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Mobile Learning Tools and Academic Achievement in Computer Science Education

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ABSTRACT

This study examined the relationship between the use of mobile learning tools and the academic achievement of Computer Science Education students in public tertiary institutions in Enugu State, Nigeria. Three research questions and three null hypotheses guided the study. A correlational survey design was adopted. The population comprised 1,300 Computer Science Education students in three public tertiary institutions, from which a sample of 297 was drawn using proportionate stratified random sampling. A total of 284 valid responses were analysed. Data were collected with a validated Mobile Learning Tools Utilisation Questionnaire (MLTUQ, $\alpha = .86$) and an achievement proforma recording students' scores in core computer science courses. Research questions were answered using mean, standard deviation, Pearson product moment correlation and multiple regression, while hypotheses were tested with regression analysis and independent samples t tests at the .05 level of significance. Findings revealed that students used mobile learning tools to a high extent (grand mean = 2.77), with communication, search and reference tools used more than coding practice and self-assessment tools. A moderate, positive and significant relationship existed between mobile learning tools use and academic achievement ($r = .47$, $p < .001$). Coding practice tools made the strongest unique contribution to achievement, followed by content access tools, while communication tools made no significant contribution. High users of mobile learning tools achieved significantly higher than low users, and no significant gender difference existed in the extent of use. The study recommends deliberate integration of mobile coding environments into Computer Science Education curricula, capacity building for lecturers on mobile pedagogy, and institutional support for affordable data access.

Keywords: *mobile learning, academic achievement, computer science education, coding apps, tertiary institutions, Enugu State*

1. INTRODUCTION

Computer Science Education occupies a strategic position in Nigeria's effort to build a digitally competent workforce. Graduates of the programme are expected not only to master programming, database management, networking and systems analysis, but also to teach these competencies to learners at the secondary and tertiary levels. The National Policy on Education emphasises the use of information and communication technology to improve the quality of teaching and learning at all levels of education (Federal Republic of Nigeria, 2014). Yet students in Computer Science Education programmes frequently record weak performance in foundational courses, particularly programming,

where conceptual difficulty, limited laboratory time and inadequate access to computers combine to depress achievement (Robins et al., 2003; Bennedsen & Caspersen, 2007).

Over the past decade, the rapid spread of smartphones among Nigerian tertiary students has created a new and largely informal learning ecosystem. Students now carry devices capable of running code editors, compilers, video tutorials, learning management systems, electronic books and artificial intelligence assistants. Mobile learning, broadly understood as learning across multiple contexts through social and content interactions using personal electronic devices (Crompton, 2013), therefore offers a potential remedy for the shortage of desktop computers and the rigidity of timetabled laboratory sessions. International meta-analyses indicate that integrating mobile devices into teaching and learning produces moderate positive effects on students' learning performance (Sung et al., 2016), and systematic reviews show steady growth in mobile learning use in higher education (Crompton & Burke, 2018).

In Enugu State, public tertiary institutions offering Computer Science Education continue to grapple with large class sizes, erratic electricity supply and an unfavourable ratio of students to functional computers. In such settings, the smartphone is often the only computing device a student owns. Casual observation suggests that students use their phones intensively for academic purposes, especially through WhatsApp class groups, YouTube tutorials and internet searches. What remains unclear is whether this use translates into better academic achievement, and which categories of mobile learning tools matter most. Much of the existing African evidence focuses on students' attitudes towards and readiness for mobile learning (Kaliisa & Picard, 2017) rather than on its relationship with measured achievement in a specific discipline.

1.1 Statement of the problem

Despite widespread smartphone ownership among Computer Science Education students in Enugu State, achievement in core computing courses remains a concern to lecturers and administrators. Students often reach final examinations with limited hands-on programming experience because laboratory access is restricted. At the same time, much of their mobile activity may be social rather than academic, and the tools they use most, such as messaging platforms, may not be those that best support the development of computational skills. Without empirical evidence on the extent of mobile learning tools use and how different categories of tools relate to achievement, institutions cannot design informed policies on mobile-supported instruction. The problem of this study, therefore, is: to what extent do Computer Science Education students in Enugu State use mobile learning tools, and how is this use related to their academic achievement?

1.2 Purpose, questions and hypotheses

The study sought to determine the extent to which students use mobile learning tools, the relationship between that use and academic achievement, and the relative contributions of coding practice tools, content access tools and communication tools. H01 stated that the three tool categories do not jointly or individually predict achievement. H02 stated that there is no significant difference in the mean academic achievement of high users and low users. H03 stated that there is no significant difference in the mean extent of use between male and female students.

2. LITERATURE REVIEW

Mobile learning tools are software applications and services accessed through handheld devices, principally smartphones and tablets, that support the acquisition, practice or sharing of knowledge. Park (2011) classified educational applications of mobile technologies according to transactional distance and the individual or collaborative nature of activity. For Computer Science Education, three

categories are especially relevant. Coding practice tools include mobile code editors and compilers, interactive coding courses, quiz applications and programming forums. Content access tools include mobile learning management systems, video tutorials, recorded lectures and electronic books. Communication tools include instant messaging and channel-based platforms used to share materials and discuss coursework. Academic achievement, in this study, refers to students' measured performance in core computer science courses, expressed as percentage scores obtained from continuous assessment and examinations.

The study is anchored on the Technology Acceptance Model and Connectivism. TAM proposes that perceived usefulness and perceived ease of use determine intention and actual use (Davis, 1989). The model explains why students gravitate towards familiar and effortless tools, such as messaging applications, while more demanding tools, such as mobile compilers, may be under-used even when they are pedagogically valuable. The Unified Theory of Acceptance and Use of Technology adds social influence and facilitating conditions (Venkatesh et al., 2003), both of which are salient in Nigerian institutions where data costs and peer norms shape device use. Connectivism holds that learning resides in networks of people and digital resources, and that the capacity to locate and connect to current knowledge is itself a core learning outcome (Siemens, 2005).

Wu et al. (2012) reviewed mobile learning studies and reported that most investigations of effectiveness recorded positive outcomes. Sung et al. (2016), in a meta-analysis of 110 experimental and quasi-experimental studies, found a moderate overall positive effect of mobile device integration on learning performance, with larger effects where mobile activities were purposefully designed rather than incidental. Crompton and Burke (2018) found that higher education studies most often reported positive outcomes for achievement and engagement. In the African context, Kaliisa and Picard (2017)

observed that mobile learning research was growing but was dominated by studies of perception and readiness. Within computing education, Robins et al. (2003) argued that novices struggle less with syntax than with constructing mental models of program execution, a problem best addressed through frequent practice and feedback. Bennedsen and Caspersen (2007) reported substantial failure rates in introductory programming courses internationally. These findings imply that tools which increase opportunities for hands-on coding practice may matter more for achievement than tools that merely distribute content.

3. METHODOLOGY

The study adopted a correlational survey design. It was carried out in three public institutions offering Computer Science Education in Enugu State: the University of Nigeria, Nsukka; the Federal College of Education, Eha-Amufu; and the Enugu State College of Education (Technical), Enugu. The population consisted of 1,300 Computer Science Education students across the first three levels of study during the 2025/2026 academic session. A sample of 297 students was determined using the Krejcie and Morgan (1970) table. Proportionate stratified random sampling used institution and level of study as strata. Of the 297 questionnaires administered, 284 were correctly completed and matched with achievement records, giving a usable return rate of 95.6%.

The Mobile Learning Tools Utilisation Questionnaire contained 12 items rated on a four-point scale from very high extent (4) to very low extent (1). Items were grouped into coding practice tools, content access tools and communication tools. An Academic Achievement Proforma recorded each respondent's mean percentage score in core computer science courses for the preceding semester. Three experts validated the questionnaire. A trial of 30 students in Ebonyi State produced subscale alphas of .81, .79 and .77 and a total alpha of .86 (Taber, 2018). A mean of 2.50 and above was

interpreted as high extent. Analyses used Pearson correlation, multiple regression and independent samples t tests in SPSS 27 at α = .05. Respondents with a mean MLTUQ score of 2.50 and above were classified as high users.

4. RESULTS

Table 1. Demographic characteristics of respondents (N = 284)

Variable	Category	n	%
Gender	Male	158	55.6
	Female	126	44.4
Institution	UNN, Nsukka	118	41.5
	FCE, Eha-Amufu	80	28.2
	ESCET, Enugu	86	30.3
Level of study	Year I	92	32.4
	Year II	101	35.6
	Year III	91	32.0
Device	Owns a smartphone	271	95.4
	No smartphone	13	4.6

Male respondents slightly outnumbered female respondents. The sample was fairly evenly distributed across levels of study. Nearly all respondents (95.4%) owned a smartphone.

Table 2. Extent of mobile learning tools use (N = 284)

Item	Mean	SD	Decision
WhatsApp class groups	3.41	0.68	High
YouTube programming tutorials	3.28	0.74	High
Interactive coding apps	2.63	0.91	High

Mobile code editors/compilers	2.41	0.97	Low
LMS on phone	2.57	0.88	High
PDF e-books and notes	3.19	0.71	High
AI assistants for code/concepts	2.86	0.93	High
Telegram tech channels	2.52	0.95	High
Quiz apps	2.18	0.96	Low
Programming forums on phone	2.34	0.99	Low
Recorded lectures	2.46	0.94	Low
Mobile web search	3.37	0.66	High
Grand mean	2.77	0.62	High

Eight of the 12 tools were used to a high extent. Use is concentrated on communication and content access rather than hands-on coding practice. The grand mean of 2.77 indicates high overall use.

Table 3. Correlation between tools use and academic achievement

Variable	N	Mean	SD	r	p
Tools use	284	2.77	0.62	.47	<.001
Achievement (%)	284	58.42	11.37	,	,

The relationship is moderate and positive. The coefficient of determination ($r^2 = .22$) indicates that 22% of the variance in achievement is associated with extent of mobile learning tools use.

Table 4. Multiple regression of tool categories on achievement

Predictor	B	β	t	p
Constant	34.16	,	10.95	<.001
Coding practice tools	4.82	.36	6.43	<.001
Content access tools	3.15	.21	3.71	<.001
Communication tools	0.97	.06	1.08	.281

R = .52, R^2 = .27, adjusted R^2 = .26, F(3, 280) = 34.52, p < .001. H01 was rejected for the joint model and for coding practice and content access tools, but retained for communication tools.

Table 5. Achievement of high versus low users

Group	n	Mean	SD	t	p	d
High users	176	62.37	10.12	8.17	<.001	1.00
Low users	108	51.98	10.84	,	,	,

H02 was rejected. Male (M = 2.81) and female (M = 2.72) students did not differ in extent of use, t(282) = 1.22, p = .224. H03 was retained.

5. DISCUSSION

High overall use matches near-universal smartphone ownership and global higher-education trends (Crompton & Burke, 2018). The skew toward WhatsApp, search and YouTube fits TAM's ease of use prediction (Davis, 1989). The moderate use, achievement correlation accords with Sung et al. (2016). The large achievement gap between high and low users strengthens this interpretation, although the correlational design means that more motivated students may simply be both heavier users and higher achievers.

The most instructive finding concerns the differential contributions of tool categories. Coding practice tools, despite being the least used, made the strongest unique contribution to achievement, whereas communication tools, the most used, made no significant unique contribution once the other categories were controlled (Robins et al., 2003; Park, 2011). The benefit of mobile learning in Computer Science Education lies less in how much students use their phones than in what they do with them. The absence of a significant gender difference in use is encouraging.

Al-Emran et al. (2016) found that students in higher education generally held positive attitudes towards mobile learning, although differences emerged by device ownership and level of study. Hamidi and Chavoshi (2018) identified perceived usefulness, ease of use and facilitating conditions as key determinants of mobile learning adoption among university students. Sabah (2016) showed that awareness and individual differences shaped students' intention to use mobile learning. Hwang and Tsai (2011) documented rising research interest in mobile and ubiquitous learning across science and engineering disciplines.

The reviewed literature shows that mobile learning is associated with positive learning outcomes, but evidence is drawn largely from outside Nigeria, rarely disaggregates tool categories, and seldom focuses on Computer Science Education. There is a notable absence of studies relating the extent and type of mobile learning tools use to measured achievement among Computer Science Education students in Enugu State. The present study addresses this gap.

The correlational design does not permit causal conclusions about the effect of mobile learning tools on achievement. Extent of use was self-reported and may be subject to recall or social desirability bias, and the study was limited to three public institutions in one state. These limits bound the claims but do not erase the practical signal that coding practice tools, though under-used, are the strongest unique predictor of achievement.

6. CONCLUSION AND RECOMMENDATIONS

Mobile learning tools are widely used by Computer Science Education students in public tertiary institutions in Enugu State and are positively and significantly related to their academic achievement. Tools that enable hands-on coding practice and structured access to course content contribute

meaningfully to achievement, while communication tools, though heavily used, add little on their own. Male and female students use mobile learning tools to a comparable extent.

Lecturers should integrate mobile code editors, interactive coding apps and quiz applications into assignments and continuous assessment. Management of tertiary institutions should provide campus-wide Wi-Fi and negotiate subsidised educational data bundles. Institutions should organise capacity-building workshops for lecturers on mobile pedagogy. Departments should formalise learning management systems accessible on mobile devices. Student orientation should highlight tools that support hands-on skill development. Future studies could employ quasi-experimental designs, device-level usage analytics, and samples from private institutions and other states in South-East Nigeria.

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Taken together, the evidence presented in this article is intended to inform classroom practice, teacher education and education-office supervision in Enugu State. The recommended actions are feasible with existing staff, existing compounds or devices, and existing scheme-of-work time, provided that school leaders protect the instructional routine long enough for teachers and students to internalize it.