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ENHANCING COMPUTER EDUCATION FOR SUSTAINABLE INNOVATION IN HIGHER EDUCATION IN ANAMBRA STATE, NIGERIA

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Abstract

Computer education in higher education fosters sustainable innovation by equipping students with digital skills for problem-solving, creativity, and technological advancement. The research focuses on evaluating the effectiveness of curriculum redesign, incorporating emerging technologies like Artificial Intelligence (AI) and Data Science, and fostering practical skills essential for innovation. This study adopted a descriptive survey research design. The population for the study comprised students, lecturers, and administrative staff from higher education institutions in Anambra State. A total sample size of 130 participants was selected using stratified random sampling to ensure representation from all key groups. To gather data, a structured questionnaire was used. Inferential analysis, specifically ANOVA, was conducted to identify and evaluate differences in perceptions among various demographic groups. In the post hoc multiple comparisons, the Scheffe and Tamhane tests were applied to evaluate significant differences between age groups regarding their perceptions. Findings indicate that the redesign of computer education curricula significantly impacts students' innovation capacity, with varying effects across different age groups. The study highlights the need for curriculum integration of hands-on, project-based learning, industry collaborations, and reliable technological infrastructure to foster an innovation-driven educational environment. The results suggest that a more inclusive and forward-thinking approach to computer education can greatly enhance sustainable innovation in Anambra's higher education institutions. Based on these findings, recommendations for curriculum reforms and educational policies are presented to better align computer education with the evolving demands of the digital economy.

Keywords: computer education, sustainable innovation, higher education, curriculum redesign, emerging technologies

Introduction

As technology evolves, so too must the ways in which computer education is imparted in higher education settings. To foster sustainable innovation, educational institutions are increasingly focusing on the integration of computer science and technological advancements into curricula that not only meet the needs of current students but also prepare them for future challenges. A critical factor in driving sustainable innovation through computer education is curriculum reform. According to Raj et al, (2020), the traditional computer science curriculum is often too rigid and slow to adapt to fast-paced technological advancements. To address this, many scholars have suggested a dynamic curriculum model that allows flexibility in course offerings, integrating emerging technologies such as artificial intelligence (AI), machine learning, and blockchain. This approach helps students remain at the forefront of technological change, preparing them to contribute to future innovations (Nwogwugwu & Sosanya, 2015). Furthermore, sustainable innovation in computer education requires courses that promote interdisciplinary learning, as technology increasingly intersects with various sectors, including healthcare, environmental science, and business (Habib et al, 2022). Offering students a chance to apply computer science skills in these contexts encourages innovation that is not only sustainable but also socially impactful.

Pedagogical approaches also play a key role in enhancing computer education for sustainable innovation. Traditional teaching methods, which focus heavily on theoretical knowledge, are being reconsidered in favor of more practical, hands-on learning experiences. According to Gemella (2024), experiential learning environments that encourage project-based learning and collaborative work are crucial for fostering creativity and innovation. In particular, the use of coding boot camps, hackathons, and interdisciplinary team projects helps students develop problem-solving skills that are essential for driving sustainable technological advancements (Rana et al, 2023). These methods encourage students to think critically, work together, and apply their knowledge to real-world problems—core components of sustainable innovation.

Moreover, the role of technology itself in teaching is essential for enhancing computer education. The integration of online learning platforms, virtual labs, and other digital tools provides students with opportunities for self-directed learning and global collaboration. According to Hutson & Hutson, 2024; Ani et al, 2015), blended learning environments that combine face-to-face and online components offer greater flexibility and access to educational resources, enabling students to learn at their own pace while also benefiting from collaborative interactions with peers and instructors. These platforms can also support the development of digital literacy, a foundational skill for navigating the digital landscape and contributing to innovations that can address societal challenges.

The rapid advancement of technology presents significant challenges and opportunities for higher education institutions, particularly in the realm of computer education. Despite the growing demand for innovative solutions in sectors such as healthcare, business, and environmental science, the current computer education framework in many institutions remains outdated and insufficient for fostering sustainable innovation (Nwadinobi et al, 2024). Traditional curricula are often too rigid and fail to integrate emerging technologies like artificial intelligence, machine learning, and blockchain, leaving graduates ill-prepared for the evolving demands of the job market. Furthermore, pedagogical approaches still predominantly focus on theoretical knowledge, neglecting the practical, hands-on learning experiences needed to cultivate creativity and problem-solving skills essential for sustainable technological innovation (Ukeje et al, 2024).

Another pressing issue is the lack of institutional support and infrastructure to facilitate the integration of new teaching methodologies, such as project-based learning and interdisciplinary collaborations, which are critical for nurturing innovation. Additionally, there is a disconnect between academia and industry, limiting students' exposure to real-world challenges and undermining their ability to contribute meaningfully to technological advancements. This study aims to investigate these challenges and propose strategies for enhancing computer education to better equip students for sustainable innovation in a rapidly changing digital landscape.

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Research Questions

1. How do students in higher education institutions in Anambra State perceive the role of computer education in fostering sustainable innovation in Higher education in Anambra state?
2. What are the key factors that influence the effectiveness of computer education in promoting sustainable innovation in Higher education in Anambra state?
3. How can computer education be redesigned to support sustainable innovation in the curricula of higher education institutions in Anambra State?

Hypotheses

1. ***Null Hypothesis 1:*** There is no significant relationship between students' perceptions of computer education and its role in fostering sustainable innovation in higher education in Anambra State.
2. ***Null Hypothesis 2:*** There are no key factors that significantly influence the effectiveness of computer education in promoting sustainable innovation in higher education in Anambra State.
3. ***Null Hypothesis 3:*** Redesigning computer education curricula in higher education institutions in Anambra State will not have a significant effect on supporting sustainable innovation.

Methodology

This study adopted a descriptive survey research design. The population for the study comprised students, lecturers, and administrative staff from higher education institutions in Anambra State. A total sample size of 130 participants was selected using stratified random sampling to ensure representation from all key groups. To gather data, a structured questionnaire was used. The questionnaire included closed-ended questions aimed at assessing the perceptions of participants regarding the integration of emerging technologies in the computer education curriculum and its role in fostering innovation. The questionnaire was pre-tested for reliability. The data analysis utilized a combination of descriptive and inferential statistical methods to examine perceptions of computer education's role in fostering sustainable innovation. Descriptive statistics were employed to summarize demographic trends and distribution patterns within the participant sample, offering insights into the general characteristics of the respondents. Inferential analysis, specifically ANOVA, was conducted to identify and evaluate differences in perceptions among various demographic groups. In the post hoc multiple comparisons, the Scheffe and Tamhane tests were applied to evaluate significant differences between age groups. Additionally, cumulative percentages were calculated to analyze the distribution of participants' agreement levels regarding the importance of computer education. The approach ensured a comprehensive understanding of the data, linking demographic variables to perceptual trends. Ethical guidelines were strictly followed, ensuring informed consent, confidentiality, and voluntary participation. Participants were fully informed about the purpose of the study and assured that their responses would be used solely for academic purposes.

Results

Table 1: Respondents demographic information for Age Group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-24 years	28	21.5	21.5	21.5
	35-44 years	32	24.6	24.6	46.2
	45 years and above	70	53.8	53.8	100.0
	Total	130	100.0	100.0	

Table 1 shows the demographic distribution of respondents by age group. The largest group was aged 45 years and above (53.8%, 70 respondents), followed by the 35-44 years group (24.6%, 32 respondents). The smallest group was the 18-24 years age group (21.5%, 28 respondents). These findings highlight a predominance of older participants in the study.

Table 2: Respondents demographic information for gender Group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	50	38.5	38.5	38.5
	Female	80	61.5	61.5	100.0
	Total	130	100.0	100.0	

Table 2 reveals the gender distribution of respondents. A majority of participants were female, comprising 61.5% (80 respondents), while males accounted for 38.5% (50 respondents). This suggests a higher representation of female respondents in the sample, highlighting potential gender differences in perspectives on the study topic.

Research Question 1: How do students in higher education institutions in Anambra State perceive the role of computer education in fostering sustainable innovation in Higher education in Anambra state?

Table 3: Frequency table on perceptions of students on the role of computer education in innovation development.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	44	33.8	33.8	33.8
	Disagree	10	7.7	7.7	41.5
	Agree	35	26.9	26.9	68.5
	Strongly Agree	41	31.5	31.5	100.0
	Total	130	100.0	100.0	

Table 3 presents students' perceptions of the role of computer education in innovation development. A significant portion, 33.8% (44 respondents), strongly disagreed with the statement, while 7.7% (10 respondents) disagreed. However, 26.9% (35 respondents) agreed, and 31.5% (41 respondents) strongly agreed, indicating a varied range of opinions about the impact of computer education on innovation.

Table 4: Frequency table on perceptions of students on the role of computer education in modern career opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	24	18.5	18.5	18.5
	Disagree	26	20.0	20.0	38.5
	Agree	24	18.5	18.5	56.9
	Strongly Agree	56	43.1	43.1	100.0
	Total	130	100.0	100.0	

Table 4 reveals students' perceptions of the role of computer education in modern career opportunities. A notable 43.1% (56 respondents) strongly agreed that computer education is crucial for career prospects, while 18.5% (24 respondents) strongly disagreed. Additionally, 20% (26 respondents) disagreed, and 18.5% (24 respondents) agreed, reflecting a strong inclination towards the importance of computer education for future careers.

Table 5: Frequency table on perceptions of students on the role of computer education in Computer education enhances creativity and critical thinking abilities.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	23	17.7	17.7	17.7
	Disagree	30	23.1	23.1	40.8
	Agree	55	42.3	42.3	83.1

	Strongly Agree	22	16.9	16.9	100.0
	Total	130	100.0	100.0	

Table 5 reflects students' views on the role of computer education in enhancing creativity and critical thinking abilities. A significant portion, 42.3% (55 respondents), agreed, and 16.9% (22 respondents) strongly agreed, highlighting the positive impact of computer education on cognitive skills. However, 23.1% (30 respondents) disagreed, and 17.7% (23 respondents) strongly disagreed, suggesting some divergence in perceptions.

Table 6: Frequency table on perceptions of students on the role of computer education in Computer skills are seen as fundamental for achieving sustainable academic success.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	36	27.7	27.7	27.7
	Agree	66	50.8	50.8	78.5
	Strongly Agree	28	21.5	21.5	100.0
	Total	130	100.0	100.0	

Table 6 reveals students' perceptions regarding the role of computer skills in achieving sustainable academic success. A majority, 50.8% (66 respondents), agreed, and 21.5% (28 respondents) strongly agreed, suggesting that computer skills are recognized as essential for academic success. However, 27.7% (36 respondents) disagreed, indicating some variation in views on the importance of computer skills.

Table 7: Frequency table on perceptions of students on the role of computer education in Computer education fosters technological innovation within higher education.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	23	17.7	17.7	17.7
	Disagree	42	32.3	32.3	50.0
	Agree	25	19.2	19.2	69.2
	Strongly Agree	40	30.8	30.8	100.0
	Total	130	100.0	100.0	

Table 7 indicates that students' perceptions of the role of computer education in fostering technological innovation in higher education show mixed responses. While 32.3% (42 respondents) disagreed and 17.7% (23 respondents) strongly disagreed, suggesting some skepticism, a significant portion (30.8%, 40 respondents) strongly agreed, and 19.2% (25 respondents) agreed, highlighting a general belief in computer education's role in promoting innovation.

Table 8: Perceptions on the Impact of Learning Technology on Problem-Solving and Innovation Skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	50	38.5	38.5	38.5
	Agree	32	24.6	24.6	63.1
	Strongly Agree	48	36.9	36.9	100.0
	Total	130	100.0	100.0	

Table 8 illustrates students' perceptions on how learning technology impacts their problem-solving and innovation skills. Of the 130 respondents, 38.5% (50 students) disagreed with the assertion that technology aids in these areas, while 24.6% (32 students) agreed, and 36.9% (48 students) strongly agreed. This suggests a general positive perception among most respondents, with a notable proportion recognizing the potential benefits of technology in enhancing these critical skills.

Research Question 2: What are the key factors that influence the effectiveness of computer education in promoting sustainable innovation in Higher education in Anambra state?

Table 9: Perceptions of the Impact of Access to Modern Hardware and Software on Enhancing the Learning Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	23	17.7	17.7	17.7
	Agree	68	52.3	52.3	70.0
	Strongly Agree	39	30.0	30.0	100.0
	Total	130	100.0	100.0	

Table 9 shows students' perceptions of how access to modern hardware and software enhances their learning experience. Among the 130 respondents, 17.7% (23 students) strongly disagreed, 52.3% (68 students) agreed, and 30% (39 students) strongly agreed. This indicates a positive response, with a majority acknowledging the benefits of modern technological resources in improving their learning outcomes.

Table 10: Perceptions on the Role of Curriculum Integration of Emerging Technologies Like AI and Data Science in Promoting Innovation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	14	10.8	10.8	10.8

	Agree	96	73.8	73.8	84.6
	Strongly Agree	20	15.4	15.4	100.0
	Total	130	100.0	100.0	

Table 10 presents students' perceptions on the integration of emerging technologies like AI and data science in the curriculum to promote innovation. Of the 130 respondents, 10.8% (14 students) disagreed, 73.8% (96 students) agreed, and 15.4% (20 students) strongly agreed. The majority viewed the incorporation of these technologies as essential for fostering innovation in education.

Table 11: Perceptions on the Importance of Reliable Internet Connectivity for Delivering Online Courses and Research

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	82	63.1	63.1	63.1
	Strongly Agree	48	36.9	36.9	100.0
	Total	130	100.0	100.0	

Table 11 highlights students' perceptions regarding the importance of reliable internet connectivity for online courses and research. A significant majority (63.1%, 82 students) agreed, while 36.9% (48 students) strongly agreed. This indicates a strong consensus on the essential role of stable internet access in ensuring effective online learning and research activities.

Table 12: Perceptions on the Role of Government Funding in Supporting Infrastructure for Computer Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	14	10.8	10.8	10.8
	Agree	68	52.3	52.3	63.1
	Strongly Agree	48	36.9	36.9	100.0
	Total	130	100.0	100.0	

Table 12 presents perceptions on the role of government funding in supporting infrastructure for computer education. A majority of respondents (52.3%, 68 students) agreed, while 36.9% (48 students) strongly agreed, highlighting the significant role government funding plays in enhancing the infrastructure for computer education. However, a smaller portion (10.8%, 14 students) disagreed, reflecting some variance in opinion on this issue.

Table 13: Perceptions on the Value of Industry Partnerships in Providing Real-World Applications and Case Studies for Students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	110	84.6	84.6	84.6
	Strongly Agree	20	15.4	15.4	100.0
	Total	130	100.0	100.0	

Table 13 shows perceptions on the value of industry partnerships in providing real-world applications and case studies for students. A large majority of respondents (84.6%, 110 students) agreed that such partnerships are beneficial, with an additional 15.4% (20 students) strongly agreeing. This indicates a strong recognition of the importance of practical, real-world experiences in the educational process.

Table 14: Perceptions on the Impact of Classroom Facilities, Such as Computer Labs and Equipment, on Teaching Quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	23	17.7	17.7	17.7
	Disagree	11	8.5	8.5	26.2
	Agree	80	61.5	61.5	87.7
	Strongly Agree	16	12.3	12.3	100.0
	Total	130	100.0	100.0	

Table 14 presents the perceptions of students regarding the impact of classroom facilities, such as computer labs and equipment, on teaching quality. The majority of respondents (61.5%, 80 students) agreed that these facilities enhance teaching quality, while 17.7% (23 students) strongly disagreed, and 8.5% (11 students) disagreed. This suggests that well-equipped classrooms are considered essential for improving the educational experience.

Research Question 3: How can computer education be redesigned to support sustainable innovation in the curricula of higher education institutions in Anambra State?

Table 15: Perceptions on the Integration of Emerging Technologies, like AI, into Computer Education Curricula to Foster Innovation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	23	17.7	17.7	17.7
	Agree	61	46.9	46.9	64.6

	Strongly Agree	46	35.4	35.4	100.0
	Total	130	100.0	100.0	

Table 15 highlights students' perceptions regarding the integration of emerging technologies, like AI, into computer education curricula to foster innovation. A significant portion (46.9%, 61 students) agreed that integrating AI is beneficial for promoting innovation, while 35.4% (46 students) strongly agreed. However, 17.7% (23 students) strongly disagreed, indicating some skepticism toward this integration.

Table 16: Perceptions on the Role of Project-Based Learning in Promoting Real-World Problem-Solving Skills in the Computer Education Curriculum

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	28	21.5	21.5	21.5
	Agree	82	63.1	63.1	84.6
	Strongly Agree	20	15.4	15.4	100.0
	Total	130	100.0	100.0	

Table 16 presents students' perceptions on the role of project-based learning in enhancing real-world problem-solving skills in computer education curricula. A majority (63.1%, 82 students) agreed that project-based learning promotes problem-solving skills, and 15.4% (20 students) strongly agreed. However, 21.5% (28 students) strongly disagreed, indicating a divide in opinions regarding its effectiveness.

Table 17: Perceptions on the Role of Industry Collaborations in Providing Practical Experiences for Students in the Computer Education Curriculum

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	28	21.5	21.5	21.5
	Agree	82	63.1	63.1	84.6
	Strongly Agree	20	15.4	15.4	100.0
	Total	130	100.0	100.0	

Table 17 highlights students' perceptions on the role of industry collaborations in providing practical experiences within the computer education curriculum. A majority of respondents (63.1%, 82 students) agreed that such collaborations are valuable, with 15.4% (20 students) strongly agreeing. However, 21.5% (28 students) strongly disagreed, suggesting varying views on the impact of industry involvement in the curriculum.

Table 18: Perceptions on the Emphasis of Coding and Data Analysis in the Computer Education Curriculum to Equip Innovators

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	46	35.4	35.4	35.4
	Agree	68	52.3	52.3	87.7
	Strongly Agree	16	12.3	12.3	100.0
	Total	130	100.0	100.0	

Table 18 presents students' perceptions on the emphasis of coding and data analysis in the computer education curriculum to foster innovation. A significant portion of respondents (52.3%, 68 students) agreed that coding and data analysis should be prioritized, while 35.4% (46 students) strongly disagreed. Only 12.3% (16 students) strongly agreed, indicating varied opinions on the relevance of these skills for innovation.

Table 19: Perceptions on the Inclusion of Practical, Hands-On Workshops in the Computer Education Curriculum

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	23	17.7	17.7	17.7
	Disagree	24	18.5	18.5	36.2
	Agree	67	51.5	51.5	87.7
	Strongly Agree	16	12.3	12.3	100.0
	Total	130	100.0	100.0	

Table 19 illustrates students' perceptions on including practical, hands-on workshops in the computer education curriculum. A majority (51.5%, 67 students) agreed that these workshops are essential, while 18.5% (24 students) disagreed, and 17.7% (23 students) strongly disagreed. Only 12.3% (16 students) strongly agreed, suggesting mixed opinions about the effectiveness of practical workshops in the curriculum.

Table 20: Perceptions on Entrepreneurship-Focused Courses in the Computer Education Curriculum

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	28	21.5	21.5	21.5
	Agree	82	63.1	63.1	84.6
	Strongly Agree	20	15.4	15.4	100.0
	Total	130	100.0	100.0	

Table 20 shows the students' perceptions on the inclusion of entrepreneurship-focused courses in the computer education curriculum. A majority (63.1%, 82 students) agreed that such courses should be part of the curriculum, while 21.5% (28 students) disagreed. Only 15.4% (20 students) strongly agreed, indicating strong support for incorporating entrepreneurial elements into the curriculum.

Hypotheses

Null Hypothesis 1: There is no significant relationship between students' perceptions of computer education and its role in fostering sustainable innovation in higher education in Anambra State.

Table 12: *ANOVA* on *Students' Perceptions of Computer Education and Its Role in Fostering Sustainable Innovation in Higher Education*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1153.558	2	576.779	33.109	.000
Within Groups	2212.450	127	17.421		
Total	3366.008	129			

The ANOVA results in Table 12 (F = 33.109, p = 0.000) indicate a significant relationship between students' perceptions of computer education and its role in fostering sustainable innovation in higher education in Anambra State.

Table 22: Post Hoc Tests Multiple Comparisons on Students' Perceptions of Computer Education and Its Role in Fostering Sustainable Innovation in Higher Education

	(I) Age Group	(J) Age Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Scheffe	18-24 years	35-44 years	2.46429	1.08008	.078	-.2110	5.1395
		45 years and above	7.05000*	.93330	.000	4.7383	9.3617
	35-44 years	18-24 years	-2.46429	1.08008	.078	-5.1395	.2110
		45 years and above	4.58571*	.89066	.000	2.3796	6.7918
	45 years and above	18-24 years	-7.05000*	.93330	.000	-9.3617	-4.7383
		35-44 years	-4.58571*	.89066	.000	-6.7918	-2.3796
Tamhan	18-24 years	35-44 years	2.46429	1.09892	.088	-.2656	5.1942

e		45 years and above	7.05000*	.65407	.000	5.4547	8.6453
	35-44 years	18-24 years	-2.46429	1.09892	.088	-5.1942	.2656
		45 years and above	4.58571*	1.10462	.000	1.8468	7.3246
	45 years and above	18-24 years	-7.05000*	.65407	.000	-8.6453	-5.4547
		35-44 years	-4.58571*	1.10462	.000	-7.3246	-1.8468

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

The post hoc tests in Table 13 further reveal significant mean differences between age groups, particularly between 18-24 years and 45 years and above ($p < 0.05$). Since the p-value is less than 0.05, the null hypothesis is rejected, indicating that there is a significant relationship between students' perceptions of computer education and its role in fostering sustainable innovation across different age groups.

Null Hypothesis 2: There are no key factors that significantly influence the effectiveness of computer education in promoting sustainable innovation in higher education in Anambra State.

Table 23: ANOVA on Effectiveness of Computer Education in Promoting Sustainable Innovation in Higher Education

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	464.389	2	232.194	61.445	.000
Within Groups	479.919	127	3.779		
Total	944.308	129			

The ANOVA results (Table 23) show a significant difference ($F = 61.445$, $p = 0.000$) between groups regarding the effectiveness of computer education in promoting sustainable innovation. This indicates that age group is a key factor influencing the perceived effectiveness.

Table 24: Post Hoc Tests Multiple Comparisons: Effectiveness of Computer Education in Promoting Sustainable Innovation in Higher Education

	(I) Age Group	(J) Age Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Scheffe	18-24 years	35-44 years	-.77232	.50304	.311	-2.0183	.4737

		45 years and above	3.34286*	.43468	.000	2.2662	4.4195
	35-44 years	18-24 years	.77232	.50304	.311	-.4737	2.0183
		45 years and above	4.11518*	.41482	.000	3.0877	5.1426
	45 years and above	18-24 years	-3.34286*	.43468	.000	-4.4195	-2.2662
		35-44 years	-4.11518*	.41482	.000	-5.1426	-3.0877
Tamhane	18-24 years	35-44 years	-.77232	.59262	.487	-2.2444	.6998
		45 years and above	3.34286*	.30142	.000	2.6007	4.0850
	35-44 years	18-24 years	.77232	.59262	.487	-.6998	2.2444
		45 years and above	4.11518*	.56634	.000	2.7000	5.5303
	45 years and above	18-24 years	-3.34286*	.30142	.000	-4.0850	-2.6007
		35-44 years	-4.11518*	.56634	.000	-5.5303	-2.7000

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

The post hoc test (Table 24) reveals that individuals aged 45 and above significantly differ from those in the 18-24 years and 35-44 years groups, with the mean difference favoring older respondents. This suggests that age plays a crucial role in the effectiveness of computer education in driving sustainable innovation in higher education. Given the significant p-value (0.000) in the ANOVA and post hoc tests, Null Hypothesis 2 is rejected. It is concluded that key factors, such as age, significantly influence the effectiveness of computer education in promoting sustainable innovation in higher education in Anambra State.

Null Hypothesis 3: Redesigning computer education curricula in higher education institutions in Anambra State will not have a significant effect on supporting sustainable innovation.

Table 25: ANOVA on Redesigning Computer Education Curricula in Higher Education Institutions

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1537.791	2	768.895	208.218	.000
Within Groups	468.979	127	3.693		
Total	2006.769	129			

The results from the ANOVA test (Table 25) indicate that redesigning computer education curricula in higher education institutions in Anambra State has a significant effect on supporting sustainable innovation ($F = 208.218$, $p < 0.05$). This suggests that the null hypothesis, which states that the redesign will have no significant effect, is rejected.

Table 26: Post Hoc Tests Multiple Comparisons: Redesigning Computer Education Curricula in Higher Education Institutions

	(I) Age Group	(J) Age Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Scheffe	18-24 years	35-44 years	-9.92857*	.49727	.000	-11.1603	-8.6969
		45 years and above	-6.72143*	.42969	.000	-7.7857	-5.6571
	35-44 years	18-24 years	9.92857*	.49727	.000	8.6969	11.1603
		45 years and above	3.20714*	.41006	.000	2.1915	4.2228
	45 years and above	18-24 years	6.72143*	.42969	.000	5.6571	7.7857
		35-44 years	-3.20714*	.41006	.000	-4.2228	-2.1915
Tamhane	18-24 years	35-44 years	-9.92857*	.60669	.000	-11.4356	-8.4216
		45 years and above	-6.72143*	.29706	.000	-7.4558	-5.9871
	35-44 years	18-24 years	9.92857*	.60669	.000	8.4216	11.4356
		45 years and above	3.20714*	.57363	.000	1.7710	4.6433
	45 years and above	18-24 years	6.72143*	.29706	.000	5.9871	7.4558
		35-44 years	-3.20714*	.57363	.000	-4.6433	-1.7710

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

Additionally, the Post Hoc Tests (Table 26) reveal that there are significant differences between age groups. The mean differences between the groups (18-24 years, 35-44 years, and 45 years and above) were statistically significant ($p < 0.05$), with notable differences in perceptions about the impact of curriculum redesign. This further reinforces that redesigning the curricula has varying impacts depending on age group, contributing to the overall conclusion that the hypothesis is rejected. Therefore, the redesign is seen as an influential factor in enhancing innovation in the education system.

Discussion of results

Computer education is foundational for fostering innovation and skill development in modern society. Universal access to computer science education significantly improves technological innovation and career readiness, highlighting its role in narrowing representation gaps in STEM fields. In contrast, Stanford researchers (Hutson & Hutson, 2024) emphasize the integration of AI and immersive technologies, showing their impact on critical thinking and problem-solving skills necessary for academic and professional success.

Similarly, Rana et al, (2023) notes that embedding computer education in curriculum design enhances students' adaptability and employability, fostering creativity essential for sustainable development. This aligns with findings from Gemella (2024), which demonstrate that computer literacy equips students with the tools to thrive in diverse career landscapes. While some argue computer education benefits mainly tech fields, Habib et al, (2022) suggests its broader utility in improving general cognitive skills and preparing students for digitally-oriented careers. These perspectives collectively underscore the transformative power of computer education, not only in promoting innovation but also in ensuring equitable academic and professional success.

Access to modern hardware and software significantly improves the learning experience by enabling students and teachers to interact with contemporary educational tools effectively. This finding agrees with the Federal Ministry of Education's policy emphasizing digital inclusion and infrastructure as pivotal for equitable learning outcomes in Nigeria. The policy highlights that tailored content and technological resources enhance teaching quality and learner engagement (Nwogwugwu & Sosanya, 2015). In contrast, a study on education technology in Nigeria noted the slow adoption of digital tools due to resistance and limited infrastructure. It found that although some universities, like NOUN, implement comprehensive e-learning systems, broader integration is hindered by poor connectivity and inadequate funding (Jacob & Ndubuisi, 2022). Curriculum integration of technologies like AI and data science fosters innovation. This aligns with findings from Nigeria's EdTech initiatives, showing that advanced curricula enable students to develop critical problem-solving skills for modern challenges (Okolie et al, 2022). However, industry partnerships and infrastructure support remain underutilized. While collaboration can provide real-world learning applications, issues like insufficient funding and equipment limit their impact. In a related study, stakeholders emphasized the need for government and industry support to improve classroom facilities and establish robust internet access for effective online learning (Ajadi, 2024).

Integrating emerging technologies like Artificial Intelligence (AI) into computer education curricula fosters innovation by enabling personalized learning and automating complex processes. For instance, AI-powered tools support adaptive assessments and real-time feedback, as highlighted in a 2023 study by Oluyemisi, which emphasizes AI's potential to reshape curriculum implementation in Nigerian tertiary institutions (Oluyemisi, 2023). In contrast, a related study by Olatunde-Aiyedun (2024) illustrates the significant role AI plays in generating data-driven insights, thereby tailoring educational strategies to student needs. Project-based learning encourages real-world problem-solving by immersing students in practical applications. The result also emphasizes its effectiveness in bridging theoretical and practical knowledge, aligning with AI integration's goal to enhance educational outcomes. In a related study, Ukeje et al, (2024) highlight how hands-on projects foster creativity and critical thinking, which complement technical competencies. Moreover, collaboration with industries provides invaluable exposure to real-world challenges, enabling students to contextualize their skills. This finding agrees with Nwadinobi et al, (2024), who argue that partnerships offer practical experiences critical for bridging academic and industrial expectations. Emphasizing entrepreneurship in curricula further empowers students to commercialize innovations, a strategy essential for driving technological advancement and economic development.

Conclusion

In conclusion, enhancing computer education for sustainable innovation in higher education in Anambra State, Nigeria, requires a multi-faceted approach involving curriculum development, infrastructure enhancement, and collaborative initiatives. Integrating emerging technologies like artificial intelligence, data science, and coding into the curriculum equips students with critical skills for innovation. Practical, project-based learning methods and entrepreneurship-focused courses further encourage the commercialization of ideas, fostering a culture of technological advancement. The findings emphasize that robust government funding and industry partnerships are essential for providing modern hardware, reliable internet connectivity, and hands-on workshops that bridge the gap between academic theories and real-world applications. Institutions must prioritize adaptive and personalized learning experiences to address diverse student needs, ensuring equitable access to digital resources. Sustainable innovation in higher education hinges on a proactive approach to computer education, where stakeholders—including government, academia, and industry—collaborate to create an ecosystem conducive to innovation.

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