



From Passive Learners to Nation Builders: The Case for Activity-Based Chemistry Curriculum Reform in Nigerian Secondary Schools



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KEYWORDS

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ABSTRACT

Nigeria's secondary school chemistry education system has long failed to cultivate the problem-solving, entrepreneurial, environmental, and civic competencies that sustainable national development demands. Rooted in a teacher-centred, lecture-based tradition inherited from the colonial era, the conventional curriculum continues to produce graduates who are academically certified yet developmentally under-equipped. This study examined the perceived role of activity-based learning (ABL) in addressing these gaps, and the extent to which the current curriculum meets national developmental needs, from the perspectives of chemistry teachers and students in Owerri Municipal Council, Imo State, Nigeria. A descriptive survey was conducted with 255 SS2 students and 14 chemistry teachers (n = 269) drawn from six government secondary schools, using a validated 36-item, four-point Likert-scale questionnaire analysed against a decision threshold of 2.50, where higher scores indicate stronger agreement. Respondents strongly affirmed ABL's developmental potential across seven dimensions, including problem-solving, social cohesion, entrepreneurship, environmental literacy, communication skills, civic thinking, and university preparation, yielding a grand mean of 3.16 out of 4.00. Conversely, the conventional curriculum was assessed as inadequate across all equivalent dimensions, with a grand mean of 2.63, only marginally above the acceptance threshold. These findings constitute an evidence-based mandate for urgent curriculum reform, sustained investment in laboratory infrastructure, and systematic teacher professional development aligned with Nigeria's national development goals.

CITATION

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INTRODUCTION

A persistent paradox of contemporary Nigeria is its ambitious national development agenda alongside a secondary school system that consistently fails to produce the human capital required to execute it. Despite more than six decades of formal independence, Nigeria continues to rank in the lower quartiles on global human development indices, not because of resource poverty but because of a systemic failure to translate formal schooling

into productive, innovative, and socially cooperative human capability (UNDP, 2020; World Bank, 2020). This failure has its intellectual roots in an educational philosophy that has long prioritised the transmission of abstract knowledge over the cultivation of practical competence, creative thinking, and the entrepreneurial disposition on which genuine development depends. Chemistry occupies a strategically revealing position in this story. As the central science providing the

foundational knowledge for pharmaceutical innovation, industrial processing, agricultural chemistry, environmental remediation, and materials technology, chemistry education should be among the most powerful engines of national development in any scientifically ambitious country (Chang & Goldsby, 2014; Taber, 2017). In Nigeria, however, chemistry education has largely become the opposite: a site of disengagement, rote memorisation, and developmental inertia. Students who have spent three years studying secondary school chemistry emerge unable to perform a titration, unable to relate any chemical principle to an everyday problem, and, most critically, unable to think scientifically about the challenges their communities and country face (Nwafor et al., 2023; WAEC, 2022).

The Brundtland Commission's foundational definition of sustainable development, meeting the needs of the present without compromising the ability of future generations to meet their own needs (1987), implies a forward-looking educational obligation: to equip each generation with the skills, values, and adaptability required to navigate an uncertain and evolving development landscape. Sen's (1999) capability approach extends this obligation in human terms, arguing that development is fundamentally about expanding what people can do and be, and that education is the primary institutional instrument through which this expansion occurs. Neither of these frameworks is consistent with an educational system that produces passive, entrepreneurially handicapped, and civically disengaged graduates.

Activity-based learning (ABL) has been internationally validated as a pedagogical paradigm capable of bridging the gap between what chemistry education currently produces and what development requires. By engaging students in hands-on investigations, real-world problem-solving, collaborative project work, and discovery-based inquiry, ABL develops precisely the competencies, including problem-solving, entrepreneurship, environmental literacy, civic reasoning, and cooperative disposition, that sustainable development demands (Agbenyeku, 2017; David Agwu & Nmadu, 2023; Nwafor et al., 2023; Freeman et al., 2014; Theobald et al., 2020). The question this study investigates is whether, from the perspective of the teachers and students who inhabit Nigerian secondary school chemistry classrooms, an activity-based curriculum is perceived as capable of fulfilling this developmental promise, and whether the current conventional curriculum is perceived as having fulfilled it. These are not merely academic questions. They carry direct implications for curriculum policy, teacher professional development, government investment in school science infrastructure, and the broader architecture of Nigeria's human capital development strategy. Generating systematic, empirical answers to

them, from the perspectives of those who live within the system, is the central contribution of this study.

Nigeria's development trajectory continues to be constrained by the failure of secondary school education to produce the problem-solving, entrepreneurial, environmentally literate, and civically engaged citizens that sustainable development requires. The conventional chemistry curriculum, implemented almost exclusively through teacher-centred, lecture-based instruction, bears significant institutional responsibility for this outcome. Activity-based curriculum has been widely advanced as a solution, but the empirical evidence for its developmental relevance, assessed from the perspectives of the key stakeholders who must ultimately implement and experience it, remains underdeveloped in the Nigerian context. This study fills that evidential gap. It does so by assessing the expected roles of an activity-based chemistry curriculum in addressing the nation's developmental challenges and determining the extent to which the chemistry curriculum currently used in secondary schools has met those needs. The following questions and hypothesis guide the research:

1. What are the role expectations of an activity-based chemistry curriculum in addressing the developmental challenges of the nation?
2. To what extent has the chemistry curriculum currently in use in secondary schools met the developmental needs of the nation?

H₀: There is no significant difference between the mean ratings of chemistry teachers and students on the perceived developmental roles of activity-based chemistry curriculum and the adequacy of the conventional curriculum.

LITERATURE REVIEW

Education, Human Capital, and Sustainable National Development

The theoretical relationship between education and development has been elaborated across multiple disciplinary traditions. Human Capital Theory, most influentially formalised by Becker (1964), established that investments in education yield returns in individual earnings, organisational productivity, and aggregate economic growth that are among the highest-yielding of any category of investment. Nigeria's economic performance, however, suggests a dissonance between the quantity of its education investment and the quality of its human capital outputs, a pattern that Hanushek and Woessmann (2020) attributed globally to education systems that measure inputs (years of schooling) without adequately attending to cognitive outputs (skills and competencies actually developed).

Sen's (1999) capability approach offers a complementary and, for development purposes, more demanding framework. On Sen's account, development is the

expansion of substantive freedoms, the genuine capabilities that individuals have to live lives they have reason to value. Education that does not expand learners' real capabilities for thinking, creating, communicating, and cooperating is not developmental but a developmental opportunity foregone. UNESCO's Education for Sustainable Development (ESD) framework operationalises these principles in educational terms, identifying systems thinking, critical thinking, collaborative problem-solving, and normative competency as the specific learning outcomes through which education contributes to sustainable development (UNESCO, 2020). The alignment between the ESD framework and the competencies developed through activity-based learning is structural, not incidental.

In the Nigerian context specifically, Onyenemezu and Okanezi (2013) have argued that sustainable national development requires not merely vocational training but also the cultivation of civic and social competencies, including interethnic cooperation, tolerance, and collective responsibility, through which citizens can act constructively toward shared developmental goals. Adeyemo and Babajide (2023) similarly identify secondary school education as the critical period for instilling these competencies, given its broad reach and position in the developmental life course. Both contributions implicitly indict a system that uses secondary schooling almost exclusively for examination preparation rather than for cultivating developmental citizenship.

The Competency Gap: What Nigeria's Graduates Lack and Why

The gap between the outputs of Nigeria's secondary school system and the competency demands of sustainable development has been well documented. Nwafor et al. (2023), in a study of secondary school chemistry in Anambra State, identified the consistent use of the lecture method as the primary source of persistently low student achievement, finding that students exposed to teacher-centred instruction demonstrated significantly weaker conceptual understanding and practical competence than those in collaborative learning conditions. These are not individual deficiencies; they are the predictable systemic products of a pedagogical approach that denies students the learning experiences through which these competencies are developed.

Employer-side evidence corroborates this picture. Adeyemo and Babajide (2023) documented consistent dissatisfaction among Nigerian industry employers with the analytical problem-solving ability, team-working capacity, and practical competence of secondary school graduates, precisely the competencies that ABL is designed to develop and that conventional instruction structurally suppresses. The World Bank's (2020) Nigeria Human Capital Index, 0.36 out of 1.0, quantifies the

aggregate cost of this systemic failure in terms of unrealised productive potential, placing Nigeria among the lowest-performing countries in the region despite being its largest economy.

Activity-Based Learning as Developmental Chemistry Pedagogy

The pedagogical efficacy of ABL rests on well-established theoretical foundations. Constructivist learning theory, most influentially developed by Piaget (1954) and extended by Vygotsky's (1978) social constructivism, holds that learners actively build knowledge through interaction with their environment and collaborative dialogue, rather than through the passive reception of transmitted content. This principle is structurally embedded in every dimension of activity-based instruction, in which students construct chemical understanding by doing, investigating, and discussing. Complementing this, Kolb's (1984) experiential learning cycle, concrete experience, reflective observation, abstract conceptualisation, and active experimentation, maps directly onto the sequence of activities in ABL chemistry: laboratory work provides the concrete experience; guided discussion produces reflection; concept formation through inquiry yields abstraction; and follow-up problem tasks or project designs constitute active experimentation. This theoretical convergence means that ABL is not merely a collection of engaging techniques but a coherent pedagogical architecture with deep epistemological justification for producing the durable, transferable competencies that development requires.

Problem-Solving and Technological Innovation

Problem-solving is the most fundamental competency for technological innovation. Doolittle et al. (2023), in a systematic review of active learning definitions and outcomes, demonstrated that higher-order cognitive skills, including analysis, synthesis, evaluation, and creative problem formulation, emerge specifically from inquiry-based, problem-centred environments and not from lecture-based instruction. Nigeria's persistent technological dependency is, in significant measure, a human capital deficit rooted in this competency gap. Activity-based chemistry instruction, by regularly placing students in authentic problem contexts such as experimental design, hypothesis testing, and interpretation of results, directly and repeatedly exercises the cognitive competencies required by technological work (Tijani, 2025).

Entrepreneurship and Economic Self-Reliance

Entrepreneurship has been identified by successive Nigerian government policy documents, including the ERGP (2017), the National Development Plan 2021 to 2025, and the National Youth Policy, as the primary

structural strategy for addressing graduate unemployment. However, the educational system continues to produce graduates with no entrepreneurial orientation and no practical experience of problem identification, resource mobilisation, or iterative experimentation. Cera et al. (2020) demonstrated that experiential learning environments produce significantly higher entrepreneurial self-efficacy and intention than conventional classroom instruction, precisely because they replicate the core activities of entrepreneurial practice. This finding aligns with Kolb's (1984) experiential learning model: entrepreneurial competence is forged through iterative cycles of doing, reflecting, and adapting that ABL chemistry deliberately structures into its pedagogical design. Activity-based chemistry instruction, through its practical projects, community problem-solving tasks, and production-oriented experiments, provides exactly the kind of formative entrepreneurial experience that Nigeria's economic development strategy demands.

Social Cohesion and Civic Cooperation

Easterly, Ritzen, and Woolcock (2006) demonstrated in a landmark cross-national study that social cohesion, the degree of civic trust, inter-group cooperation, and shared developmental commitment within a society, is among the strongest predictors of long-term development outcomes. In Nigeria, ethnic conflict, religious tension, and political divisiveness constitute formidable structural impediments to collective action for development (Onyenemezu & Okanezi, 2013). Activity-based chemistry instruction, through its systematic reliance on cooperative group work and peer collaboration, creates structured, purposeful contexts in which young Nigerians of diverse backgrounds develop the interpersonal trust, mutual respect, and collaborative disposition that are prerequisites for the social cohesion development requires. Vygotsky's (2001) Cultural-Historical Activity Theory (CHAT) framework provides the theoretical grounding for this claim: consistent with the constructivist principle that higher mental functions are first formed intersubjectively before being internalised, it is precisely through meaningful collective activity of the kind that ABL systematically provides that social consciousness and civic orientation are formed.

The Conventional Curriculum: A Developmental Critique

Freire's (1970) banking metaphor, in which students are passive depositories into whom teachers deposit knowledge, captures, with uncomfortable precision, the epistemological model of Nigeria's conventional chemistry classroom. The implications of this model for development are severe and multi-layered. Cognitively, it produces surface learning and poor retention, knowledge that cannot be transferred to novel problem contexts

because it was never meaningfully constructed (Bransford et al., 2000). From a constructivist standpoint (Piaget, 1954), such passive reception prevents the active schema-building through which durable, transferable knowledge is formed, an absence with direct consequences for the innovative and applied thinking that development demands. Motivationally, it fosters disengagement and instrumentalism, with students learning for certificates rather than competence (Ryan & Deci, 2020). Civically, it produces passivity and dependency, with citizens who wait for the government to provide solutions rather than generating them (Adeyemo & Babajide, 2023). Each of these outcomes is directly antagonistic to the human capital requirements of sustainable national development.

Dahiru (2010) specifically critiqued the conventional approach as antithetical to the investigative nature of science itself, noting that science cannot be taught through the chalk-and-talk method without fundamentally misrepresenting the discipline. When chemistry is taught as a body of settled, transmissible facts rather than as a dynamic process of questioning, investigation, and provisional knowledge construction, it not only fails to develop scientific thinking but also cultivates an anti-scientific passivity inimical to the innovative and adaptive thinking development requires.

METHODOLOGY

A descriptive survey research design was adopted. Survey methodology is particularly well-suited to policy-relevant educational research, where understanding the distribution of stakeholder orientations across a diverse population is the primary analytical objective.

Population and Sampling

The study was conducted in Owerri Municipal Council, Imo State, south-eastern Nigeria, the state's administrative capital, with ten government-owned secondary schools serving a combined SS2 chemistry student population of 2,425 and 26 chemistry teachers (2025/2026 academic year). The concentration of schools in this municipality and its position as a reference point for state-level educational policy make it a particularly relevant site for generating evidence that can inform Imo State and, by extension, national curriculum reform decisions. Simple random sampling was used to select six of the ten schools. A 20% sampling ratio was applied to student populations in selected schools, yielding 255 students. All 14 chemistry teachers in the six selected schools participated. Both teachers and students responded, giving a combined analytical sample of 269. All 255 sampled students returned completed questionnaires, representing a 100% student response rate, consistent with the personal administration and retrieval procedure adopted. Basic demographic data were collected from all respondents.

Among students, 138 (54.1%) were female, and 117 (45.9%) were male; among teachers, 9 (64.3%) were male, and 5 (35.7%) were female. All six schools were government-owned; three were classified as urban and three as peri-urban schools within the municipal council. These demographic characteristics are noted to contextualise findings and are available for subgroup analysis.

Instrument for Data Collection

Data were collected using a researcher-designed 36-item structured questionnaire, with 9 items per research question, scored on a 4-point Likert scale: Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, Strongly Disagree (SD) = 1. Two specialists in measurement and evaluation validated the instrument. A forced-choice, even-numbered scale was used to eliminate neutral responses. Internal consistency reliability was established using Cronbach's alpha coefficient (α). The full 36-item instrument yielded $\alpha = 0.83$; the ABL sub-scale (items 1–18) yielded $\alpha = 0.79$; and the conventional curriculum sub-scale (items 19–36) yielded $\alpha = 0.81$. All coefficients exceed the widely accepted threshold of $\alpha \geq 0.70$ (Nunnally, 1978), confirming adequate reliability for research purposes. Questionnaires were personally administered and retrieved by the researchers, ensuring a 100% return rate.

Method of Data Analysis

Arithmetic mean and standard deviation statistics were used to analyse all items. The decision threshold was 2.50, obtained by averaging the Likert scale weights. The decision threshold of 2.50 was adopted following the conventional midpoint criterion widely applied in Likert-scale research in Nigerian educational studies (Agbenyeku, 2017; Nwafor et al., 2023). The threshold is derived by averaging the four scale weights:

$$Mean = \frac{4+3+2+1}{4} = 2.50$$

A mean at or above 2.50 indicates that the weighted balance of responses falls on the agreement side of the scale, representing majority endorsement of the item; a mean below 2.50 indicates majority rejection. To test the hypothesis, an independent-samples t-test (Welch's approximation) was applied to grand-mean scores, disaggregated by respondent group, at $\alpha = 0.05$. Grand means were computed as the unweighted average of item means per research question.

RESULTS AND DISCUSSION

Role Expectations of Activity-Based Curriculum for National Development

Table 1 presents the mean scores, standard deviations, and decisions for nine items measuring respondents' perceptions of ABL's developmental roles.

Table 1: Role Expectations of Activity-Based Chemistry Curriculum in Addressing Nigeria's Developmental Challenges (n = 269)

S/N	Questionnaire Item	SA	A	D	SD	Mean	SD	Remark
1	Activity-based learning equips students with problem-solving skills essential for technological innovation and national advancement.	113(452)	120(360)	21(42)	15(15)	3.23	0.82	Accepted
2	Collaborative learning cultivates in students a disposition toward peaceful coexistence, indispensable for social cohesion and national development.	116(464)	127(381)	16(32)	10(10)	3.30	0.74	Accepted
3	Learning chemistry through practical work directly enhances students' entrepreneurial capacity and readiness for economic participation.	168(672)	78(234)	12(24)	11(11)	3.50	0.76	Accepted
4	Activity-based instruction addresses structural youth unemployment by producing graduates capable of job creation rather than mere job-seeking.	98(392)	106(318)	32(64)	33(33)	3.00	0.99	Accepted
5	Engaging students in real-world chemistry projects develops the environmental literacy and scientific stewardship the nation urgently needs.	102(408)	117(351)	28(56)	22(22)	3.11	0.89	Accepted

6	Activity-based learning develops students' communication and presentation skills necessary for effective participation in the modern workforce.	95(380)	118(354)	35(70)	21(21)	3.07	0.89	Accepted
7	Critical thinking and evidence-based reasoning, cultivated through inquiry-based learning, are essential for Nigeria's political and civic development.	88(352)	121(363)	40(80)	20(20)	3.03	0.88	Accepted
8	ABL prepares students more effectively for the demands of tertiary science and technology programmes than conventional instruction.	107(428)	114(342)	30(60)	18(18)	3.15	0.87	Accepted
9	Sustained engagement with activity-based chemistry fosters a growth mindset and adaptive capacity for lifelong learning in students.	90(360)	119(357)	38(76)	22(22)	3.03	0.90	Accepted
Grand Mean							3.16	Accepted

Note: Figures in parentheses are weighted scores (frequency × scale value). SD = Standard Deviation.

All nine items were accepted, with means ranging from 3.0 to 3.5 and a grand mean of 3.16, substantially above the acceptance threshold and approaching the Strongly Agree band of the scale. Standard deviations ranged from 0.74 to 0.97, indicating moderate response variability and suggesting that while consensus exists, some divergence in individual perceptions is present. This grand mean represents the highest aggregate score in the study. It reflects a strong consensus among respondents that activity-based chemistry instruction is directly and powerfully relevant to Nigeria's developmental challenges across a broad range of dimensions.

The highest-rated item, which is that practical chemistry work enhances entrepreneurial capacity (item 3; $\bar{X}$ = 3.5, SD = 0.74), is the most strategically critical finding in the study. With formal graduate unemployment consistently estimated at 30%–40%, and the ERGP (2017) explicitly identifying entrepreneurship as a core economic strategy, the endorsement of practical chemistry instruction as an entrepreneurial development tool constitutes a direct policy mandate. This corroborates Cera et al. (2020), who demonstrated that hands-on, project-oriented learning environments produce significantly higher entrepreneurial self-efficacy than classroom-bound instruction, and aligns with the UNESCO (2020) ESD framework's identification of practical competency development as central to education for sustainable development.

The strong endorsement of collaborative learning to cultivate peaceful coexistence (item 2; $\bar{X}$ = 3.3, SD = 0.75) warrants further attention. Easterly, Ritzen, and Woolcock (2006) establish social cohesion as a stronger predictor of long-term development outcomes than most conventional economic variables. Cultural-Historical Activity Theory (Vygotsky, 2001; Nwosu et al., 2022) provides robust theoretical grounding: meaningful collective activity is the primary mechanism through which social consciousness and cooperative orientation are internalised.

Items 5 and 6, addressing ABL's development of environmental literacy ($\bar{X}$ = 3.1, SD = 0.86) and communication skills ($\bar{X}$ = 3.1, SD = 0.87), extend ABL's developmental profile beyond conventional competency domains. Items 7, 8, and 9, addressing civic and critical thinking ($\bar{X}$ = 3.0, SD = 0.84), tertiary preparation ($\bar{X}$ = 3.2, SD = 0.82), and growth mindset ($\bar{X}$ = 3.0, SD = 0.87), consistently reinforce the breadth of ABL's perceived developmental relevance.

The Conventional Curriculum Against National Development Needs

Table 2 presents responses from 269 teachers and students to items assessing the developmental adequacy of the conventional curriculum.

Table 2: Assessment of the Conventional Chemistry Curriculum Against Nigeria's National Development Needs (n = 269)

S/N	Questionnaire Item	SA	A	D	SD	Mean	SD	Remark
1	Students taught through the conventional method lack adequate problem-solving skills for contributing to national development.	82(328)	81(243)	54(108)	52(52)	2.72	1.09	Accepted
2	Conventionally taught students are poorly equipped with entrepreneurial skills, limiting their economic contribution.	71(284)	104(312)	60(120)	34(34)	2.79	0.97	Accepted
3	Conventional instruction has failed to cultivate creativity and originality in chemistry students.	55(220)	81(243)	84(168)	49(49)	2.53	1.01	Accepted
4	The teacher-centred approach produces uncreative citizens who depend on government employment rather than generating their own income.	68(272)	80(240)	69(138)	52(52)	2.61	1.06	Accepted
5	Students taught by conventional methods demonstrate poor communication and presentation skills in science-related contexts.	72(288)	84(252)	68(136)	45(45)	2.68	1.04	Accepted
6	Conventional chemistry instruction does not cultivate environmental awareness or a sense of responsibility for sustainable resource use.	60(240)	79(237)	78(156)	52(52)	2.55	1.04	Accepted
7	Students taught solely through lectures are ill-prepared for the practical demands of tertiary science programmes.	74(296)	86(258)	62(124)	47(47)	2.70	1.05	Accepted
8	The conventional curriculum does not develop the civic and critical thinking skills necessary for democratic participation in students.	58(232)	76(228)	82(164)	53(53)	2.52	1.04	Accepted
9	Conventional instruction produces graduates who are dependent and reactive rather than independent and proactive contributors to development.	65(260)	83(249)	70(140)	51(51)	2.60	1.05	Accepted
Grand Mean							2.63	Accepted

Note: Figures in parentheses are weighted scores (frequency × scale value). SD = Standard Deviation

All nine items were accepted, with means ranging from 2.5 to 2.9 and a grand mean of 2.63. Standard deviations for this table ranged from 0.94 to 1.08, markedly higher than those in Table 1, indicating greater internal diversity in respondents' assessments of the conventional curriculum's adequacy. This dispersion is analytically consistent with the threshold-hugging means on items 3, 6, and 8 (all $\bar{X} = 2.5$): while a bare majority accepts the conventional curriculum's developmental inadequacy on these dimensions, a substantial minority of approximately one-third remains unconvinced, possibly reflecting the

belief that these competencies are not the primary responsibility of formal schooling, or a perception that individual teachers occasionally develop these outcomes despite the structural constraints of lecture-based pedagogy.

The highest-rated item, which conventionally teaches students to lack entrepreneurial skills (item 2; $\bar{X} = 2.9$, $SD = 0.97$), is analytically consistent with Adeyemo and Babajide (2023) and with the structural analysis of Nigeria's graduate unemployment problem. The acceptance of item 7, that conventionally taught students

are ill-prepared for tertiary science demands ($\bar{X}$ = 2.7, SD = 1.01), has direct implications for tertiary admission standards and bridging programme design.

Hypothesis Testing: Teacher versus Student Perceptions

H₀: There is no significant difference between the mean ratings of chemistry teachers and students on the

perceived developmental roles of activity-based chemistry curriculum and the adequacy of the conventional curriculum (α = 0.05). Table 3 presents the results of independent-samples t-tests (Welch's approximation) comparing teacher and student grand means for each research question.

Table 3: Independent-Samples t-Test — Teacher vs. Student Mean Ratings

Scale	Group	n	$\bar{X}$	SD	t	df	Sig.	Decision
ABL Curriculum	Teachers	14	3.22	0.61	0.649	15	p > .05	H ₀ retained
	Students	255	3.11	0.74				
Conventional Curriculum	Teachers	14	2.59	0.71	0.561	15	p > .05	H ₀ retained
	Students	255	2.70	0.78				

Note: Welch's independent-samples t-test applied (unequal group sizes). α = 0.05.

The null hypothesis was retained for both scales. For the ABL curriculum scale, $t(15) = 0.649$, $p > .05$, indicating no statistically significant difference between teacher ($\bar{X}$ = 3.22) and student ($\bar{X}$ = 3.11) perceptions of ABL's developmental roles. For the conventional curriculum scale, $t(15) = 0.561$, $p > .05$, indicating no significant group difference. These findings suggest that the consensus favouring ABL over conventional instruction is broadly

shared across both stakeholder groups and is not driven by one group's perceptions disproportionately influencing the combined sample results.

Comparative Analysis: A Development-Oriented Profile

Table 4 synthesises findings from both research questions into a direct comparative developmental profile.

Table 4: Comparative Developmental Profile: Activity-Based vs. Conventional Chemistry Curriculum (n = 269)

Development Dimension	ABL Mean	Conv. Mean	Gap	Interpretation
Problem-solving/Technological Innovation	3.2	2.7	+0.5	ABL is substantially stronger; it directly addresses Nigeria's technology deficit
Entrepreneurship/Economic Self-Reliance	3.5	2.9	+0.6	Largest gap; most critical for addressing graduate unemployment
Creativity and Originality	—	2.5	—	Conventional acknowledged deficiency; ABL philosophy inherently fosters creativity
Social Cohesion/Peaceful Co-existence	3.3	—	—	ABL actively develops; conventional offers no comparable feature
Environmental Literacy	3.1	2.5	+0.6	ABL fosters stewardship; conventional does not address sustainability
Civic and Critical Thinking	3.0	2.5	+0.5	ABL develops informed citizenship; conventional produces passive recipients
Workforce and HE Preparation	3.2	2.7	+0.5	ABL-trained graduates are better equipped for tertiary science demands
Grand Means	3.16	2.63	+0.46	Activity-based curriculum consistently superior across all dimensions

Note: ABL Mean scores from Table 1; Conventional Mean scores from Table 2. Gap = ABL Mean minus Conventional Mean, where both are directly measurable.

Table 4 crystallises the study's central argument. Activity-based curriculum outperforms the conventional approach across all assessed dimensions of developmental relevance. The largest gaps, entrepreneurship and environmental literacy (both +0.6), are also the most

developmentally consequential. The corrected overall grand mean differential (3.16 for ABL versus 2.63 for conventional instruction, a gap of 0.46 scale points) is not a marginal preference but a consistent, multi-dimensional assessment that ABL is a substantially more

developmentally productive curriculum paradigm. These findings fully corroborate Agbenyeku (2017), David Agwu and Nmadu (2023), Nwafor et al. (2023), and the broader international evidence base, building a convergent case for curriculum reform grounded in both international literature and local Nigerian stakeholder evidence.

CONCLUSION

This study has generated empirical evidence for a proposition that educational theorists and development scholars have long advanced but Nigerian education policy has been slow to act upon: that the conventional chemistry curriculum currently dominant in Nigerian secondary schools is developmentally inadequate, and that activity-based chemistry curriculum represents a substantively superior alternative for producing the problem-solving, entrepreneurial, environmentally literate, and civically cooperative citizens that sustainable national development requires.

The convergence of findings across a 36-item instrument, a combined sample of 269 teachers and students, nine research schools, and seven development dimensions is not coincidental. It reflects a systemic, settled, and empirically defensible judgment by the Nigerian secondary school chemistry community that the pedagogical status quo is not working and that a viable, theoretically grounded, and internationally validated alternative exists and deserves adoption. The responsibility for translating this evidence into policy now lies with the government, curriculum bodies, teacher development agencies, and school administrators who have the institutional capacity to act on it.

Limitations of the Study

Several limitations of this study should be acknowledged when interpreting its findings. First, all data were self-reported perceptions rather than direct measures of behaviour or achievement. Respondents' assessments of ABL's developmental potential reflect anticipated rather than empirically observed outcomes and may be subject to social desirability bias, particularly among students who may perceive endorsement of activity-based learning as academically or socially expected. Second, the study was geographically restricted to the Owerri Municipal Council in Imo State. While this site is administratively significant, its urban-to-peri-urban profile, resource environment, and teacher quality may not be representative of rural or northern Nigerian contexts, and generalisation beyond south-eastern Nigeria should be undertaken with caution. Third, the cross-sectional design captures perceptions at a single point in time; longitudinal designs tracking actual learning outcomes following ABL implementation would provide stronger evidence for the causal claims implicit in the developmental argument. Fourth, the small teacher sample ($n = 14$) limits the statistical power of group

comparisons; replication with a larger teacher sample across multiple states is warranted. These limitations delineate the evidential boundaries of the study's findings without undermining their core policy relevance.

Practical Implications and Implementation Challenges

The strong stakeholder consensus documented in this study must be read alongside the structural barriers that constrain ABL implementation in Nigerian secondary schools. Three barriers are particularly acute and must be explicitly addressed in any reform agenda.

First, laboratory infrastructure deficits are pervasive. Most government secondary schools in Owerri Municipal Council, consistent with national patterns (Nwafor et al., 2023), lack the reagents, glassware, and functioning equipment required for authentic practical chemistry. Advocacy for ABL without parallel investment in laboratory infrastructure risks producing a superficial pseudo-ABL in which teachers adopt the language of activity-based methods without the materials those methods require, potentially discrediting the approach without ever giving it a fair test.

Second, teacher professional development presents a formidable challenge. Teachers whose own science education was entirely lecture-based and whose pre-service preparation provided minimal exposure to inquiry- or project-based pedagogy are unlikely to implement ABL with fidelity without sustained, school-embedded professional development support, rather than the single-day workshop model that characterises most Nigerian in-service provision. Investment in subject-specific, ongoing coaching for chemistry teachers is a necessary condition for meaningful pedagogical reform.

Third, large class sizes, frequently 40–60 students per classroom in government secondary schools in urban centres, create significant logistical constraints for organising group work, supervising practical tasks, and conducting the formative assessment that effective ABL requires. Class-size reduction, or at a minimum, supplementary laboratory technician support, must be part of any serious infrastructure conversation. Curriculum reform conceived in isolation from these structural realities will not achieve the developmental outcomes that this study documents as desirable.

Recommendations

At the national policy level, the findings of this study should be read as a direct empirical mandate for curriculum reform, not as an academic preference but as a development necessity. The documented failure of the conventional curriculum across seven developmental dimensions is not merely a pedagogical inconvenience; it is a structural constraint on Nigeria's human capital development with compounding costs over time. Every cohort of secondary school chemistry graduates who

leave school without problem-solving ability, entrepreneurial orientation, or civic competency represents a developmental loss that is both measurable and preventable.

At the state level, Imo State's Ministry of Education should treat the positive stakeholder perceptions documented in this study as a specific asset, evidence that the social readiness for reform exists within the state's secondary school chemistry community, and mobilise it through targeted investment in the structural enablers identified in the findings. A pilot programme in Owerri Municipal, building on this study's evidence base, would generate local proof of concept that could be scaled across the state and serve as a model for other states.

The Federal Ministry of Education and NERDC should initiate an immediate, evidence-based revision of the national secondary school chemistry curriculum to formally embed activity-based instructional frameworks. Each topic in the revised curriculum should be accompanied by a specific, resource-sensitive practical activity guide, with locally sourced alternatives specified for low-resource school contexts.

Federal and state governments should substantially increase capital allocations for secondary school science laboratory infrastructure, treating this investment as a direct human capital development expenditure with quantifiable returns. Procurement should prioritise consumable reagents, basic glassware, and safety equipment that are accessible even in rural schools.

NERDC and WAEC should collaboratively revise the WASSCE chemistry practical examination to more authentically assess activity-based competencies, including experimental design, data interpretation, and applied problem-solving, creating an examination-side incentive for schools to invest in practical instruction.

Industry, professional associations such as the Chemical Society of Nigeria, and civil society should be formally engaged as partners in secondary chemistry education, providing real-world problem challenges, mentorship, enterprise sponsorships, and career pathway information that connect students' ABL experiences to tangible national development outcomes.

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