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DIGITAL SKILLS DEVELOPMENT AND WORKFORCE READINESS IN THE 21ST CENTURY: A PHYSICS EDUCATION PERSPECTIVE

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ABSTRACT

Digital competence has become one of the defining measures of workforce readiness in the twenty-first century, with fluency in digital tools and computational thinking increasingly treated as being on par with, or more important than, conventional literacy when assessing employability. This paper considers digital skills development and workforce readiness through the lens of physics education, a discipline whose core methods, quantitative reasoning, data handling, and structured problem-solving, align closely with computational thinking. Drawing on literature published between 2020 and 2026, the paper reviews Nigeria's digital skills policy landscape, including the 2023 National Digital Skills Framework and National Digital Literacy Framework, together with World Bank projections indicating that around twenty-eight million Nigerian workers will need digital-skills training by 2030 . It also considers how the 2025 national curriculum reform brought programming, artificial intelligence, and data science into the curriculum alongside a newly structured physics syllabus, creating an opening to link computational and physics teaching more deliberately than earlier curricula allowed. The paper finds that, notwithstanding reasonably coherent national policy, implementation continues to lag behind ambition because of limited digital infrastructure, underprepared teachers, and a persistent disconnect between policy intent and what actually happens in classrooms. It argues that physics education is unusually well placed to help narrow this gap, provided computational tools are woven directly into physics teaching rather than left as a separate, parallel track.

Keywords: digital skills; workforce readiness; physics education; computational literacy; digital literacy; Nigeria

1.INTRODUCTION

Competence in digital tools is now widely treated as a core marker of employability and economic participation, with some assessments suggesting it rivals, or exceeds, fluency in a national language as an indicator of a person's readiness for work [1]. This carries particular weight in Nigeria, where the World Bank projects that roughly twenty-eight million workers will need digital-skills training by 2030, a transformation large enough to touch nearly every sector of the economy, including fields that have traditionally drawn on physics and applied-science graduates [2].

Physics education sits in an unusual position within this shift. Its central skills, quantitative reasoning, mathematical modelling, and methodical problem-solving, overlap substantially with the computational thinking that digital-economy employers increasingly look for. Nigeria's 2025 curriculum reform reflects this connection directly: programming, artificial intelligence, and data science now appear as formal subjects alongside a restructured physics syllabus covering mechanics, waves, electricity, and nuclear physics [3], [4]. This paper asks whether, and how, Nigeria's digital-skills policy architecture and its physics curriculum can be brought into closer alignment to support workforce readiness.

Three questions guide the discussion: (a) what is the scale and shape of Nigeria's digital-skills challenge and the policy response to it; (b) what does available evidence say about the gap between that policy and what happens in classrooms; and (c) what specific role can physics education play in closing the gap. The Methodology section sets out the review approach. The Results and Discussion section then works through Nigeria's policy architecture, the implementation gap, a synthesis linking policy to physics-relevant curriculum reform, and closes with recommendations and a conclusion.

2.METHODOLOGY

This paper uses a narrative literature review combined with policy document analysis to examine digital skills development and workforce readiness in Nigeria from a physics education standpoint. Policy analysis focused on Nigeria's 2023 National Digital Skills Framework and National Digital Literacy Framework, and the 2025 curriculum reform, given the direct relevance of these documents and the still-limited body of independent peer-reviewed work evaluating their implementation.

Academic sources were located through structured searches of ResearchGate, Taylor & Francis Online, and relevant World Bank and Nigerian federal agency publications, combining search terms such as "digital skills," "digital literacy," "workforce readiness," "physics education," and "Nigeria." The review favoured material published between 2020 and 2026, while retaining one earlier systematic review of the relationship between twenty-first-century skills and digital skills [5] as conceptual grounding, given how frequently it is cited in this area of research.

Findings were organised into a policy-to-curriculum framework and summarised in a comparative table (Table 1) that maps key digital-skills policies and curriculum reforms against their relevance to physics and computational readiness. Claims about policy provisions, workforce projections, and curriculum content are attributed to their originating source throughout; the argument connecting physics education to Nigeria's digital-skills gap is the paper's own analytical contribution.

3.RESULTS AND DISCUSSION

3.1Conceptual Background: Digital Skills as 21st-Century Workforce Readiness

The idea of digital literacy has moved on from a narrow, technical definition centred on operating a computer toward a broader set of cognitive, social, and technical competencies needed to function in densely digital environments [6]. An earlier systematic review established that twenty-first-century skills, critical thinking, collaboration, and problem-solving among them, are closely bound up with digital skills specifically, rather than sitting in a separate category [5]. More recent analysis describes a 'digital skills gap' that runs through the whole economy rather than being confined to programmers or data scientists, reflecting a broader shortfall in the skills needed for efficient, creative, and collaborative work with technology [6].

3.2Nigeria's Digital Skills Policy Architecture

The Scale of Nigeria's Digital Skills Challenge

The scale of Nigeria's digital-skills challenge is considerable. World Bank analysis puts the number of workers who will need digital-skills training by 2030 at roughly twenty-eight million, a figure that reflects the scale of change required across the economy [2]. The same assessment notes that access to computers, the internet, and digital learning tools remains a basic precondition for a digitally literate society, and that public-private partnerships could help mobilise the resources needed to close the gap [2].

National Policy Response: The 2023 Frameworks

Nigeria responded to this challenge by approving two policy frameworks in 2023: the National Digital Skills Framework and the National Digital Literacy Framework [1], [2]. The Digital Literacy Framework treats digital literacy as central to resolving Nigeria's difficulties around education, unemployment, low productivity, and economic diversification, placing digital competence on the same footing as traditional language literacy in determining job readiness [1]. It also establishes a Digital Literacy Institute tasked with leading training, assessment, and certification nationally [1].

The 2025 Curriculum Reform: Formal Integration of Coding and Physics

Nigeria's 2025 curriculum reform is the clearest structural attempt so far to bring digital-skills development and formal science education together. At junior secondary level, Digital Literacy and Coding becomes a formal subject covering Python basics, Scratch programming, and robotics kits, taught alongside Integrated Science, which spans physics, chemistry, biology, and earth science [3], [4]. At senior secondary level, the Technology and Innovation strand extends to more advanced programming in Python, JavaScript, and HTML/CSS, plus data science, artificial intelligence, and cybersecurity, running in parallel with an expanded Sciences track covering mechanics, waves, electricity, and nuclear physics [3]. Placing computational and physics instruction side by side like this opens a real, though not automatic, opportunity for the two to be taught together.

3.3 The Gap Between Policy Design and Classroom Implementation

Infrastructure and Teacher Preparedness Constraints

Well-designed policy has not translated smoothly into classroom practice. A systematic review covering fourteen empirical studies from Sub-Saharan Africa published between 2016 and 2023 found that digital skills among higher-education students remain underdeveloped, largely because of weak digital infrastructure and lecturers who are not well prepared, compounded by ICT policies that are outdated or simply absent [7]. This lines up with Nigeria-specific evidence that most Nigerian teachers lack functional digital literacy, a constraint that bears directly on how well the newly introduced coding and computational strands can be delivered alongside physics instruction [1].

Community-Level Interventions and Their Limits

Smaller-scale interventions offer some indication of what can work. Action research on a peer-led digital literacy mentorship programme in Igbaja, a rural community in Kwara State, found that mentorship made a substantial difference in closing digital literacy gaps among young people, particularly where technology access, internet connectivity, and trained mentors were all in short supply [8]. Promising as this is, such interventions are localised and cannot on their own replace the systemic infrastructure and teacher-training investment that national-scale digital-skills development requires.

3.4 Synthesis: Connecting Digital Skills Policy to Physics Education

Table 1 sets Nigeria's digital-skills policy architecture and 2025 curriculum reform against their relevance to physics and computational readiness. It suggests that Nigeria has a reasonably coherent policy base, spanning national framework, institutional infrastructure, and curriculum reform, but that turning this into integrated physics-computational teaching at classroom level remains largely unaddressed.

Table 1 :*Nigeria's Digital Skills Policy Architecture and Relevance to Physics*

Policy/Reform	Key Provision	Relevance to Physics/Computational Readiness
National Digital Skills Framework (2023)	Approved federal framework guiding digital skills strategy nationally [2]	Provides the policy umbrella under which computational-physics and STEM digital skills integration could be coordinated
National Digital Literacy Framework (2023)	Establishes digital literacy as a criterion for employment and economic diversification, with a Digital Literacy Institute leading training, assessment, and certification [1]	Frames digital literacy as equally foundational to employability as core academic literacy, directly relevant to computational physics skills
2025 NERDC Curriculum Reform: Digital Literacy and Coding strand	Introduces Python basics, Scratch, and robotics at junior secondary level, and advanced programming, data science, and AI at senior secondary level, alongside Integrated Science [3], [4]	Creates formal curricular space to connect physics content (mechanics, waves, electricity) with parallel computational and data-science instruction
World Bank/Federal Government digital skills demand projection	Nigeria's labour force projected to require approximately 28 million digitally skilled workers by 2030 [2]	Establishes the scale of workforce transformation physics and STEM education must help support over the coming decade

3.5 Implications: Physics as a Natural Bridge to Computational Literacy

This evidence points toward physics education as a natural entry point for narrowing Nigeria's digital-skills gap, given its inherent grounding in quantitative reasoning, data analysis, and systematic problem-solving, competencies that overlap substantially with the digital skills the literature identifies as most critically lacking [6]. Rather than running the new Digital Literacy and Coding strand alongside the Sciences strand as two unconnected tracks, physics teachers could use programming exercises to model physical phenomena, analyse experimental data, and visualise concepts such as motion, waves, and electrical circuits, reinforcing both computational and physics learning at the same time. Realising this, however, depends on tackling the teacher-preparedness and infrastructure constraints noted above with the same urgency currently given to curriculum design.

This bridging role is more than curricular convenience; it reflects a pedagogical opportunity that is particularly strong in physics among the sciences. Chemistry and biology teaching can certainly incorporate computational tools too, but physics content, motion, waves, circuits, and energy, lends itself especially well to direct computational modelling and simulation, because the underlying mathematical relationships are usually explicit and straightforward to visualise through simple programs. A physics teacher who can guide students through writing a short program to plot projectile motion, model a basic circuit, or simulate wave interference is teaching physics and computational thinking at the same time, precisely the combination Nigeria's digital-skills policy and curriculum reform are trying to build. This suggests that investment in physics teachers' computational capacity may deliver disproportionately strong returns relative to investment in other subjects, given how naturally physics content maps onto computational representation.

4.RECOMMENDATIONS

1. Build computational tools into physics laboratory instruction. Physics teacher training should explicitly include programming tools such as Python for analysing data and modelling physical phenomena, linking the new Digital Literacy and Coding strand directly to Sciences instruction [3].
2. Prioritise digital literacy training for physics teachers. Given documented shortfalls in teacher digital literacy, professional development should treat physics and science teachers as a priority group, given their central role in delivering the newly integrated curriculum [1].
3. Scale evidence-based community mentorship models. The demonstrated success of peer-led mentorship in rural settings such as Igbaja suggests this model could be adapted for physics-relevant computational skills in underserved communities [8].
4. Align infrastructure investment with curriculum rollout timelines. Given the documented link between weak digital infrastructure and poor outcomes, government should ensure computer laboratories and connectivity are in place ahead of, not after, each cohort's move to the new curriculum [7].
5. Establish monitoring metrics linking digital-skills policy to physics learning outcomes. The National Digital Skills Framework and Digital Literacy Institute should track whether computational literacy gains are translating into stronger physics problem-solving and data-analysis competence, rather than relying solely on generic digital-skills metrics [1].

5.CONCLUSION

Nigeria faces a digital-skills challenge of substantial scale, with the labour force projected to need roughly twenty-eight million digitally skilled workers by 2030. The country has put together a reasonably coherent policy response, including the 2023 National Digital Skills Framework and National Digital Literacy Framework, and has structurally embedded computational subjects alongside physics content in its 2025 curriculum reform. Persistent gaps in digital infrastructure and teacher preparedness, however, continue to separate policy ambition from classroom reality. Physics education, given its grounding in quantitative reasoning and systematic problem-solving, is well placed to bridge Nigeria's digital-skills policy goals and classroom practice, provided computational tools are deliberately built into physics teaching rather than kept as a separate track. Achieving this will require sustained investment in physics teachers' digital literacy and in classroom infrastructure, matched to the ambition already evident in Nigeria's policy design.

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