



Integration of Pragmatic Pedagogical Approaches in Basic Science and Technology Education Teaching among Post-Basic Schools in Nigeria: A Systematic Review

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Abstract

This paper examines the integration of pragmatic pedagogical approaches within the Basic Science and Technology (BST) curriculum under Nigeria's Universal Basic Education (UBE) framework. Grounded in John Dewey's philosophy of experimental pragmatism ("learning by doing"), the study addresses the systemic failure of traditional, teacher-centered rote instruction to cultivate functional scientific literacy and self-reliance among Nigerian youth. Through a conceptual analysis, this paper explores adaptable, student-centered strategies—including Project-Based Learning (PBL), Ethno-Scientific Contextualization, and Collaborative Inquiry Syndicates—proposing a structured curriculum matrix tailored to navigate large class sizes and severe resource constraints through low-cost instructional improvisation. The study analyzes critical structural barriers, such as infrastructural deficits, teacher professional inertia, and the constraints of terminal, exam-centric testing. Ultimately, the paper provides a holistic conceptual framework and offers actionable, multi-tiered policy recommendations for curriculum re-engineering, localized teacher up skilling, and assessment reforms necessary to foster a technologically proficient, inventive, and self-reliant generation.

Keywords: Pragmatic Pedagogical Approach, Basic Science and Technology Education, Teaching

Introduction

Education serves as the primary engine for sustainable national development, technological advancement, and economic self-reliance. Recognizing this imperative, the Federal Government of Nigeria, through the Nigerian Educational Research and Development Council (NERDC), restructured the basic education curriculum to establish the Basic Science and Technology (BST) theme under the 9-Year Universal Basic Education (UBE) programme. This integrated theme—comprising Basic Science, Basic Technology, Computer Studies (ICT), and Physical and Health Education—was intentionally designed to lay a solid foundation for scientific literacy, critical thinking, and inventive problem-solving from an early age. However, a severe disconnect persists between the progressive objectives stated in the National Policy on Education and the instructional realities of the average Nigerian classroom. Driven by institutional pressures to cover dense syllabi ahead of high-stakes standardized examinations, instruction remains overwhelmingly dominated by what Paulo Freire termed the "banking concept" of education. Teachers default to passive, lecture-style dictation, treating knowledge as an abstract, static commodity. Science laboratories, where they exist, are frequently non-functional or treated as restricted demonstration zones rather than active spaces for hands-on exploration. Consequently, students view science and technology as alien, theoretical frameworks detached from their lived socio-cultural and economic realities. To bridge this chasm, a profound paradigm shift toward pragmatic pedagogies is essential. Rooted in the philosophical traditions of Charles Sanders Peirce, William James, and John Dewey, pragmatism asserts that the validity and value of knowledge reside entirely in its practical application and utility.



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When operationalized within the BST framework, pragmatic pedagogy transforms the classroom from a site of passive reception into an active laboratory of discovery, where learning is an iterative, transactional process between the student and their immediate environment. This paper provides a comprehensive conceptual examination of pragmatic pedagogical approaches within Nigerian basic education. By analyzing localized instructional strategies, designing an adaptable curriculum matrix, and addressing systemic institutional barriers, this study outlines a clear pathway toward a functional, experiential, and self-reliant model of science and technology education in Nigeria.

Literature Review

The discourse surrounding the effectiveness of Basic Science and Technology (BST) instruction in Nigeria has gained significant traction among indigenous scholars, particularly concerning the persistent failure of traditional instructional methods. This section evaluates the current literature across three primary thematic areas: the crisis of pedagogical delivery in Nigeria, the concept of strategic instructional improvisation, and the integration of ethno-science within the school curriculum.

The Crisis of Pedagogical Delivery in Nigerian BST Education

Numerous Nigerian scholars have documented the systemic limitations of the traditional lecture method—often referred to as the "talk-and-chalk" approach. Okebukola (2020) argues that science instruction in Nigerian secondary schools remains fundamentally moribund due to its over-reliance on rote memorisation. This method treats science as an absolute, immutable body of facts rather than an active process of inquiry. Furthermore, research by Jegede (2017) highlights the "cognitive dissonance" experienced by Nigerian learners when abstract scientific laws are taught without physical contexts or tactile experimentation. In a highly crowded classroom environment, typical of urban public schools in states like Lagos and Kano, the teacher's role defaults to an authoritarian information provider, rendering students passive observers in their own educational journey.

Strategic Instructional Improvisation in Resource-Constrained Environments

Given the chronic underfunding of public education, the absence of standard laboratory apparatus (such as glass beakers, indicators, and test tubes) is a defining feature of the Nigerian educational landscape. To counter this bottleneck, the concept of Instructional Improvisation has emerged as a central focus within indigenous educational research. Onoja (2019) defines improvisation as the deliberate sourcing, design, and deployment of local, low-cost, or upcycled materials from the immediate environment to replicate standard educational equipment. Scholars such as Bichi (2021) have demonstrated empirically that students taught using improvised materials often perform as well as, or better than, peers taught using conventional laboratory equipment. This is because the act of sourcing and building improvised tools forces students into an active, hands-on relationship with scientific principles. Pragmatically, improvisation is not merely a desperate stopgap for poverty; it is an active pedagogical strategy that demystifies science by stripping it of its foreign, industrial mystique and grounding it in everyday household materials.

Ethno-Science and Indigenous Knowledge Systems (IKS)

A critical sub-theme in contemporary Nigerian science education is Ethno-science—the study of scientific ideas from the perspective of local cultures. Historically, Western-style schooling in Africa severed the connection between school science and community practices. Eshiet (2018) points out that traditional Nigerian societies possess highly sophisticated, functional scientific knowledge, ranging from food preservation (smoking fish, fermenting cassava) to chemical processing (local soap making, palm oil extraction) and metallurgy. When teachers consciously integrate these indigenous knowledge systems into the BST curriculum, they bridge the cultural alienation often felt by African

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children. By utilizing local socio-industrial processes as primary teaching aids, the educator validates the student's prior cultural experiences, creating a smoother cognitive transition into formal scientific reasoning.

Conceptual Framework

Philosophical Alignment: Mapping Dewey onto African Communalism

The conceptual framework of this study synthesizes John Dewey's *Transactional Theory of Learning* with the socio-cultural principles of *African Communalism* (often articulated through the concept of *Ubuntu* or *Omoluwabi*). Dewey's pragmatism posits that learning is not a passive internal cognitive state, but an active, transactional process between the organism (the student) and their environment. Knowledge is a tool generated to resolve a felt disruption or problem in that environment.

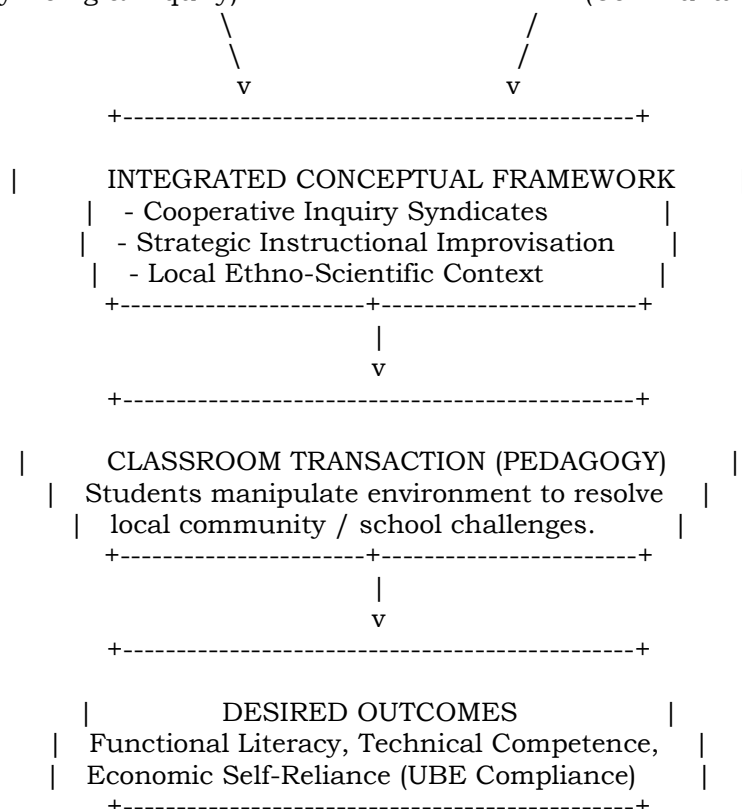
In the African context, this transactional relationship is naturally collective rather than individualistic. Traditional African education was inherently pragmatic and communal; children learned agriculture, medicine, and engineering by actively participating in the daily socioeconomic life of the community alongside adult mentors.

JOHN DEWEY'S PRAGMATISM

(Learning by Doing & Inquiry)

AFRICAN COMMUNALISM

(Communalism & Self-Reliance)



Operational Framework Components

This framework models how these two philosophies intersect to dictate instructional delivery within the Nigerian Universal Basic Education (UBE) system:

1. The Experiential Stimulus (The Localized Problem): The pedagogical process begins with a real, observable problem within the school or local community (poor drainage, waste accumulation, crop pests). This acts as the disruptive trigger that initiates reflective thought.



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2. The Cooperative Inquiry Syndicate: To navigate large class sizes, students are organized into collective units that mirror traditional communal work groups. Learning becomes a social dialogue where students debate, share tasks, and collaborate on solutions.
3. The Transactional Manipulation (Improvisation): Students actively alter their environment by sourcing local waste or natural materials to construct functional, physical prototypes (artifacts).
4. The Evaluation of Utility (Authentic Assessment): In strict alignment with pragmatic philosophy, the project is judged not on its ability to match a textbook definition, but on its functional utility—does the filter clarify the water? Does the mechanical pulley reduce the effort needed to lift the load?

By blending Deweyan transaction with local communal structures, this framework provides a culturally responsive, highly practical roadmap for transforming the teaching of Basic Science and Technology in Nigeria. The article further maps out a full sample curriculum matrix showing how other BST topics (like ICT/Computer Studies or Health Education) can be translated into these project-based rubrics

Standards-Based Scoring Rubric

To remove teacher bias and ensure fairness, grading must rely on a structured rubric distributed to students before the project begins.

Sample Authentic Assessment Rubric (Total: 20 Marks)

Assessment Criteria	Unacceptable (1-2 Marks)	Proficient (3-4 Marks)	Exemplary (5 Marks)
Scientific & Tech Reasoning	Model shows no understanding of forces or material properties.	Model shows basic design concepts but has structural weaknesses.	Model perfectly applies concepts of stability, strength, and material properties.
Use of Local Materials	Used expensive, store-bought materials; no resourcefulness.	Used some local materials, but relied heavily on ready-made items.	Exceptional improvisation; 100% sourced from free, local, or recycled waste materials.
Functionality & Design	The prototype collapses or fails to channel water/withstand force.	The prototype holds up but requires manual assistance to function fully.	The prototype is stable, durable, and fully functional under simulated conditions.
Teamwork & Presentation	One or two students did all the work; group cannot explain their design.	Most members contributed; presentation is clear but lacks technical depth.	Equal participation; group confidently defends their technical choices during the viva.

Integrating PBL with Large Class Realities in Nigeria

To make project-based assessment realistic in an average public school with 80+ students per class:

1. Group Structuring: Divide the class into large syndicates of 10 students. Assign specific operational roles within each group (e.g., 1 Project Manager, 2 Material Sorters, 3 Builders, 2 Documentation Officers, 2 Presenters). This ensures individual accountability and prevents the teacher from grading 80 individual projects.
2. Progressive Milestones: Do not grade everything at the end. Break the 20-mark assessment down across the term: 5 marks for the initial sketch/plan (Week 4), 10 marks for the physical prototype build (Week 8), and 5 marks for the final group defense (Week 10).

The table below maps out a comprehensive Pragmatic Curriculum Matrix for Basic Science and Technology (BST) at the Nigerian Junior Secondary School (JSS) level. This matrix is explicitly

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designed to function within the Universal Basic Education (UBE) framework, replacing abstract theories with localized, low-cost projects that address large class realities through group syndicates.

Pragmatic Curriculum Matrix for JSS Basic Science and Technology

BST Theme Class	Sub- Curriculum & Topic (NERDC Standard)	The Pragmatic Problem Prompt (Local Context)	Group Project Deliverable (The Artifact)	Low-Cost Improvisation Materials Locally	/ Authentic Assessment (PBL Allocation)	Focus Rubric
Basic Science (JSS 1)	Environmental Pollution (Air, Water, Land)	"Our community dump site is layered with burning waste, polluting the air and water channels. How can we clean or reuse this water?"	A functional, open filtration column and an awareness poster on the dangers of open burning.	Plastic bottles, charcoal from kitchen stoves, clean sand, gravel, cotton cloth.	5M: Filter Design 10M: Water Clarity/Utility 5M: Team Presentation (Total: 20 Marks)	
Basic Technology (JSS 1)	Woodwork Hand Tools / Properties & Uses	"The school desks are falling apart because nails are loose and the joints are failing. How can we fix them?"	A small, functional wooden storage crate or bench using local geometric joints.	Scrap timber from local sawmills, discarded nails, handsaws, local gum (Ache).	5M: Joint Accuracy 10M: Structural Strength 5M: Adherence (Total: 20 Marks)	Safety
Computer Studies (ICT) (JSS 2)	The Internet & Search Engines (Information Retrieval)	"Local farmers in our area are losing crops to pests because they do not know the latest chemical-free remedies."	A printed or handwritten "Local Farmer's Info-Brochure" compiled by extracting data via internet search strategies.	Shared mobile phone/tablet, cybercafé access, used printing sheets or cardboard.	5M: Search Query Logic 10M: Relevance of Data 5M: Formatting/Layout (Total: 20 Marks)	
Physical Health (JSS 2)	Community & Health Ed. Sanitation (Disease Vector Control)	"Malaria and typhoid peak in our neighborhood during the rainy season due to stagnant puddles and poor drainage."	A physical map of the school community highlighting vector breeding grounds, plus a 10-day drainage plan.	Cardboard sheets, colored markers/pencils, community waste charts.	5M: Breeding Ground Mapping 10M: Execution of Action Plan 5M: Peer Review (Total: 20 Marks)	



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		clearance action log.							
Basic Science (JSS 3)	Electrical Energy Circuits & Circuits)	"Frequent power outages hit our classrooms & during evening study prep. How can we build an emergency lighting backup system?"	A working parallel- circuit lighting model using small bulbs that can stay lit even if one bulb fails.	Used torchlight batteries, scrap electrical wires from mechanics, small LEDs, cardboard box.	5M: Diagram 10M: System Functionality 5M: Technical Defense (Total: 20 Marks)	Circuit Proof System Technical (Total: 20 Marks)			
Basic Technology (JSS 3)	Mechanical Engineering Motion (Gears & Pulleys)	"Deep-well water retrieval in our community requires intense physical strength, causing muscle strain for children."	A functional, scale-model mechanical pulley or windlass system capable of lifting weights with minimal effort.	Used spools, hanger strong small buckets, blocks.	thread 5M: coat Advantage wires, 10M: twine, Capacity plastic 5M: wood Innovation (Total: 20 Marks)	Mechanical Calc. Load-Bearing Material (Total: 20 Marks)			

Implementation Guidelines for the Matrix

To seamlessly integrate this matrix into a term-long Nigerian academic schedule without overwhelming teachers, use the following operational structure:

1. Week 1–2 (Contextual Lectures): Teach the core scientific or technological laws using local examples. Introduce the project prompt early so groups can begin brainstorming.
2. Week 3–4 (Design and Material Sourcing): Groups submit a rough sketch or structural plan of their artifact for approval. Students spend this time gathering free, local, or upcycled materials.
3. Week 5–7 (The In-Class Build): Dedicate two standard practical periods to let groups construct their prototypes in class. This allows the teacher to monitor individual contributions and guide group collaboration.
4. Week 8–9 (The Defense / Exhibition): Instead of a standard test, organize a "Science and Tech Exhibition Day" in the school courtyard. Groups present their models, and the teacher grades their technical performance on the spot using the predefined rubric.

Discussion: The Socio-Economic Imperative of Pragmatic Pedagogy

The conceptual arguments presented in this paper underscore an urgent reality: Nigeria's aspiration for technological advancement and economic self-reliance, as outlined in the Vision 2030 agendas and the National Policy on Education, cannot be achieved through passive pedagogical frameworks. The traditional reliance on rote memorisation and abstract instruction has created a systemic paradox—producing graduates who hold certificates in science and technology but lack the functional capacity to troubleshoot local technical problems, innovate industrial processes, or drive independent entrepreneurship. By repositioning the Basic Science and Technology (BST) curriculum



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within John Dewey's pragmatic philosophy, education is transformed into a direct catalyst for national development. When a junior secondary school student builds a functional water filtration column from charcoal and sand, or constructs a parallel circuit using upcycled mechanics' wire, they are not merely memorising facts for an examination; they are mastering the foundational processes of industrial engineering, resource optimization, and environmental management. Furthermore, the integration of strategic instructional improvisation and ethno-science directly dismantles the colonial-era misconception that science is an imported, unattainable Western construct. Grounding chemistry, physics, and technology in local practices like palm oil extraction or mud-hut architecture validates the learner's socio-cultural environment. This cultural validation fosters an innovative mindset, encouraging students to view their immediate communities not as landscapes of lack, but as active laboratories ripe for scientific intervention and sustainable development.

Overcoming the Crux of Large Class Realities

Critics of student-centered, pragmatic approaches in developing nations often cite the logistical impossibility of managing project-based learning within classrooms containing 80 to 100 students. This paper explicitly counters that critique through the structural introduction of Cooperative Inquiry Syndicates. By organizing large classrooms into structured, self-governing student teams modeled after traditional African communal work groups, the teacher's role shifts from an overwhelmed disciplinarian to a high-level strategic facilitator. Instead of grading 100 individual assignments, the educator evaluates 10 collective, multi-dimensional projects. This collective approach distributes the logistical burden of sourcing materials among the students, builds critical soft skills—such as peer accountability, conflict resolution, and technical division of labor—and ensures that underfunded schools can deliver high-quality, practical STEM experiences with zero capital expenditure.

Concluding Synthesis

The current structural stagnation within Nigerian BST classrooms is not a failure of curriculum design, but a failure of pedagogical and assessment alignment. The NERDC curriculum possesses progressive, application-oriented goals on paper, but the institutional mechanics of the Universal Basic Education (UBE) system continue to reward the passive replication of text. To break this cycle, Nigeria must boldly operationalise a pragmatic educational framework. This requires moving beyond temporary teacher workshops and adopting a systemic approach that links teacher promotions to instructional improvisation, anchors 40% of basic school grading metrics to physical project artifacts, and transforms the local community into an active extension of the science classroom. Ultimately, pragmatism offers more than just a teaching method for resource-scarce environments; it offers a liberating philosophy of education. By shifting the pedagogical focus from "what to think" to "how to do," Nigeria can cultivate a new generation of scientifically literate, critically thinking, and technologically resourceful citizens capable of inventing local solutions to national challenges.

Formal Policy Recommendations

To systematically institutionalize pragmatic pedagogies within the Nigerian Basic Education ecosystem, a coordinated, multi-tiered intervention is required from federal, state, and local educational authorities. The following actionable policy recommendations are proposed:

1. Re-Engineer the National Assessment Architecture (NERDC & NECO): The Nigerian Educational Research and Development Council (NERDC) and the National Examination Council (NECO) must reform the Basic Education Certificate Examination (BECE) guidelines to mandate that 40% of the Continuous Assessment (CA) score be derived strictly from standardized, group-based Project-Based Learning (PBL) artifacts. Create standardized regional portfolio moderation panels to audit



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- school project rubrics, ensuring that terminal written examinations are balanced by verified, practical student creations.
2. Standardize "Improvisation Lab" Protocols in Teacher Upskilling (UBEC & SUBEBs): The Universal Basic Education Commission (UBEC), in partnership with State Universal Basic Education Boards (SUBEBs), must transition all in-service training to an "Improvisation Lab" format. Teachers must be trained on how to use free, locally sourced, and upcycled materials to deliver complex BST lessons. This training should explicitly focus on methods for dividing large, crowded classes (80+ students) into structured cooperative learning syndicates.
 3. Reform Pre-Service Teacher Curricula (NCCE & NUC); The National Commission for Colleges of Education (NCCE) and the National Universities Commission (NUC) must overhaul the teacher education curriculum for BST disciplines. Introduce mandatory coursework in *Ethno-Science*, *Instructional Improvisation*, and *Constructivist Facilitation Techniques*. Graduation requirements for pre-service teachers must include a teaching practice portfolio that demonstrates the successful execution of student-centered, project-based inquiry.
 4. Link License Renewal and Career Advancement to Pragmatic CPD Credits (TRCN); The Teachers Registration Council of Nigeria (TRCN) should mandate that a specific percentage of Continuous Professional Development (CPD) credits required for license renewal be earned through verified courses in practical, experiential pedagogy. In tandem, state civil service commissions should make the defense of an original, localized instructional improvisation model a core requirement for promotion across teaching cadres.
 5. Establish Community-School Technology Clusters (LGEAs): Local Government Education Authorities (LGEAs) must broker strategic partnerships between public schools and local vocational networks. Establish protocols where JSS students can conduct structured field studies and project builds within local automobile mechanic workshops, carpentry sheds, and agricultural hubs. This turns the immediate community into an active, low-cost extension of the school's science laboratory.

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