria. The sample size of this study comprised two hundred and thirty-five (235) undergraduate students of Faculty of Education drawn from intact classes in three Federal Universities in South-South Nigeria. This was made up of 47 students Department of Curriculum Studies and Educational Technology for experimental group 1 (University of Port Harcourt), 17 students from Department of Educational Technology experimental group 2 (University of Calabar), and 171 students from Department of Educational Technology for control group (Federal University Otuoke). These samples arrived as all students in Faculty of Education in the selected Universities in South-South Nigeria offer Computer-in-Education. The multi-stage sampling procedure was used to obtain the sample for this study as more than one sampling technique was adopted at various stages of selection. Three researcher-developed and validated instruments for data collection for this study included; the Learning Platform Self-

Engagement Scale (LPSES), Computer-in-Education Performance Test (CPT) and Computer-in-Education Retention Test (CRT) with reliability coefficients of 0.87, 0.86 and 0.84 obtained using Cronbach Alpha and Kuder Richardson-21 (KR-21) formula respectively. The method of data collection was carried out in phases. The researcher sought permission to access the students, as well as some facilities in the selected schools (departments), and course lecturers. This letter was for onward communication to the departments under the study, requesting permission to access relevant data. Permission was granted, and the researcher was subsequently introduced to the Heads of Departments and the lecturers teaching the courses in the various schools, as well as to the affected students in the schools. This phase involved the administration of LPSES, CPT, and CRT as pre-tests to both experimental groups and control groups to ascertain baseline knowledge of the students. Thereafter, treatments commenced and lasted for five weeks (5) weeks which enabled the research assistants to complete the chosen contents for three of the groups. At the end of the treatments, the items from the instruments were re-organized and re-administered to the same students. The scores obtained from the second administration of the instrument served as the post-test scores of this study. The reason for the re-organization was to distract the students from realizing that the questions were the same, and the test items were the same for both experimental and control groups. The pre-test scores were compared to find out if both experimental and control groups were equivalent before exposure to treatment. The post-test achievement scores were compared with pre-test achievement scores to determine the effect size of treatments. The data for this study was collected through the administration and scoring of LPSES, CPT, and CRT. Descriptive statistics of means and standard deviation were used to answer the researcher's questions while Analysis of Co-variance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

RESULTS

Research Question 1: *What is the difference among the engagement levels of students of different age ranges?*

Table 1: Mean and Standard deviation values of students' engagement level classified by Age Range

Age		Pretest Engagement	Post Test Engagement	Mean Gain (Mg) (Engagement)
18-21	Mean	2.7552	3.1201	0.3649
	Std. Deviation	0.4350	0.4770	0.5982
	N	69	69	69
22-25	Mean	2.6117	3.1114	0.4997
	Std. Deviation	0.5688	0.4756	0.7490
	N	114	114	114
26-29	Mean	2.5650	3.1069	0.5419
	Std. Deviation	0.6188	0.4896	0.6926
	N	48	48	48
30-33	Mean	2.7900	3.3800	0.5900
	Std. Deviation	0.4151	0.0173	0.4004
	N	3	3	3
34 & Above	Mean	3.5700	3.5300	-0.0400
	Std. Deviation	--	--	--
	N	1	1	1
Total	**N**	**235**	**235**	**235**

Table 1 reveals that the students of 18-21 age range had a mean gain of 0.37 and standard deviation of 0.60 (Mg = 0.37, SD = 0.60), the students of 22-25 age range had a mean gain of 0.50 and standard deviation of 0.75 (Mg = 0.50, SD = 0.75), the students of 26-29 age range had a mean gain of 0.54 and standard deviation of 0.69 (Mg = 0.54, SD = 0.69), the students of 30-33 age range had a mean gain of 0.59 and standard deviation of 0.40 (Mg = 0.59, SD = 0.40), the student of 34 & Above age range had a mean gain of -0.04 and standard deviation of 0.00 (Mg = -0.04, SD = 0.00).

These results shows that the students of 30-33 age range had the highest level of engagement, followed by the students of 26-29 age range, followed by the students of 22-25 age range, followed by the students of 18-21 age

range, followed by the students of 34 & Above age range which had the least engagement level. This indicates that the students of 30-33 age range had the highest level of engagement when compared with students of other age ranges.

Research Question 2: *What is the difference in the performance of students of different age ranges?*

Table 2: Mean and Standard deviation values of students' performance classified by Age

Age		Pretest	Post Test	Mean Gain (Mg) (Performance)
18-21	Mean	16.1304	30.0290	13.8986
	Std. Deviation	5.7290	7.3143	6.2147
	N	69	69	69
22-25	Mean	15.6579	31.7807	16.1228
	Std. Deviation	5.2661	6.2581	5.6068
	N	114	114	114
26-29	Mean	17.1042	33.9583	16.8542
	Std. Deviation	5.2399	7.3801	6.0424
	N	48	48	48
30-33	Mean	19.0000	28.0000	9.0000
	Std. Deviation	3.6056	7.2111	4.3589
	N	3	3	3
34 & Above	Mean	15.0000	30.0000	15.0000
	Std. Deviation	--	--	--
	N	1	1	1
Total	**N**	**235**	**235**	**235**

Table 2 reveals that the students of 18-21 age range had a mean gain of 13.90 and standard deviation of 6.22 (Mg = 13.90, SD = 6.22), the students of 22-25 age range had a mean gain of 16.12 and standard deviation of 5.61 (Mg = 16.12, SD = 5.61), the students of 26-29 age range had a mean gain of 16.85 and standard deviation of 6.04 (Mg = 16.85, SD = 6.04), the students of 30-33 age range had a mean gain of 9.00 and standard deviation of 4.36 (Mg = 9.00, SD = 4.36), the student of 34 & Above age range had a mean gain of 15.00 and standard deviation of 0.00 (Mg = 15.00, SD = 0.00).

These results show that the students of 26-29 age range had the highest performance, followed by the students of 22-25 age range, followed by the students of 34 & Above age, followed by the students of 18-21 age range followed by the students of 30-33 age range which had the least performance. This indicates that the students of 26-29 age range had the highest performance when compared with students of other age ranges.

Research Question 3: *What is the difference in the retention of students of different age ranges?*

Table 3: Mean and Standard deviation values of students' retention classified by Age

Age		Post Test	Post-Post Test	Mean Gain (Mg) (Retention)
18-21	Mean	30.0290	38.0725	8.0435
	Std. Deviation	7.3143	6.2716	5.6345
	N	69	69	69
22-25	Mean	31.7807	38.7719	6.9912
	Std. Deviation	6.2581	5.5543	5.3505
	N	114	114	114
26-29	Mean	33.9583	40.0417	6.0833
	Std. Deviation	7.3801	4.8067	4.7303
	N	48	48	48
30-33	Mean	28.0000	31.0000	3.0000
	Std. Deviation	7.2111	1.0000	7.9373
	N	3	3	3
34 & Above	Mean	30.0000	41.0000	11.0000
	Std. Deviation	--	--	--
	N	1	1	1
Total	**N**	**235**	**235**	**235**

Table 3 reveals that the students of 18-21 age range had a mean gain of 8.04 and standard deviation of 5.64 (Mg = 8.04, SD = 5.64), the students of 22-25 age range had a mean gain of 6.99 and standard deviation of 5.35 (Mg = 6.99, SD = 5.35), the students of 26-29 age range had a mean gain of 6.08 and standard deviation of 4.73 (Mg = 6.08, SD = 4.73), the students of 30-33 age range had a mean gain of 3.00 and standard deviation of 7.94 (Mg = 3.00, SD = 7.94), the student of 34 & Above age range had a mean gain of 11.00 and standard deviation of 0.00 (Mg = 11.00, SD = 0.00).

These results show that the students of 34 & Above age range had the highest retention, followed by the students of 18-21 age range, followed by the students of 22-25 age, followed by the students of 26-29 age range followed by the students of 30-33 age range which had the least retention. This indicates that the student of 34 & Above age range had the highest retention when compared with students of other age ranges.

Hypothesis 1: There is no significant difference in the engagement level of students of differentage ranges.

Table 4: Summary of Analysis of Covariance of Students' engagement level classified by Age range using Pretest as Covariate

Tests of Between-Subjects Effects

Dependent Variable: POST-TEST ENGAGEMENT

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.717[a]	5	.143	.632	.675	.014
Intercept	52.961	1	52.961	233.418	.000	.505
PREENGAGEMENT	.330	1	.330	1.456	.229	.006
AGE	.314	4	.079	.346	.847	.006
Error	51.959	229	.227			
Total	2337.702	235				
Corrected Total	52.676	234				

a. R Squared = .014 (Adjusted R Squared = -.008)

Table 4 reveals a value of $F_{4,229} = 0.346$, $p = 0.847$ ($p > 0.05$) for the effect of Age range on the engagement level of the students. Furthermore, the partial eta squared value for age is 0.006, indicating that age accounts for only 0.6% of the variance in students' engagement levels. This is a very small effect size, implying that differences in engagement among students of different age groups are minimal. The null hypothesis is therefore retained, indicating that there is no significant difference among the engagement levels of students of different age ranges.

Hypothesis 2: There is no significant difference in the academic performance of students ofdifferent age ranges.

Table 5a: Summary of Analysis of Covariance of students' performance classified byAge range using Pretest as Covariate

Tests of Between-Subjects Effects

Dependent Variable: POST TEST

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3841.853[a]	5	768.371	23.884	.000	.343
Intercept	3750.351	1	3750.351	116.574	.000	.337
PRETEST	3360.148	1	3360.148	104.446	.000	.313
AGE	429.347	4	107.337	3.336	.011	.055
Error	7367.228	229	32.171			
Total	246693.000	235				
Corrected Total	11209.081	234				

a. R Squared = .343 (Adjusted R Squared = .328)

Table 5a reveals a value of $F_{4,229} = 3.336$, $p = 0.011$ ($p < 0.05$) for the effect of Age range on students' performance. The Partial Eta Squared value for AGE is 0.055, indicating that age accounted for approximately 5.5% of the total variance in students' post-test scores. Although this effect size is relatively small. The null hypothesis is therefore rejected, indicating that there is asignificant difference in the academic performance of students of different age ranges.

Table 5b: Least Significant Difference Post Hoc Analysis of students' performance classifiedby Age range

Pairwise Comparisons

Dependent Variable: Post Test

(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.b	95% Confidence Interval for Differenceb	
					Lower Bound	Upper Bound
18-21	22-25	-2.087*	0.866	0.017	-3.793	-0.381
	26-29	-3.239*	1.068	0.003	-5.344	-1.134
	30-33	4.064	3.351	0.226	-2.539	10.667
	34 & Above	-0.773	5.713	0.893	-12.030	10.485
22-25	18-21	2.087*	0.866	0.017	0.381	3.793
	26-29	-1.152	0.981	0.242	-3.085	0.781
	30-33	6.151	3.326	0.066	-0.402	12.703
	34 & Above	1.314	5.697	0.818	-9.911	12.539
26-29	18-21	3.239*	1.068	0.003	1.134	5.344
	22-25	1.152	0.981	0.242	-0.781	3.085
	30-33	7.303*	3.378	0.032	0.647	13.959
	34 & Above	2.466	5.733	0.667	-8.829	13.762
30-33	18-21	-4.064	3.351	0.226	-10.667	2.539
	22-25	-6.151	3.326	0.066	-12.703	0.402
	26-29	-7.303*	3.378	0.032	-13.959	-0.647
	34 & Above	-4.837	6.555	0.461	-17.753	8.080
34 & Above	18-21	0.773	5.713	0.893	-10.485	12.030
	22-25	-1.314	5.697	0.818	-12.539	9.911
	26-29	-2.466	5.733	0.667	-13.762	8.829
	30-33	4.837	6.555	0.461	-8.080	17.753

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Table 5b, which shows the Least Significant Difference Post hoc analysis of students' performance classified by Age range, reveals a mean difference of 7.303 and a p-value of 0.032 ($p < 0.05$) between the students of 26-29 age range and 30-33 age range, a mean difference of 3.239 and a p-value of 0.003 ($p < 0.05$) between the students of 26-29 age range and 18-21 age range, a mean difference of 2.087 and a p-value of 0.017 ($p < 0.05$) between the students of 22-25 age range and 18-21 age range. This indicates that the students of 26-29 age range contributed most to the significantdifference among the performance of the students of different age ranges.

Hypothesis 3: There is no significant difference among the students of different age ranges in theirretention of the knowledge of Computer in Education concepts.

Table 6: Summary of Analysis of Covariance of students' retention classified by Age rangeusing Pretest as Covariate

Tests of Between-Subjects Effects

Dependent Variable: POST POST TEST

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3328.095[a]	5	665.619	36.141	.000	.441
Intercept	3205.568	1	3205.568	174.053	.000	.432
POSTTEST	3031.077	1	3031.077	164.578	.000	.418
AGE	113.597	4	28.399	1.542	.191	.026
Error	4217.548	229	18.417			
Total	360161.000	235				
Corrected Total	7545.643	234				

a. R Squared = .441 (Adjusted R Squared = .429)

Table 6 reveals a value of $F_{4,229} = 1.542$, $p = 0.191$ ($p > 0.05$) for the effect of Age range on students' retention. Additionally, the Partial Eta Squared value (0.026) indicates that age accounts for only 2.6% of the total variance in students' retention, which is relatively small. The null hypothesis is therefore retained, indicating that there is no significant difference among the students of different age ranges in their retention of the knowledge of Computer in Education concepts.

DISCUSSION OF FINDINGS

The studies reviewed regarding the relationship between age and student engagement on e-learning platforms show differing results, and when compared with the statistical outcome in *Table 4* ($F4,229 = 0.346$, $p = 0.847$), which suggests no significant age-related differences in engagement levels, the findings of the individual studies can be classified as follows:

Binyamin, Rutter and Smith, (2020) reviewed the moderating effect of gender and age on students' acceptance of Learning Management Systems in Saudi Higher Education. Their study found that age had no influence on engagement levels or perceived usefulness of Learning Management Systems (LMS) in Saudi universities. This aligns with the null hypothesis in the table, where age did not significantly affect engagement. Thus, Binyamin and Rutter's study agrees with the statistical finding in *Table 4* that age did not influence engagement levels.

Dampson (2021) conducted research at a University in Ghana, he aimed to identify the determinants of the learning management system's adoption in the Covid-19 Era. Dampson's study identified age as a dominant factor influencing engagement levels on LMS platforms, with older students showing greater engagement. This disagrees with the table's findings, where no significant age difference was observed. Dampson's results contradict the null hypothesis, showing that age plays a crucial role in engagement.

Salta et al. (2022) examined the shift from traditional to distance learning environments during the COVID-19 pandemic, specifically focusing on university students' engagement and interactions. The research found that older students exhibited higher emotional and cognitive engagement. This suggests age influences engagement

levels, with older students having more substantial interactions with instructors. This disagrees with the table's result, as the study showed significant age-based differences in engagement.

Martin and Bolliger (2018) explored student perceptions of the importance of engagement strategies in online learning environments in the United States. The study indicated that older students, especially at the graduate level, valued student-instructor interactions more than younger students. The findings suggest that age impacts engagement, with older students reporting higher satisfaction. This disagrees with the null hypothesis in *Table 4*. Means and Neisler (2020) focused on the shift to online learning during the COVID-19 pandemic. In their research they found that older students (aged 22+) were more engaged than younger students, attributing this difference to higher self-regulation skills. This disagrees with the table's findings, as the study demonstrated clear age-related differences in engagement.

Wood et al. (2022) conducted in the United States, examined emotional and social engagement among 300 university students, specifically during the transition to online learning. This study revealed that younger students showed a decrease in emotional engagement, while older students maintained stronger emotional connections. This disagrees with the null hypothesis, supporting the idea that age impacts emotional engagement. Revere and Kovach (2011) conducted a study on student-student interactions in online learning environments, surveying 500 students from various U.S. universities. The study found that older students preferred asynchronous learning, which allowed for more flexible peer interactions. This suggests a difference in engagement preferences based on age, disagreeing with the table's null hypothesis. Chatterjee and Correia (2020) conducted a mixed-methods study to explore the interaction types—student-content, student-student, and student-instructor among university students across various institutions in the United States. The mixed-methods study indicated that older students were more cognitively engaged with course content, while younger students were more focused on social interactions. This disagrees with the table's null hypothesis, showing that age influences the type of engagement.

Banna et al. (2015) focused on the role of age in student-student interactions within e-learning environments, with a sample size of 600 university students across various U.S institutions. This study found that older students had higher engagement in collaborative work compared to younger students. Like the previous studies, this disagrees with the table's null hypothesis.

It is obvious that the present research findings disagree with Dampson (2021), Salta et al. (2022), Martin and Bolliger (2018), Means & Neisler (2020), Hughes et al. (2022), Revere & Kovach (2011), Chatterjee & Correia (2020), and Banna et al. (2015) all suggest that age has a significant impact on engagement levels. It agrees with Binyamin and Rutter (2020) who found no significant effect of age on engagement, which aligns with the table's result.

The findings of the study summarized in tables (5a and 5b) that show significant differences in the academic performance of students from different age ranges are consistent with several key points from the studies referenced. Varga-Atkins, et al. (2021) in digital multitasking and age, highlight that younger students (average age 20) are more prone to distractions, especially with digital multitasking. This aligns with this study findings showing significant differences in academic performance among age groups. The younger age group (18-21 years) may be more susceptible to distractions or less effective in self-regulation, which could contribute to their lower performance compared to older students. The significant mean differences between the age groups, particularly between the 18-21 and 26-29 age ranges, support the idea that maturity and self-regulation (key factors in multitasking behaviours) can influence academic outcomes. While the studies you referenced suggest that younger students may face challenges in self-regulation and multitasking, they do not directly address the nuanced relationship between age and performance in academic contexts. The finding in Table 4.20 of significant differences in performance across age groups could indicate that the developmental aspects of self-regulation and attention span might be less stark in some educational settings or disciplines compared to others.

Nie, Pang, Wang, Rozelle, and Sylvia, (2020) in their work on "Impact of Visual Aids" suggests that younger students in rural areas who received eyeglasses showed improved academic performance. The improvement could be because younger students may benefit more from interventions that directly address physiological needs (like vision correction). Similarly, the 18-21 age group, which may still be in the early stages of their academic trajectory, might benefit more from addressing barriers to learning, such as digital distractions or

insufficient self-regulation. Although this study focuses on a different kind of intervention, it implies that younger students may have more potential for improvement, which could be linked to the observed differences in academic performance across age groups in your study The study by Nie et al. focused on rural China and highlighted health interventions, but the sample was not necessarily representative of a broad range of educational contexts. The significant difference in academic performance observed in this study may not fully align with their findings, as it may be driven more by cognitive or environmental factors like digital distractions, which may not be a focal point in Nie et al.'s research.

Strietholt, et al., (2021) in their work on Digital Literacy and Academic Performance. They demonstrate that older students, particularly those in secondary school, benefit more from digital literacy, suggesting that digital competence is crucial for academic success. This may explain why the 26-29 age group in your study performs better. They are likely more skilled in navigating digital tools and information, a factor that increasingly influences academic performance. While Fraillon et al.'s findings suggest a strong correlation between digital literacy and academic performance, your study's results based on age ranges may not directly align with these findings. Digital literacy could vary significantly within age ranges depending on the specific context of the study (e.g., discipline or access to digital resources), suggesting that the observed differences in age-related performance in your study may stem from factors other than just digital literacy.

Masoud and Bohra (2020) suggested that older students (16–18 years) demonstrate better adaptability and self-regulation in online learning environments, which is consistent with the results in Table 4.21. In particular, the 26-29 age range students, who contributed most to the significant difference, could reflect a similar developmental stage, showing improved self-regulation and digital literacy. These traits align with the findings of Masoud and Bohra, where older students perform better in online settings due to higher maturity and the ability to manage independent learning. The study's focus on students being more self-disciplined and better at managing time in online learning environments aligns with the report in Table 4.21, particularly between students aged 26-29 and those aged 18-21. These findings emphasize that older students have developed skills that help them perform better academically in environments that require greater self-direction, a trend also noted in Masoud and Bohra's work.

Anthonysamy et al. (2020) found that ICT has a more pronounced positive effect on older students who are more adaptable to technology. This finding mirrors the significant difference seen in the 26-29 age range students in Table 4.21, indicating that older students may benefit more from technology or new learning modalities, much like how ICT use positively influenced academic performance for older students in their study. The study highlighted that younger student needed more structured support to benefit from ICT. This is in line with the findings in Table 4.21, where younger age ranges (18-21, 22-25) had lower academic performance than those in the 26-29 range, suggesting that students in the 18-21 group may struggle more in self-regulated learning environments or require additional support, which was evident in Anthonysamy et al.'s work.

Masrom, *et al.* (2021) highlight that older students benefit from the flexibility and resources of blended learning platforms, particularly those aged 26 and above, due to their maturity, self-regulation, and digital proficiency. The result in (Tables 5a and 5b) also finds that there is a significant difference in the academic performance of students from different age ranges, with particular emphasis on the 26-29 age group. This aligns with the notion in Masrom, et al.'s study that older students, such as those in the 26-29 range, tend to perform better academically, which may be due to their increased ability to navigate blended learning platforms effectively. The significant differences observed in the post-hoc analysis (Table 5b) between the 26-29 age group and other age groups (30-33, 18-21, and 22-25) support the idea that older students show better academic engagement and performance. This is consistent with the findings of Masrom, et al. (2021), which attribute the positive outcomes of older students to factors such as self-regulation and maturity.

Mahaffey (2024) Remote Learning and Age-Related Performance Differences. The study discusses the varying impacts of remote learning on students of different age ranges, highlighting that students aged 14-16 showed the most significant gains in both academic performance and digital skills. The statistical results in Table 5a and 5b also suggest that age is a significant factor in academic performance, with a notable difference between the 26-29 age range and other age groups, particularly the 18-21 range. The result aligns with Mahaffey's

conclusion that age-related factors, such as adaptability to remote tools and developmental differences, significantly influence academic outcomes. Both Mahaffey's findings and the statistical results indicate that age affects performance, with certain age groups performing better due to their developmental maturity and engagement with learning tools. However, Mahaffey's study emphasizes digital skills and remote learning, while the statistical analysis suggests broader academic performance differences across a broader age range (18-33), rather than focusing solely on remote learning.

Dukes (2023): Game-Based Learning and Engagement Across Age Groups. The study examines the impact of game-based learning on student engagement and performance, noting that younger students (12-14 years) showed higher engagement but smaller academic gains, while older students (15-18 years) demonstrated stronger academic performance. The statistical analysis from Table 5b also reveals significant differences in academic performance across age ranges, particularly between the 26-29 and 18-21 age groups, which is somewhat similar to the findings of Dukes regarding older students outperforming younger ones. Both the Dukes study and the statistical results suggest that older students may benefit more in terms of academic performance due to better self-regulation and maturity. However, Dukes focuses on engagement and performance in game-based learning, whereas the statistical results encompass a wider range of age groups and do not specifically address the effects of gamification.

Van der Ven (2020) in ICT in STEM Education. The study suggests that older students (16-18 years) benefit more from ICT integration in STEM subjects, especially in problem-solving tasks. This aligns with the statistical results showing that the 26-29 age range outperforms younger age groups in academic performance. Both findings suggest that older students are better able to leverage digital tools and manage independent learning tasks. The positive correlation between age and academic performance is evident in both studies, particularly about how older students utilize digital tools and tackle more complex academic challenges. While Van der Ven focuses specifically on ICT in STEM, the statistical results are more general and don't specify the subject areas in which performance differences occur.

Huang, et al. (2021) in Flipped Classroom Effectiveness by Age. Huang's research highlights that older student (16-17 years) adapted better to the flipped classroom model, benefiting more from self-regulated learning, while younger students (13-15 years) required more structure. This is in line with the statistical results in Table 4.21, which show that older students (26-29 years) perform better than younger age groups, particularly in self-regulated learning contexts. Both Huang's study and the statistical analysis suggest that older students perform better academically due to higher self-regulation and maturity, which allows them to adapt to more autonomous learning models like flipped classrooms. However, Huang's study focuses specifically on the flipped classroom model, whereas the statistical analysis includes a broader academic context without specifying teaching methods.

Table 6 shows that the effect of age range on students' retention of Computer-in-Education concepts is not statistically significant ($F(4,229) = 1.542$, $p = 0.191$). Since the p-value is greater than 0.05, the null hypothesis is retained, meaning there is no significant difference in retention between students of different age groups.

Buddha**,** et al (2024) The article Technology-Assisted Learning Retention (2022) examines how digital tools, particularly adaptive learning and real-time feedback, enhance student retention. Based on a meta-analysis of 583 studies mainly from the U.S. and Europe, it highlights two key factors, Adaptive Learning; Digital tools that personalize learning help keep students engaged and motivated, preventing them from feeling overwhelmed or bored. Real-Time Feedback, Immediate feedback helps students identify and correct mistakes, fostering reflection and continuous improvement. The study emphasizes that combining these factors significantly boosts retention. While the research provides strong evidence of the benefits of digital tools, it has limitations, such as its focus on Western countries and the lack of specificity about which digital tools are most effective. The findings suggest that personalized learning and continuous feedback should be central in modern educational systems to improve outcomes.

CONCLUSION

In conclusion, this study underscores the significant influence of age on students' engagement, academic performance, and retention when taught Computer-in-Education concepts in South-South Nigeria. The findings

reveal that age plays a crucial role in determining how students interact with and retain information from these concepts. The results indicate that older students showed higher levels of engagement compared to their younger counterparts. However, the difference in engagement levels across age groups was not statistically significant. In terms of academic performance, older students performed better than younger students, demonstrating a significant positive effect of age on academic outcomes. Additionally, age significantly influenced the retention of concepts, with older students retaining more information over time. These findings highlight the need for tailored teaching strategies that consider the age of students to maximize their engagement, performance, and retention in Computer-in-Education courses. By implementing age-appropriate instructional methods, educators can enhance the overall learning experience and outcomes for students of all ages.

RECOMMENDATION

Based on the results and conclusion of this study, the following recommendations were made:

1. E-tutors, lecturers should design engagement strategies that are universally effective across all age groups, as age does not significantly influence students' engagement levels, ensuring inclusive participation and interaction for all learners.
2. Lecturers should develop age-specific instructional strategies to address the distinct academic needs of different age groups, with particular emphasis on enhancing the performance of students in the 30-33 age range, while building on the strengths of students in the 26-29 age range to optimize overall performance.
3. Lecturers should implement consistent retention strategies for all age groups, as age does not significantly affect retention, ensuring that all students have equal opportunities to retain knowledge of Computer in Education concepts.

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