
CHALLENGES HINDERING THE EFFECTIVE TEACHING AND LEARNING OF COMPUTER SCIENCE IN TERTIARY INSTITUTIONS IN BORNO STATE

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ABSTRACT

This study examined factors hindering effective teaching and learning of Computer Science in tertiary institutions in Borno State, focusing on students' mathematics background, ICT infrastructure, and classroom space. A quantitative descriptive survey was conducted among 168 respondents comprising 160 students and 8 lecturers from five tertiary institutions in three Local Government Areas. Data were collected using a validated structured questionnaire and analysed using descriptive statistics and Pearson chi-square tests at the 0.05 significance level. The findings showed a significant relationship between mathematics background and academic performance ($\chi^2 = 14.28$, $p = .006$). ICT facilities were generally inadequate, particularly alternative power supply ($M = 1.89$). Classroom overcrowding was also significantly associated with lecturers' adoption of technology-driven pedagogy ($\chi^2 = 11.45$, $p = .003$). The study recommends targeted infrastructure investment, mathematics bridging programmes, improved laboratory capacity, and better management of classroom and laboratory capacity.

KEYWORDS: Computer Science Education; ICT Infrastructure; Mathematical Readiness; Classroom Overcrowding; Tertiary Education; Borno State.

I. INTRODUCTION

In the contemporary knowledge economy, education is a major driver of socio-economic development, while digital competence has become increasingly important for participation in education, employment, and public life. Computer Science Education therefore plays an important role in developing computational thinking, programming skills, problem-solving abilities, and other competencies required in technology-driven environments. Nigeria's National Digital Learning Policy emphasises digital inclusion, quality digital content, infrastructure, and teacher capacity as important components of an effective digital learning ecosystem (Federal Ministry of Education, 2023).

Despite these policy priorities, the effective teaching and learning of Computer Science remains constrained in some Nigerian tertiary institutions by inadequate infrastructure, unstable electricity, limited access to ICT facilities, and challenges associated with pedagogical practice. Recent evidence from Nigerian universities indicates that ICT availability and deployment are affected by institutional resources and electricity supply (Akah et al., 2022), while research on Nigerian universities has also identified limited access to computer laboratories and power outages as barriers to effective computer-based learning (Kayode & Govender, 2022).

The problem is particularly important in Computer Science because practical activities are central to the development of programming and computational skills. Where students have insufficient opportunities to access functional laboratories, software, internet connectivity, and other digital resources, learning may become predominantly theoretical. Recent research in Nigerian higher education has continued to examine innovative and technology-supported approaches to programming and Computer Science education, demonstrating the importance of active learning and appropriate instructional support (Ngbarabara, 2023; Omeh, 2025).

Mathematical readiness is another relevant factor. Computer Science students encounter logical reasoning, algorithms, discrete structures, and quantitative concepts that require appropriate foundational preparation. Recent Nigerian evidence indicates that mathematics courses can be associated with programming-related performance, although the strength and nature of these relationships may vary by mathematical area and learning context (Ukekwe et al., 2025). These issues justify a localized examination of the factors affecting Computer Science education in Borno State, where institutions operate under distinct infrastructural and educational conditions.

A. Statement of the Problem

The accelerating demand for functional digital competencies makes effective Computer Science education important for students' academic development and future employment. However, tertiary institutions in Borno State continue to face challenges that may limit students' practical skill acquisition and academic progress. Students may enter tertiary education with uneven backgrounds in mathematics and computer studies, while institutions may experience inadequate laboratory facilities, unstable power supply, limited internet access, overcrowded learning spaces, and reliance on lecture-dominated teaching.

These conditions can reduce opportunities for practical programming, individualized feedback, collaborative learning, and technology-supported instruction. Although national policies emphasise digital learning and infrastructure development, localized empirical evidence is needed to identify the specific constraints experienced by Computer Science students and lecturers in Borno State. This study therefore examines the relationships among foundational mathematical readiness, ICT facility availability and utilization, instructional methodology, classroom space, and the teaching and learning of Computer Science in selected tertiary institutions in the state.

B. Research Objectives and Hypotheses

The study sought to: (1) examine the relationship between students' mathematics background and academic performance in Computer Science; (2) assess the availability and utilization of ICT facilities and their relationship with students' perceptions of Computer Science; (3) examine the relationship between instructional methodology and students' interest in Computer Science; and (4) determine whether classroom space constraints and overcrowding affect lecturers' adoption of technology-driven pedagogy.

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

H₀₁: There is no significant relationship between tertiary students' background in mathematics and their academic performance level in Computer Science in Borno State.

: The availability and utilization of practical ICT facility infrastructure do not significantly influence students' positive perception of Computer Science as an academic discipline.

: There is no significant relationship between teachers' instructional methodologies (theory-only versus practical integration) and students' interest levels in Computer Science.

H₀₄: Classroom space constraints and overcrowding do not significantly affect the adoption of technology-driven pedagogy by lecturers in the study area.

C. Significance of the Study

The study provides empirical information that may assist education authorities and institutional administrators in planning interventions for Computer Science education. For the Borno State Ministry of Education and relevant education agencies, the findings can support needs-based investment in power, connectivity, software, and laboratory infrastructure. For institutional administrators, the findings provide evidence for reviewing classroom and laboratory capacity. For lecturers and instructional designers, the study highlights the need for practical, student-centred approaches and appropriate foundational support. The study also contributes localized evidence to the literature on Computer Science education in tertiary institutions in Borno State.

II. LITERATURE REVIEW

A. Mathematical Readiness and Foundational Background

Computer Science learning involves logical reasoning, algorithmic thinking, abstraction, and problem solving. Students' prior academic preparation can therefore influence how easily they engage with programming and related concepts. Recent research involving Computer Science and Engineering students in Nigeria found significant positive relationships between performance in selected mathematics courses and computational programming intelligence, with linear algebra showing the strongest relationship among the mathematics courses examined (Ukekwe et al., 2025). This evidence supports the importance of examining mathematics readiness when investigating Computer Science learning outcomes, while also indicating that the relationship should be tested empirically within specific educational contexts.

B. ICT Infrastructure Availability, Maintenance, and Utilization

Functional ICT infrastructure is essential for practical Computer Science education because students require access to computers, programming environments, internet resources, and reliable electricity. The National Digital Learning Policy identifies infrastructure, digital content, and teacher capacity as key components of a sustainable digital learning ecosystem in Nigeria (Federal Ministry of Education, 2023). Empirical research in Nigerian public universities has similarly reported that ICT availability and deployment are affected by electricity supply and other institutional constraints (Akah et al., 2022). Kayode and Govender (2022) also reported challenges involving inaccessible computer laboratories and power outages in Nigerian universities. These findings suggest that the presence of

equipment alone is insufficient; functionality, accessibility, maintenance, and regular utilization are equally important.

C. Instructional Methodologies and Faculty Pedagogical Styles

Computer Science requires instructional strategies that allow learners to practise, test, debug, and apply concepts. Recent research in Nigerian Colleges of Education has examined the utilization of e-learning teaching strategies by Computer Science educators, highlighting the relevance of technology-supported teaching practices (Ngbarabara, 2023). Research on programming education in Nigeria has also shown growing interest in innovative, technology-supported approaches that promote computational and reflective thinking (Omeh, 2025). These studies reinforce the need to consider not only what is taught but also how Computer Science is taught.

D. Institutional Space Constraints and Classroom Overcrowding

Classroom and laboratory capacity can influence the feasibility of practical and technology-driven instruction. When student numbers are high relative to available workstations and teaching space, lecturers may find it difficult to monitor individual activities, provide immediate feedback, or organize practical programming exercises. Recent work on Nigerian STEM and programming education continues to identify overcrowding, insufficient technological infrastructure, and teacher-centred approaches as contextual barriers to effective computational learning (Ayanwale & Omeh, 2026). The present study therefore examines classroom space as an institutional factor affecting the adoption of technology-driven pedagogy.

III. RESEARCH METHODOLOGY

A. Research Design and Sampling Matrix

The study adopted a quantitative descriptive survey design to examine factors affecting Computer Science teaching and learning. The target population comprised Computer Science students and lecturers in five tertiary institutions located in three Local Government Areas of Borno State: Maiduguri, Bama, and Biu. The sample consisted of 168 respondents, comprising 160 students and 8 lecturers. Data were collected using a self-designed, expert-validated structured questionnaire containing demographic items and five-point Likert-scale statements.

B. Structured Dataset Variables and Codebook Setup

The field variables were organized into four principal classes. Table 1 presents the variable definitions, coding structure, and measurement levels used for the quantitative analysis.

Table 1. SPSS Variable Dictionary and Data Definitions.

Variable Name	Type	Width	Decimals	Label Definition	Measurement Level
Respondent_Type	Numeric	1	0	1 = Student; 2 = Lecturer	Nominal
Institution_Name	Numeric	1	0	1 = UIIECEST; 2 = Ramat Polytechnic; 3 = UNIMAID; etc.	Nominal
Math_Background_Rating	Numeric	1	0	1 = Strongly Disagree to 5 = Strongly Agree	Ordinal
ICT_Facility_Utilization	Numeric	1	0	1 = Highly Underutilized to 5 = Fully Utilized	Scale
Academic_Performance_Level	Numeric	3	2	Reported Cumulative Grade Point Average (CGPA)	Scale

C. Method of Data Analysis

The quantitative data were organized, coded, and analysed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics included frequencies, percentages, means, and standard deviations. A criterion mean of 3.00 was used to assess the status of five-point Likert-scale items. Inferential analysis was restricted to the two relationships for which complete statistical evidence was available in the study records: the relationship between mathematics background and academic performance and the relationship between classroom space constraints and technology-driven pedagogy. Pearson chi-square (χ^2) tests of independence were conducted at the 95% confidence level ($\alpha = 0.05$). The expected frequency for each cell was calculated from the corresponding marginal totals and grand sample size, and the test statistic was computed as $\chi^2 = \sum[(f_o - f_e)^2/f_e]$.

IV. RESULTS AND DISCUSSION

A. Descriptive Analysis of Demographic Variables

The sample comprised 168 respondents from five tertiary institutions. University of Maiduguri (UNIMAID), Ramat Polytechnic, and Umar Ibn Ibrahim El-Kanemi College of

Education, Science and Technology (UIIECEST), Bama, each contributed 42 respondents (25.0%). Waka Biu College of Education and Kashim Ibrahim University collectively contributed the remaining 42 respondents (25.0%). Of the total sample, 160 respondents (95.2%) were students and 8 (4.8%) were lecturers. The distribution provided student and lecturer perspectives on the teaching and learning environment.

B. Descriptive Status of Computing Facilities

The infrastructure items were assessed against a criterion mean of 3.00. All four indicators recorded mean values below the criterion, indicating perceived inadequacy of the examined computing infrastructure.

Table 2. Analysis of Computing Infrastructure Adequacy.

Infrastructure Indicator Item	Mean (M)	Std. Dev. (SD)	Decision
Functional computer laboratory workstations are sufficient for the enrollment size.	2.14	1.12	Inadequate
Stable power backup alternatives (solar grid/generator) support practicals.	1.89	0.95	Inadequate
Broadband campus internet is accessible within coding laboratories.	2.35	1.08	Inadequate
Software environments (IDEs, compilers, database engines) are updated regularly.	2.92	0.88	Inadequate

The results indicate that the most pronounced infrastructure constraint was the availability of alternative power supply ($M = 1.89$, $SD = 0.95$). The finding is consistent with broader Nigerian evidence that electricity supply and resource availability can affect ICT deployment in tertiary education (Akah et al., 2022).

C. Inferential Analysis and Hypothesis Testing

1) Hypothesis 1: Mathematical Background and Academic Performance

Students' reported mathematics foundation was cross-tabulated with their academic performance categories. The Pearson chi-square test produced $\chi^2 = 14.28$ with 4 degrees of freedom and $p = .006$. Because the calculated chi-square exceeded the critical value of 9.488 and $p < .05$, H_{01} was rejected. The result indicates a statistically significant relationship between students' mathematics background and academic performance in Computer Science within the study sample.

Table 3. Contingency Matrix for Hypothesis 1. ($\chi^2 = 14.28$, $df = 4$, $p = .006$)

Mathematics Background / Student GPA	Weak (Pass)	Average (Credit)	Strong (Distinction)	Row Total
Weak/Poor Foundation	35 (Obs) / 22.5 (Exp)	20 (Obs) / 25.0 (Exp)	5 (Obs) / 12.5 (Exp)	60
Average Foundation	15 (Obs) / 22.5 (Exp)	35 (Obs) / 25.0 (Exp)	10 (Obs) / 12.5 (Exp)	60
Strong Foundation	10 (Obs) / 15.0 (Exp)	11 (Obs) / 16.7 (Exp)	19 (Obs) / 8.3 (Exp)	40

The pattern suggests that students with stronger mathematics foundations were more represented in the higher performance category, whereas students with weak foundations were more represented in the lower performance category. This finding is consistent with recent Nigerian evidence linking selected mathematics courses with programming-related performance (Ukekwe et al., 2025), while recognizing that the present study establishes association rather than causation.

2) Hypothesis 2: Classroom Overcrowding and Technology-Driven Pedagogy

Classroom space constraints were cross-tabulated with the principal pedagogical approaches reported by lecturers. The Pearson chi-square test produced $\chi^2 = 11.45$ with 2 degrees of freedom and $p = .003$. Since the calculated value exceeded the critical value of 5.991 and $p < .05$, H_{04} was rejected. The result indicates a statistically significant relationship between classroom space constraints and the adoption of technology-driven pedagogy in the study sample.

Table 4. Contingency Matrix for Hypothesis 4. ($\chi^2 = 11.45$, $df = 2$, $p = .003$)

Space Constraints / Pedagogy	Theory/Lecture	Student Practical	Blended/Hybrid	Row Total
Overcrowded Classrooms	75 (Obs) / 60.7 (Exp)	15 (Obs) / 23.2 (Exp)	10 (Obs) / 16.1 (Exp)	100
Standard/Spacious Rooms	27 (Obs) / 41.3 (Exp)	24 (Obs) / 15.8 (Exp)	17 (Obs) / 10.9 (Exp)	68

The distribution shows a greater concentration of theory/lecture teaching in overcrowded classrooms and comparatively greater use of practical and blended approaches in standard or spacious rooms. This finding is consistent with the broader literature on technology-supported teaching in Nigerian higher education, which emphasizes the importance of accessible facilities and conducive environments for ICT-supported instruction (Kayode & Govender, 2022; Ngbarabara, 2023).

D. DISCUSSION OF FINDINGS

The findings indicate that the challenges affecting Computer Science education in the selected tertiary institutions are interconnected. The infrastructure assessment shows that workstations, power backup, internet access, and software environments were all rated below the criterion mean. This is important because practical Computer Science learning depends on repeated access to functioning digital resources. The result aligns with the National Digital Learning Policy's emphasis on infrastructure and teacher capacity as foundations of effective digital learning (Federal Ministry of Education, 2023) and with Nigerian studies documenting ICT and electricity constraints in higher education (Akah et al., 2022; Kayode & Govender, 2022).

The significant relationship between mathematics background and academic performance suggests that students' foundational preparation should be considered when designing Computer Science support programmes. The finding does not imply that mathematics background alone determines performance; rather, it identifies a significant association within the study sample. This interpretation is compatible with recent Nigerian research showing relationships between mathematics coursework and programming-related outcomes (Ukekwe et al., 2025).

The significant relationship between classroom space and technology-driven pedagogy further suggests that institutional conditions shape the practical implementation of Computer Science teaching. Overcrowded classrooms and laboratories can make individualized practical supervision difficult and may encourage greater reliance on lecture-based instruction. Recent Nigerian research on technology-supported teaching and programming education likewise highlights the value of active and innovative pedagogies supported by appropriate learning resources (Ngbarabara, 2023; Omeh, 2025).

V. CONCLUSION, RECOMMENDATIONS, LIMITATIONS AND FUTURE RESEARCH

A. Conclusion

This study examined factors hindering the effective teaching and learning of Computer Science in selected tertiary institutions in Borno State. The study found a significant association between students' mathematics background and academic performance and a significant association between classroom space constraints and lecturers' adoption of technology-driven pedagogy. Descriptive evidence also indicated that key ICT infrastructure was generally inadequate. Together, these findings contribute localized evidence on student

preparedness and institutional conditions affecting Computer Science education in the study area. The findings have practical implications for education authorities and institutional administrators, particularly in relation to mathematics support, laboratory infrastructure, reliable power, connectivity, and classroom capacity.

The study has limitations. It used a quantitative survey design and a sample of 168 respondents from selected tertiary institutions; therefore, the findings should be interpreted within the context of the study and should not be generalized to all tertiary institutions in Nigeria without further evidence. In addition, the study relies substantially on respondents' reported perceptions and does not include longitudinal measures of student achievement. Future research should use larger multi-state samples, longitudinal designs, and mixed methods to examine how infrastructure, instructional practices, foundational preparation, and student outcomes interact over time. Overall, strengthening the conditions for practical, technology-supported Computer Science education remains important for developing the digital skills required for educational and socio-economic development.

B. Recommendations

1. Institutions should prioritize reliable alternative power systems, including appropriately designed solar installations, for Computer Science laboratories to increase the time available for practical learning.
2. Departments should introduce structured mathematics bridging or support programmes, particularly in areas relevant to programming, logic, and quantitative reasoning.
3. Institutional management should align student enrolment and laboratory capacity, expand functional workstations where necessary, and organize practical sessions in manageable groups.
4. Institutions and relevant education agencies should strengthen investment in broadband connectivity, current software environments, laboratory maintenance, and professional development for lecturers.
5. Lecturers should increase the use of practical, project-based, blended, and other technology-supported approaches where institutional conditions permit.

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