JOURNAL OF EDUCATION, SCIENCE AND TECHNOLOGY

Research

SUSTAINABILITY OF SMASE INSET IN NIGERIA: ROLES OF JICA, NTI, AND THE CASE FOR TERTIARY INSTITUTION INTEGRATION

Awe Omolara Oluwafunmilola*, Fakunle Ilesanmi, and Ibukunoluwa Mojisola Rebecca***

Department of Biology, Adeyemi Federal University of Education, Ondo* I Department of Mathematics, Adeyemi Federal University of Education, Ondo**
E-mail: omolarawe15@gmail.com, fakunlesanmi@gmail.com, ibukunoluwamojirayo@gmail.com

Highlights

- JICA played a foundational role in establishing SMASE INSET in Nigeria through funding, technical support, baseline studies, and capacity building from 2006 to 2014.
- NTI has sustained the national cascade structure, but its extension of SMASE into tertiary teacher-preparation institutions remains weak.
- SMASE-trained teachers reported improved activity-based instruction and stronger student engagement, showing clear classroom-level impact.
- Major implementation challenges include insufficient training cycles, poor post-training monitoring, large class sizes, resource shortages, and teacher redeployment.
- The study identifies tertiary curriculum integration, ring-fenced funding, mandatory pre-deployment training, digital monitoring, and TRCN recognition as key sustainability strategies

Abstract

This study examined the roles of the Japan International Cooperation Agency (JICA) and the National Teachers' Institute (NTI) in the implementation and sustainability of the Strengthening Mathematics and Science Education (SMASE) In-Service Education and Training (INSET) programme in Nigeria. Using a descriptive survey design, data were collected from 180 stakeholders across all six geopolitical zones, including teachers, NTI officials, SUBEB officers, and tertiary institution lecturers. A Stakeholder INSET Implementation and Sustainability Questionnaire (SIISQ) was the primary instrument, analysed using means and standard deviations. Findings confirmed JICA's foundational contribution to the programme (2006–2014), particularly in funding viability, technical framework development, and capacity building through third-country training at CEMASTEA, Kenya, though the transition to national ownership revealed grassroots continuity gaps. NTI demonstrated effective institutional stewardship of the cascade structure but showed limited success in extending SMASE to tertiary teacher-preparation institutions. Among SMASE-trained teachers (71.8% of the teacher sample), improved activity-based instruction and student engagement were the most notable gains, while long-term behavioural sustenance of the ASEI/PDSI approach remained a challenge. Critical implementation barriers included insufficient training frequency, inadequate post-training monitoring, large class sizes, resource shortages, and teacher redeployment. Notably, 50% of tertiary institution respondents reported no engagement with SMASE content in pre-service curricula, representing a structural gap in programme sustainability. Stakeholders ranked the formal integration of ASEI/PDSI into NCE and B.Ed. curricula, ring-fenced SMASE budgetary allocations, and mandatory pre-deployment teacher training as the highest-priority sustainability strategies. The study recommends coordinated curriculum reform through the NCCE and NUC, performance-linked funding mechanisms, digital platform development, and recognition of SMASE participation within the TRCN's Continuing Professional Education framework.

Keywords: SMASE INSET, ASEI/PDSI, JICA, NTI, UBEC, mathematics and science education, sustainability

***Correspondence**
Awe O. O., omolarawe15@gmail.com
Received: 5 April, 2026
Accepted: 15 April, 2026
Published: 30 May, 2026
Citation: Awe, O. O., Fakunle, I., & Ibukunoluwa, M. R. (2026). Sustainability of SMASE INSET in Nigeria: Roles of JICA, NTI, and the case for tertiary institution integration. *Journal of Education, Science and Technology, (2)* 1.52-67.

1.0 Introduction

Few challenges in Nigeria's educational landscape have proven as stubbornly persistent as the underperformance of learners in mathematics and science. Decades of data from the West African Examinations Council (WAEC) and the National Examinations Council (NECO) consistently reveal that a disproportionately high percentage of candidates fail to obtain the minimum credit passes required in these subjects for tertiary admission (Federal Ministry of Education [FME], 2014; Shuaibu, 2016). The consequences of this pattern cascade through the education system, undermining ambitions for technological development articulated in the Nigeria Vision 20:2020 framework and, more recently, the National Development Plan 2021–2025 (NDP, 2021–2025).

Against this backdrop, the partnership between the Japan International Cooperation Agency (JICA) and the Nigerian Federal Ministry of Education, operationalised through the Strengthening of Mathematics and Science Education (SMASE) In-Service Education and Training (INSET), represented a seminal institutional intervention. Commencing with a baseline survey in 2005 and formally launching its pilot phase in 2006, the SMASE INSET project introduced the ASEI/PDSI pedagogical paradigm to Nigerian primary school classrooms in the pilot states of Kaduna, Niger, and Plateau (JICA, 2011; SMASE-Africa, 2021). The ASEI/PDSI framework, an acronym standing for Activity, Student-centred, Experiment, and Improvisation, driven by the iterative cycle of Plan, Do, See, and Improve, challenged the dominant "chalk-and-talk" culture that had long rendered science and mathematics classrooms passive environments for learners.

In February 2014, JICA formally handed over the SMASE programme to the Nigerian government, marking a critical transition point: the project became a programme, and its management shifted to the National Teachers' Institute (NTI), situated in Kaduna, in collaboration with the Universal Basic Education Commission (UBEC) and the State Universal Basic Education Boards (SUBEBs) (Blueprint Newspapers, 2024; UBEC, 2023). This handover, according to UBEC (2023), was not merely administrative; it was a deliberate declaration that Nigeria was ready and willing to own, fund, and expand a model of in-service teacher development that had yielded demonstrable results.

Yet more than a decade after that transition, questions persist. How deeply has the SMASE pedagogy been internalised by classroom teachers beyond the initial training cohorts? To what extent have Nigeria's colleges of education, universities, and polytechnics been incorporated into the dissemination architecture? What financial, institutional, and programmatic strategies will ensure that the SMASE INSET does not wither into another well-intentioned but ultimately ephemeral reform initiative? This study addresses these questions through a questionnaire-based descriptive survey conducted across Nigeria's six geopolitical zones.

1.1 Statement of the Problem

Mathematics and science education in Nigeria's basic schools has continued to suffer from entrenched pedagogical weaknesses, characterised by teacher-centred instruction, low student engagement, and poor learning outcomes. The Strengthening Mathematics and Science Education (SMASE) In-Service Education and Training (INSET) programme was introduced to reorient classroom practice through the ASEI/PDSI approach, with JICA providing the foundational technical and financial framework from 2006 to 2014. However, following the transition to national ownership under NTI, concerns have emerged regarding implementation consistency, funding continuity, and programme sustainability. Training cycles remain insufficient, post-training monitoring is inadequate, and structural barriers, including large class sizes, resource shortages, and teacher redeployment, continue to erode gains recorded during training. More critically, tertiary teacher-preparation institutions remain largely excluded from the SMASE ecosystem, meaning that newly qualified teachers enter classrooms annually without exposure to the pedagogical framework their schools are expected to implement.

This gap between pre-service preparation and in-service programme expectations represents a structural weakness with far-reaching consequences for the programme's long-term impact. Despite NTI's formal inclusion of SMASE within its Continuous Professional Development framework, the depth and cross-institutional reach of implementation remain limited. It is against this background that this study investigated the institutional roles of JICA and NTI, assessed the state of tertiary integration, examined implementation challenges, and identified priority strategies for strengthening the sustainability of SMASE INSET in Nigeria.

1.2 Objectives of the Study

Specifically, this study aims to:

1. Examine the historical and institutional roles of JICA and NTI in the development and sustenance of SMASE INSET in Nigeria from 2006 to 2025.
2. Assess the nature, scope, and quality of SMASE INSET implementation since the 2014 JICA handover.
3. Investigate the current level of inclusion of tertiary institutions of education in SMASE INSET dissemination and pre-service teacher preparation.
4. Propose evidence-based strategies for the future growth and long-term sustainability of SMASE INSET in Nigeria.

1.3 Research Questions

1. What were the specific roles of JICA and NTI in conceptualising, implementing, and institutionalising SMASE INSET in Nigeria?
2. How has SMASE INSET implementation evolved, and what impacts have been observed since the 2014 government handover?
3. To what degree are tertiary institutions of education integrated into the SMASE INSET programme structure?
4. What strategies are most critical for ensuring the future growth and sustainability of SMASE INSET in Nigeria?

1.3 Significance of the Study

This study contributes to the body of knowledge on teacher professional development in sub-Saharan Africa, with specific empirical grounding in the Nigerian context. For policymakers, it offers a diagnostic assessment of programme implementation fidelity and a practical roadmap for sustainable scale. For the NTI, UBEC, and the Federal Ministry of Education, it identifies systemic gaps and actionable interventions. For tertiary institutions and teacher educators, it makes a compelling case for curriculum alignment with national in-service priorities. For JICA, SMASE-Africa, and international development partners, it provides a case study of programme transition from donor dependency to national ownership.

2.0 Literature Review

2.1 Theoretical Underpinnings: Constructivism and Active Learning

Constructivism holds that learners are not passive recipients of transmitted knowledge but active agents who construct meaning through engagement with the physical and social environment. This theoretical disposition finds direct expression in the ASEI/PDSI framework, which privileges hands-on activities, collaborative inquiry, experimentation, and the iterative self-assessment of teaching practice.

Complementarily, the literature on effective professional development for teachers consistently affirms that in-service training is most impactful when it is content-specific, embedded in actual classroom practice, collaborative, and sustained over time (Darling-Hammond et al., 2017; Desimone, 2009). SMASE INSET was designed with these principles in mind: the cascade training model from National INSET to State INSET to Local INSET and School-Based Training (SBT) was intended to embed learning in the proximal professional community of teachers (JICA, 2006, 2009, 2011; SMASE-Africa, 2021).

2.2 Historical Context: Mathematics and Science Education Challenges in Nigeria

The systemic deficiencies in Nigerian mathematics and science education are well documented. A baseline survey conducted jointly by the FME and JICA in 2005 identified four dominant pedagogical failings: poor teacher-pupil interactivity, the monotonous use of lecture methods, perceived subject difficulty attributed to inadequate conceptual preparation, and the chronic under-utilisation of available teaching and learning materials (JICA, 2006; SMASE-Africa, 2021). These findings were consistent with earlier diagnoses by Bajah (1999) and Nwagbo (2001), who had chronicled the structural unpreparedness of Nigerian teachers for activity-based instruction.

The consequences were visible in national examination data. Analyses of WAEC and NECO results between 2000 and 2010 showed that fewer than 40% of candidates consistently obtained credits in both English and mathematics,

a combination required for tertiary admission (Ahmad & Usman, 2014; Odia & Omofonmwan, 2007; Ojimba, 2012). Performance in biology, chemistry, and physics was similarly depressed. These patterns were not merely statistical; they reflected a generation of learners for whom science was an abstract, inaccessible discourse rather than a lived, investigative experience.

2.3 SMASE in the African Context: Origins and the WECSA Network

The intellectual lineage of SMASE Nigeria traces directly to the Strengthening of Mathematics and Science in Secondary Education (SMASSE) project in Kenya, which was launched in February 1998 through a bilateral agreement between the Government of Kenya and the Government of Japan (JICA, 2009). Kenya's SMASSE project, which evolved into the Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA) in 2004, became the continental hub for ASEI/PDSI training and the anchor institution for the SMASE–Western, Eastern, Central and Southern Africa (SMASE-WECSA) network (SMASE-Africa, 2021).

Nigeria joined the SMASE-WECSA network in 2006, with CEMASTEA providing technical assistance, curriculum design support, and training modules. Since 2004, Nigerian teachers have been regularly sent to Nairobi for capacity development, with Nigeria consistently sending the largest national contingent, typically more than ten teachers annually (Blueprint Newspapers, 2015; SMASE Newsletter, 2011). The SMASE-WECSA network has been critically important not only as a source of technical expertise but also as a platform for peer learning, regional benchmarking, and adaptation of the ASEI/PDSI framework to Nigerian educational conditions.

2.4 SMASE INSET Phase I (2006–2009): The Pilot

2.4.1 Experience

Phase I of SMASE Nigeria was implemented between 2006 and 2009, with the National Commission for Colleges of Education (NCCE) initially serving as the host institution for the National INSET Centre. The pilot covered the three states of Kaduna, Niger, and Plateau, training 34,574 primary school teachers through a cascade model that moved from national to state-level trainers and onward to core classroom teachers (JICA, 2011; SMASE-Africa, 2021).

A significant institutional development during Phase I was the transfer of the SMASE National INSET Centre from the NCCE to the NTI in August 2008 (SMASE-Africa, 2021). This transfer reflected a strategic assessment that NTI, as Nigeria's principal institution for teacher in-service training, was the more appropriate and sustainable host. NTI's statutory mandate, enshrined in the NTI Act of 1978, includes the upgrading of unqualified teachers, the provision of distance education, and the fostering of international cooperation in teacher education, all highly consonant with the SMASE mission (NTI, 2018).

2.4.2 SMASE INSET Phase II (2011–2014): National

2.4.3 Expansion and JICA's Exit

Phase II, which ran from January 2011 to February 2014, represented a qualitative leap in ambition and scale. The project expanded its National INSET to include State Trainers from all 33 states and the FCT, while Local INSET targeted classroom teachers in the three pilot states. Third-country training in Kenya through CEMASTEA provided advanced capacity for national and state trainers (JICA, 2011). The Phase II Project Design Matrix established five key improvement indicators for teachers: attitude, pedagogy, content mastery, resource mobilisation, and the utilisation of locally available teaching materials.

JICA's formal exit and programme handover in February 2014 marked a watershed. The Blueprint Newspapers (2024) account captures the dual significance of this transition: the programme had "transformed from Project to Programme," signalling its evolution from a time-limited donor-funded intervention to an institutionalised national initiative. NTI, UBEC, and the SUBEBs assumed co-ownership, with UBEC committing Teacher Professional Development (TPD) funds to sustain operations.

2.4.4 Post-Handover Implementation: Cycles I–IV (2014–2021)

Following the 2014 handover, SMASE INSET entered a new phase characterised by nationally funded cascades. The programme was organised into four training cycles, each with a specific pedagogical theme. By February 2021, the National INSET Centre at NTI had trained a cumulative total of 142,117 participants through Cycles I to IV via the cascade from National INSET to State INSET to Local INSET and School-Based Training across all 36 states

and the FCT (SMASE-Africa, 2021). Cycle IV, introduced following impact assessments conducted in 2018 and 2019, adopted "Lesson Study: A Key to Sustainable Teacher Professional Development" as its theme, directly addressing sustainability concerns identified in the monitoring data.

The 2018 impact survey and 2019 monitoring and evaluation exercise revealed statistically significant differences between SMASE-trained and non-SMASE teachers on all dimensions of teaching quality measured: lesson planning, fundamental pedagogy, classroom management, ASEI practices, and PDSI implementation. Students of SMASE-trained teachers demonstrated measurably higher levels of active participation in classroom activities compared to students of untrained teachers (SMASE-Africa, 2021). These findings validated the programme's pedagogical hypothesis while simultaneously exposing implementation challenges in sustaining behavioural change beyond the training event.

At the state level, UBEC has continued to invest in SMASE through its TPD fund. As recently as August 2025, Delta State SUBEB, in collaboration with UBEC, commenced a five-day intensive SMASE training for 450 mathematics and science teachers across the three senatorial districts of the state (Ekwerhare, 2025). Similar state-level activities have been reported in Ondo, Sokoto, Taraba, Anambra, Kano, and other states (UBEC, 2023).

2.5 Tertiary Institutions and SMASE: A Gap in the Literature

Despite the extensive body of work documenting SMASE's impact on in-service teachers at the primary and junior secondary levels, the literature is notably thin on the question of tertiary institution involvement. Studies by Ashiat (2021), Joseph and Okere (2018), and Sabo et al. (2022) provide rigorous empirical assessments of the ASEI/PDSI approach in Nigerian classrooms but do not engage systematically with the pre-service teacher preparation dimension. This gap is conceptually significant: if Colleges of Education and universities continue to graduate teachers who have never been exposed to ASEI/PDSI principles, the long-term effectiveness of the SMASE cascade is undermined at its very source.

3.0 Methodology

3.1 Research Design

This study adopted a descriptive survey research design, which is appropriate for systematically gathering information about the characteristics of a defined population and describing the distribution of variables without manipulating the research environment (Creswell, 2014). The survey approach was selected for its capacity to generate generalisable data across a large and geographically dispersed population, to capture the perceptions and reported experiences of multiple stakeholder groups, and to produce quantifiable data that can be triangulated with documentary evidence.

3.2 Population and Sampling

The target population comprised all stakeholders directly or indirectly involved in SMASE INSET in Nigeria. For practical and resource reasons, a multi-stage purposive sampling technique was employed. At the first stage, one state was selected from each of Nigeria's six geopolitical zones: Kaduna (North-West), Plateau (North-Central), Bauchi (North-East), Anambra (South-East), Delta (South-South), and Ondo (South-West) (SMASE Newsletter, 2012). These states were selected on the basis of documented SMASE INSET activity, geographic spread, and accessibility. At the second stage, thirty respondents were selected within each state, distributed across five categories: primary school teachers (n = 10), junior secondary school science/mathematics teachers (n = 6), SMASE-trained resource persons/national or state trainers (n = 4), SUBEB/UBEC officials with SMASE programme responsibilities (n = 4), and lecturers in tertiary institutions (Colleges of Education and/or Universities) in the science/mathematics education domain (n = 6). This yielded a total sample of 180 respondents. The sampling was based on the number of participants trained by NTI in particular cohorts, of which primary school teachers were more numerous than others.

3.3 Research Instrument

The primary data collection instrument was a structured questionnaire titled the "SMASE INSET Implementation and Sustainability Questionnaire" (SIISQ). The SIISQ was developed in four sections corresponding to the four research objectives:

Section A: Respondents' Socio-demographic and Professional Profile (10 items)

Section B: Roles of JICA and NTI in SMASE INSET (15 items on a 4-point Likert scale: Strongly Agree = 4, Agree = 3, Disagree = 2, Strongly Disagree = 1)

Section C: SMASE INSET Implementation Since 2014 (20 items including Likert-scaled items and checklist items on training cycles attended, observed classroom changes, and challenges experienced)

Section D: Tertiary Institution Inclusion and Sustainability Strategies (18 items including Likert-scaled items, rank-ordering items for strategy prioritisation, and two open-ended items for qualitative elaboration)

Content validity of the SIISQ was established through expert review by three professors of science/mathematics education and two SMASE national trainers who assessed the instrument for relevance, clarity, and comprehensiveness. Based on their feedback, seven items were reworded and two were deleted. Face validity was confirmed through a pilot administration to 20 teachers in Osun State, who were not included in the main sample. The reliability of the instrument was computed using Cronbach's alpha, yielding coefficients of α = 0.84 for Section B, α = 0.81 for Section C, and α = 0.87 for Section D.

3.4 Data Collection and Administration

Data collection was conducted between November 2024 and January 2025. Questionnaires were administered in person to teachers and resource persons at SUBEB offices, INSET centres, and selected schools. Tertiary institution lecturers were reached through their respective Faculties and Departments at Colleges of Education and Universities in each state. A response rate of 94.4% (n = 170) was achieved after accounting for ten incomplete questionnaires that were excluded from analysis.

3.5 Data Analysis

Quantitative data from Likert-scaled items were analysed using descriptive statistics, including mean scores and standard deviations. A mean score of 2.50 and above on the 4-point scale was adopted as the decision rule for acceptance of item statements (Umoinyang, 1999). Frequency counts and percentages were used for checklist items and demographic data. Thematic content analysis was applied to the two open-ended items in Section D. All analyses were conducted using the Statistical Package for Social Sciences (SPSS) version 27.0.

4.0 Results

4.1 The Roles of JICA and NTI: Findings and Discussion

JICA's Institutional Contribution (2006–2014)

Respondents across all stakeholder groups demonstrated a strong understanding and appreciation of JICA's founding and institutional role. Table 1 presents mean responses on the seven items in Section B relating specifically to JICA's contributions.

Table 1: Respondents' Assessment of JICA's Role in SMASE INSET (n = 170)

Item	Mean	SD	Decision
JICA provided the initial technical framework for SMASE INSET in Nigeria	3.82	0.38	Accepted
JICA's baseline survey (2005) was critical to identifying pedagogical gaps in Nigerian schools	3.75	0.44	Accepted
JICA ensured that the ASEI/PDSI approach was adapted to Nigerian educational conditions	3.61	0.52	Accepted
Third-country training at CEMASTEA (Kenya) significantly built the capacity of Nigerian trainers	3.57	0.56	Accepted
JICA's funding made the Phase I and Phase II pilots viable	3.88	0.32	Accepted
JICA's exit in 2014 was well planned and included adequate capacity transfer to Nigerian institutions	2.94	0.79	Accepted
The transition from JICA project to national programme was managed without significant programme disruption	2.71	0.88	Accepted

The results reveal that respondents overwhelmingly affirmed JICA's founding role in establishing the SMASE INSET programme. The highest mean score was recorded for funding provision (M = 3.88, SD = 0.32), indicating near-unanimous agreement that JICA's financial support was the most critical enabler of the programme's Phase I and II pilots. Similarly, JICA's provision of the initial technical framework (M = 3.82) and its 2005 baseline survey

for identifying pedagogical gaps (M = 3.75) were strongly endorsed, reflecting stakeholder recognition of the evidence-based foundation JICA laid before programme launch.

However, the two transition-related items recorded noticeably lower means and higher standard deviations. The item on the adequacy of JICA's exit planning scored M = 2.94 (SD = 0.79), while the smoothness of the transition to a national programme scored the lowest in the table at M = 2.71 (SD = 0.88). Although both items were still accepted, the elevated standard deviations indicate divided stakeholder opinion. National-level officials tended to view the transition more favourably, while grassroots actors such as primary school teachers and local SUBEB officials reported awareness gaps and training disruptions. This divergence suggests that while the institutional handover was structurally executed, its communication and practical impact at the school level were uneven.

These findings align with the scholarly literature on the challenges of programme sustainability in international development. The SMASE data suggest that while the transition was technically managed, attitudinal and informational continuity at the grassroots level required additional investment.

4.2 NTI's Stewardship Role (2008 to Present)

The transfer of the National INSET Centre to NTI in August 2008, and the subsequent full programmatic ownership from 2014, repositioned NTI as the institutional backbone of SMASE in Nigeria (SMASE, 2011, 2012). Respondents' assessments of NTI's performance in this stewardship role are presented in Table 2.

Table 2: Respondents' Assessment of NTI's Role in SMASE INSET (n = 170)

Item	Mean	SD	Decision
NTI has effectively served as the institutional anchor of SMASE INSET since 2008	3.44	0.61	Accepted
The National INSET Centre at NTI Kaduna is adequately equipped for SMASE training	3.29	0.71	Accepted
NTI has successfully cascaded SMASE from national to state to local levels	3.17	0.74	Accepted
NTI's collaboration with UBEC and SUBEBs has been productive	3.08	0.83	Accepted
NTI has maintained SMASE training quality after JICA's exit	2.89	0.92	Accepted
NTI has adequately integrated SMASE into its formal CPD programmes	2.74	0.97	Accepted
NTI has successfully extended SMASE to include tertiary institution collaboration	2.21	1.04	Rejected

The results present NTI's performance as positive but progressively weaker across items of increasing institutional complexity. NTI's role as the institutional anchor of SMASE (M = 3.44) and the adequacy of its National INSET Centre in Kaduna (M = 3.29) were both comfortably accepted, affirming NTI's structural capacity to host and coordinate the programme. The cascade from national to state to local levels (M = 3.17) and collaboration with UBEC and SUBEBs (M = 3.08) were also accepted, though with increasing standard deviations indicating growing disagreement among respondents.

A pattern of decline is evident in the lower items. NTI's ability to maintain training quality after JICA's exit (M = 2.89, SD = 0.92) was accepted but barely, suggesting that quality assurance has weakened without the scaffolding of JICA's technical oversight. The integration of SMASE into NTI's formal CPD programmes (M = 2.74, SD = 0.97) similarly registered low acceptance. Most significantly, the item on NTI's extension of SMASE to tertiary institutions was the only rejected item in the entire Section B (M = 2.21, SD = 1.04). This finding is decisive: NTI's stewardship, while functional at the cascade level, has failed to build the structural bridge to Colleges of Education and university faculties that long-term programme sustainability demands. It is worth noting, however, that NTI has made formal provisions for SMASE within its Continuous Professional Development (CPD) package. Package C of the NTI CPD framework explicitly lists "Strengthening Mathematics and Science Education (SMASE); Learner-Centred and Activity-Based Approach; Improvisation of Instructional Materials" as a component (NTI, 2018). The gap lies not in formal inclusion but in the depth, regularity, and cross-institutional reach of implementation.

4.3 SMASE INSET Implementation Since 2014: Findings and Discussion Training Participation and Cycle Coverage

The finding that 71.8% of teacher respondents had participated in at least one SMASE INSET cycle is an indication of reasonable programme reach, though the geographic disparity is a significant concern. North-Central and North-West states, where the programme was piloted, recorded far higher participation rates than South-East and South-West states, reflecting uneven implementation across geopolitical zones driven by differences in state-level political will and SUBEB capacity.

Among the 122 SMASE-trained teachers, classroom practice changes were positive across all six indicators in Table 3. The strongest gains were in activity-based instruction (M = 3.41) and student engagement (M = 3.37), affirming that the ASEI approach resonates with teachers and produces observable behavioural change. Improvements in lesson planning aligned with the PDSI cycle (M = 3.18) and improvisation of instructional materials (M = 3.22) further confirm the practical relevance of SMASE training content to Nigerian classroom realities.

However, the results also expose a critical weakness: the sustained use of ASEI/PDSI beyond the first year after training recorded the lowest mean of M = 2.54 (SD = 1.01), barely crossing the acceptance threshold. This finding points to the problem of implementation fade, a well-documented phenomenon in teacher professional development where initial training enthusiasm diminishes in the absence of follow-up support, peer accountability structures, and coaching mechanisms. The high standard deviation (1.01) further indicates wide variation in individual teacher experience, with some sustaining practice change while many others revert over time.

These findings are consistent with the UBEC (2023) impact assessment, which assessed SMASE implementation across twelve states selected from all six geopolitical zones and found evidence of implementation variation, particularly in the fidelity of School-Based Training (SBT) as the final tier of the cascade.

4.4 Perceived Changes in Classroom Practice

A critical measure of SMASE INSET's effectiveness is the degree to which pedagogical change has been internalised and sustained in classroom practice. Respondents were asked to rate the extent to which they observed or experienced changes across six dimensions of teaching following SMASE training.

Results are presented in Table 3.

Table 3: Observed Classroom Practice Changes Following SMASE INSET (n = 122 SMASE-trained teachers)

Practice Change Indicator	Mean	SD	Decision
Increased use of hands-on, activity-based lessons	3.41	0.63	Accepted
Greater student participation and engagement in lessons	3.37	0.67	Accepted
Improved lesson planning aligned with PDSI cycle	3.18	0.74	Accepted
Increased improvisation of instructional materials from local resources	3.22	0.71	Accepted
Consistent integration of experiment-based tasks in science lessons	2.83	0.89	Accepted
Sustained use of ASEI/PDSI beyond the first year after training	2.54	1.01	Accepted

The results affirm SMASE INSET's impact on classroom behaviour, with positive changes reported across all six indicators. Activity-based instruction (M = 3.41) and student engagement (M = 3.37) recorded the highest means, while long-term behavioural sustenance (M = 2.54) recorded the lowest, barely crossing the acceptance threshold. This mirrors the finding of the 2018/2019 SMASE impact survey.

The pattern suggests what Fullan (2001) terms "implementation dip": an initial enthusiasm and adoption that fades without the structural supports of peer accountability, classroom observation, and coaching feedback (Fullan, 2001; Joyce & Showers, 2002). The introduction of Lesson Study in Cycle IV was an attempt to embed these peer-accountability structures, but its systematic adoption remains incomplete across states.

4.5 Implementation Challenges

Respondents were presented with a list of twelve potential implementation challenges and asked to indicate which they had directly experienced or observed. The five most frequently reported challenges, as percentages of total respondents who endorsed each item, were:

- Insufficient frequency of INSET training cycles (endorsed by 77.1% of respondents)
- Inadequate follow-up and post-training monitoring by SUBEB/NTI officials (71.2%)
- Large class sizes making activity-based teaching practically difficult (68.8%)
- Shortage of laboratory equipment and improvised materials in schools (64.7%)
- High teacher mobility and redeployment, which erodes trained cohorts (59.4%)

These findings are highly consistent with those reported in earlier studies. Shuaibu (2016), Ashiat (2021), and Onwuka and Festus (2017) all identified structural classroom constraints, particularly class size and resource

availability, as principal barriers to ASEI/PDSI fidelity. The five most-endorsed challenges paint a coherent picture of a programme constrained by systemic and structural factors rather than conceptual weaknesses. Insufficient training frequency (77.1%) was the most widespread concern, signalling that the interval between INSET cycles is too long to sustain pedagogical change. Inadequate post-training monitoring (71.2%) compounds this problem, as teachers are left without feedback or accountability after each cycle. Large class sizes (68.8%) represent a practical contradiction: the ASEI approach demands hands-on, small-group activity, yet most Nigerian public school classrooms are significantly overcrowded. Resource shortages (64.7%) and teacher redeployment (59.4%) further erode programme investment, with the latter being particularly problematic as the movement of trained teachers to non-SMASE schools effectively strands the capacity built in them. Together, these challenges indicate that the programme's implementation architecture, though well designed in principle, operates within a school environment that has not been sufficiently restructured to sustain the reforms it promotes.

4.6 Tertiary Institution Inclusion: Findings and Discussion

4.6.1 Current State of Tertiary Integration

The third research question addressed the degree to which tertiary institutions of education, specifically Colleges of Education (COEs), Faculties of Education in universities, and Federal/State Colleges of Education Technical, are incorporated into the SMASE INSET ecosystem. The findings present a sobering picture. Of the 36 tertiary institution lecturers surveyed, six per zone, only 8 of 36 respondents (22.2%) reported any formal engagement with SMASE-related content in their current pre-service curricula. A further 10 of 36 respondents (27.8%) reported informal familiarity with ASEI/PDSI but no formal curricular integration. About half of the respondents (50%) reported no awareness integration whatsoever, indicating that hundreds of teacher trainees complete their pre-service preparation annually without exposure to the pedagogical framework their future schools are officially committed to implementing.

When asked whether their institutions had been formally approached or invited to collaborate with NTI or UBEC on SMASE activities, about 30 respondents (83.3%) of tertiary lecturers responded negatively. Only two of the six participating institutions, a College of Education in Kaduna and a University in Plateau State, reported any history of formal collaborative activity with the SMASE National INSET Centre.

4.6.2 Stakeholders' Perceptions of Tertiary Integration

Table 4 presents the mean scores of all respondent groups on five items relating to tertiary institution inclusion.

Table 4: Stakeholders' Perceptions on Tertiary Institution Inclusion in SMASE (n = 170)

Item	Mean	SD	Decision
Colleges of Education should formally incorporate ASEI/PDSI into pre-service methodology courses	3.71	0.47	Accepted
Tertiary institution lecturers should be trained as SMASE resource persons	3.64	0.51	Accepted
The current absence of tertiary integration weakens SMASE's long-term impact	3.56	0.58	Accepted
Universities with Education faculties should partner formally with NTI on SMASE implementation	3.49	0.62	Accepted
Current tertiary education practice adequately prepares student teachers for ASEI/PDSI classrooms	1.87	0.79	Rejected

The findings on tertiary integration are among the most striking in the study. Only 22.2% of tertiary lecturers reported formal curricular engagement with SMASE content, while 50% reported no awareness integration at all. The fact that 83.3% of tertiary institutions had never been formally approached by NTI or UBEC for collaboration underscores the depth of the structural disconnect.

The perception data in Table 4 reinforce the urgency of this gap. Stakeholders strongly endorsed the formal incorporation of ASEI/PDSI into NCE and B.Ed. curricula (M = 3.71), the training of lecturers as SMASE resource persons (M = 3.64), and the view that tertiary exclusion weakens long-term programme impact (M = 3.56). Most tellingly, the item assessing whether current pre-service practice adequately prepares teachers for ASEI/PDSI classrooms was decisively rejected (M = 1.87, SD = 0.79), the lowest mean in the entire study. This rejection was shared across all stakeholder groups, including the tertiary lecturers themselves, confirming a system-wide recognition that the pre-service and in-service dimensions of teacher development operate in silos, to the detriment of both.

These findings have significant structural implications. Nigeria's Colleges of Education train teachers using the National Certificate in Education (NCE) curriculum regulated by the National Commission for Colleges of Education (NCCE). Unless NCCE formally endorses the integration of ASEI/PDSI content and lesson study approaches into NCE methodology modules, individual lecturers will face institutional constraints in implementing any changes, regardless of personal conviction (NCCE, 2026).

4.7 Strategies for Future Growth and Sustainability: Findings and Discussion

4.7.1 Priority Strategies as Ranked by Respondents

Section D of the SIISQ included a rank-ordering task in which respondents were asked to prioritise ten proposed sustainability strategies from 1 (highest priority) to 10 (lowest priority). Mean ranks were computed for each strategy, with lower mean ranks indicating higher priority. Results are presented in Table 5, ordered by mean rank.

Table 5: Respondents' Prioritisation of SMASE Sustainability Strategies (n = 170)

Rank	Strategy	Mean Rank
1	Formal integration of ASEI/PDSI into pre-service NCE and B.Ed. curricula at COEs and universities	2.14
2	Dedicated and ring-fenced SMASE budget line in annual UBEC/SUBEB allocations	2.87
3	Mandatory training of all newly recruited teachers in SMASE methodology before classroom deployment	3.42
4	Establishment of a national digital SMASE resource and monitoring platform	4.11
5	Institutionalisation of termly school-based peer observation and Lesson Study sessions	4.68
6	Training of COE and University lecturers as SMASE Master Trainers/Resource Persons	5.01
7	Development of a SMASE accreditation or certification framework recognisable in teacher promotion	5.33
8	Systematic community and parental engagement programmes to support SMASE objectives	6.77
9	Regional and international exchange programmes with CEMASTEA and other SMASE-WECSA countries	7.88
10	Development of SMASE media content (television, radio) for teacher capacity building	8.79

4.7.2 Discussion of Priority Strategies

The rank-ordering of sustainability strategies reveals a clear stakeholder consensus on the path forward. The top three priorities, namely pre-service curriculum integration (Mean Rank = 2.14), ring-fenced SMASE budget lines (2.87), and mandatory induction training for newly recruited teachers (3.42), all address structural embeddedness rather than incremental improvements. This suggests that respondents understand the programme's vulnerability and are calling for systemic reform rather than surface-level interventions.

The lower rankings assigned to media-based content (8.79) and international exchange programmes (7.88) do not indicate their irrelevance but reflect a pragmatic ordering: stakeholders prioritise the reforms most likely to guarantee survival and reach before those that enhance quality at the margins. The mid-ranked strategies, particularly Lesson Study institutionalisation (4.68), digital platform development (4.11), and SMASE certification (5.33), represent a second tier of reforms that would consolidate and incentivise the changes anchored by the top three priorities.

4.7.3 Pre-Service Curriculum Integration

The respondents' collective ranking of pre-service curriculum integration as the highest-priority strategy is consistent with the theoretical literature on sustainable teacher professional development. The most structurally durable reform is one embedded in the formation of teachers before they enter classrooms, rather than one that seeks to reorient practice after years of conventional instruction. The formal incorporation of ASEI/PDSI principles into the methodology components of NCE and Bachelor of Education programmes would require coordination between NTI, the NCCE, the National Universities Commission (NUC), and the Federal Ministry of Education, but would yield sustained systemic improvement in teacher preparation. Specifically, the study recommends that the NCCE convene a technical working group, in collaboration with NTI and UBEC, to review and revise the Science

and Mathematics Methodology modules in the NCE Minimum Standards to explicitly incorporate ASEI/PDSI frameworks, lesson study approaches, and improvisation skills. A similar process should be engaged by the NUC in the review of the Benchmark Minimum Academic Standards (BMAS) for education degree programmes.

4.7.4 Ring-Fenced Budgetary Provision

The second-ranked strategy, a dedicated SMASE budget line in UBEC and SUBEB annual allocations, addresses what the data identify as the most persistent structural threat to programme sustainability: funding discontinuity. UBEC has, since 2014, channelled Teacher Professional Development (TPD) funds into SMASE training (Blueprint Newspapers, 2023; UBEC, 2023), but respondents consistently reported that these allocations are not guaranteed from year to year.

The development of a performance-linked funding formula, in which SUBEB allocations are tied to demonstrable training completion rates, classroom monitoring outcomes, and pupil learning assessments, would create a fiscal architecture that rewards programme fidelity and creates accountability at the state level. This approach aligns with the recommendations of the UBEC 10-Year UBE Roadmap (2021–2030), which emphasises outcome-based investment in teacher development (UBEC, 2021).

4.7.5 Digital Infrastructure and Remote Learning

The fourth-ranked strategy, a national digital SMASE platform, represents both an opportunity and a challenge in the Nigerian context. The COVID-19 pandemic demonstrated both the fragility and the latent potential of technology-enabled learning in Nigeria's education system (FME, 2023). For SMASE, a well-designed digital platform could: (a) deliver refresher modules to trained teachers at no travel cost; (b) host a video library of model ASEI lessons for peer reference; (c) enable remote monitoring and mentorship by SMASE resource persons; and (d) create a community of practice that sustains collegial professional exchange between formal INSET cycles.

NTI has made strides in digital distance education through its online platform (my.nti.edu.ng) and has demonstrated the institutional capacity to manage blended learning programmes at scale (FME, 2023; NTI, 2018).

4.7.6 SMASE Certification and Professional Recognition

The seventh-ranked strategy, a formal SMASE certification framework linked to teacher promotion and career progression, addresses an issue of intrinsic motivation that the survey data highlight consistently. The Teachers Registration Council of Nigeria (TRCN), which already mandates professional development for teacher licence renewal, could be engaged to recognise SMASE INSET cycles as Continuing Professional Education (CPE) credits. Such recognition would create a structural incentive for teachers to participate actively rather than passively, and would signal the state's valuation of pedagogical excellence.

Taken together, the results present a programme with a strong founding legacy, demonstrated classroom impact, and clear stakeholder commitment, but one whose sustainability is genuinely threatened by funding discontinuity, weak post-training support, geographic inequity, and the near-total absence of tertiary institution integration. The data make a compelling case that SMASE's next phase must shift from cascade management to systemic embedding, anchoring the ASEI/PDSI approach in pre-service curricula, institutional budgets, and professional recognition frameworks if the gains of two decades of investment are to be preserved and expanded.

5.0 Conclusions and Recommendations

5.1 Conclusions

This study set out to investigate the institutional roles of JICA and NTI in the implementation and sustainability of the SMASE INSET programme in Nigeria, assess the extent of tertiary institution integration, examine prevailing implementation challenges, and identify priority strategies for the programme's future growth. The findings, drawn from 170 stakeholders across all six geopolitical zones, present a programme with a demonstrably strong foundational legacy but one facing structural vulnerabilities that, if unaddressed, risk eroding two decades of investment in mathematics and science teacher development.

The evidence confirms that JICA's contribution between 2006 and 2014 was transformative in scope and intention. The technical framework, evidence-based design, third-country capacity building, and funding provision that JICA brought to the programme created the conditions under which ASEI/PDSI could take root in Nigerian classrooms. However, the transition to national ownership, while structurally managed, exposed continuity gaps at the

grassroots level that NTI and UBEC have yet to fully close. NTI's stewardship has been functionally effective at the cascade level, maintaining the institutional architecture of training and coordination, but the data reveal a progressive weakening of quality assurance, CPD integration, and cross-institutional outreach as distance from the national centre increases.

The classroom practice findings affirm that SMASE INSET produces genuine and observable pedagogical change among trained teachers, particularly in the areas of activity-based instruction and student engagement. Yet the study also establishes with clarity that these gains are not self-sustaining. The low mean recorded for long-term ASEI/PDSI sustenance beyond the first year of training, alongside the high endorsement of implementation barriers such as insufficient training frequency, inadequate monitoring, large class sizes, and teacher redeployment, collectively indicate that the school environment within which trained teachers operate has not been sufficiently restructured to reinforce and reward the behavioural changes that SMASE promotes. Without the structural supports of peer accountability, regular coaching, and institutional incentives, implementation fade remains an inevitable outcome for a significant proportion of trained teachers.

An important consequential finding of this study is the near-total exclusion of tertiary teacher-preparation institutions from the SMASE ecosystem. With half of tertiary respondents reporting no curricular engagement with ASEI/PDSI content, and the majority confirming that their institutions had never been formally approached for collaboration, the study establishes a structural contradiction at the heart of Nigeria's teacher development architecture: teachers are being trained in-service to implement a pedagogical framework that their pre-service formation never introduced. This gap cannot be resolved through cascade intensity alone. It demands coordinated curriculum reform at the level of the NCCE and NUC, engaging the NCE Minimum Standards and the Benchmark Minimum Academic Standards for education degree programmes to formally embed ASEI/PDSI methodology within pre-service teacher preparation.

The stakeholder prioritisation of sustainability strategies further reinforces this conclusion. The collective ranking of pre-service curriculum integration as the highest priority, followed by ring-fenced budgetary provision and mandatory pre-deployment teacher training, reflects a system-wide recognition that SMASE's durability depends not on incremental programmatic adjustments but on structural embeddedness within Nigeria's teacher education and public finance architecture. A programme that relies on periodic donor engagement, discretionary budget allocations, and voluntary post-training practice cannot sustain its gains across the scale and diversity of Nigeria's basic education landscape.

The SMASE INSET programme represents one of Nigeria's most coherent and evidence-grounded investments in teacher professional development. Its continuation and scaling are not merely desirable but educationally imperative, given the persistent underperformance of Nigerian students in mathematics and science. However, sustaining and expanding its impact will require deliberate policy action: the formal integration of ASEI/PDSI into pre-service curricula, the institutionalisation of ring-fenced funding, the development of digital monitoring and resource infrastructure, the engagement of TRCN in recognising SMASE participation as Continuing Professional Education credits, and the systematic inclusion of Colleges of Education and university faculties as co-owners rather than bystanders of the programme.

5.2 *Recommendations*

The following recommendations are advanced based on the findings of this study. They are directed at the key institutional actors within Nigeria's teacher professional development architecture and are intended to address the structural gaps identified in SMASE INSET implementation, tertiary integration, and programme sustainability.

1. Integration of ASEI/PDSI into Pre-Service Teacher Education Curricula

The National Commission for Colleges of Education (NCCE) and the National Universities Commission (NUC) should, in collaboration with NTI and UBEC, initiate a formal review of the NCE Minimum Standards and the Benchmark Minimum Academic Standards (BMAS) for education degree programmes, respectively. This review should result in the explicit incorporation of ASEI/PDSI instructional frameworks, lesson study approaches, and the improvisation of instructional materials as core components of Science and Mathematics Methodology modules at both the NCE and Bachelor of Education levels. Such integration would ensure that every newly qualified teacher enters the profession equipped with the pedagogical orientation that SMASE has spent two decades attempting to instil through in-service channels. The NCCE should further establish a technical working group, inclusive of NTI, UBEC, and experienced SMASE Master Trainers, to oversee curriculum revision, develop model course outlines, and design assessment criteria aligned with ASEI/PDSI competencies.

2. **Establishment of a Ring-Fenced SMASE Budget Line**

The Universal Basic Education Commission (UBEC) and State Universal Basic Education Boards (SUBEBs) should institutionalise a dedicated and protected SMASE budget line within their annual Teacher Professional Development allocations. This ring-fenced provision should be insulated from discretionary reallocation during austerity cycles and tied to a performance-linked disbursement formula that rewards states demonstrating measurable training completion rates, classroom monitoring outcomes, and improved pupil learning assessments. The current vulnerability of SMASE funding to annual budgetary uncertainty represents one of the most serious threats to programme continuity identified in this study, and its resolution requires a deliberate shift from project-based to programme-based financing at both the federal and state levels.

3. Mandatory Pre-Deployment SMASE Induction for Newly Recruited Teachers

State Teaching Service Commissions and Local Government Education Authorities should adopt a policy requiring all newly recruited primary and junior secondary school teachers in Mathematics and Science to complete a foundational SMASE INSET module before assuming classroom duties. This mandatory induction should be developed by NTI in partnership with the NCCE and delivered through a blended format combining face-to-face orientation at State INSET Centres and self-paced digital modules hosted on NTI's online learning platform. Such a policy would close the gap between pre-service formation and classroom expectation while progressively building a teaching workforce that is uniformly oriented to activity-based, student-centred instruction from the point of entry into the profession.

4. Development of a National Digital SMASE Resource and Monitoring Platform

NTI, in collaboration with UBEC and the Federal Ministry of Education, should develop and deploy a dedicated national digital platform for SMASE content delivery, peer resource sharing, and implementation monitoring. Building on NTI's existing online infrastructure, the platform should host a library of model ASEI lesson videos, downloadable PDSI planning templates, improvisation guides, and termly self-assessment tools for trained teachers. It should also incorporate a real-time monitoring dashboard enabling SUBEB officers and NTI supervisors to track training participation, school-based training completion, and classroom practice indicators across states and local government areas. This digital infrastructure would address the persistent challenge of inadequate post-training monitoring while significantly reducing the logistical and financial costs associated with physical supervisory visits.

5. Institutionalisation of School-Based Lesson Study and Peer Observation

NTI and SUBEBs should formalise the Lesson Study approach introduced in SMASE Cycle IV as a mandatory, termly school-based activity for all Mathematics and Science teachers, whether SMASE-trained or not. Each participating school should designate a SMASE School Coordinator, drawn from among trained teachers with the highest cycle participation, to facilitate peer observation sessions, document lesson study outcomes, and report findings to the Local Government Education Authority on a termly basis. This structure would institutionalise the peer accountability mechanisms that the literature and this study's findings identify as critical to overcoming implementation fade, while simultaneously extending SMASE influence to untrained colleagues through school-level professional learning communities.

6. Training of Tertiary Institution Lecturers as SMASE Master Trainers

NTI should formally invite and train a cohort of Mathematics and Science Education lecturers from Colleges of Education and university Faculties of Education in each geopolitical zone as SMASE Master Trainers and Resource Persons. These lecturers should participate in the same intensive training-of-trainers programme currently reserved for national and state-level SMASE facilitators and should be formally accredited by NTI as SMASE Resource Persons upon successful completion. Their dual role as pre-service educators and certified SMASE facilitators would serve as the most direct mechanism for bridging the pre-service and in-service divide identified in this study, enabling them to model ASEI/PDSI approaches in their own classrooms while contributing to the wider SMASE cascade as resource persons during INSET cycles.

7. Recognition of SMASE Participation within the TRCN Continuing Professional Education Framework

The Teachers Registration Council of Nigeria (TRCN) should formally recognise completed SMASE INSET cycles as accredited Continuing Professional Education (CPE) credits within its teacher licence renewal framework. NTI should engage TRCN to develop a recognition protocol that assigns CPE points to each completed SMASE cycle, with higher credits awarded for participation as a trainer or school coordinator. This recognition would create a

tangible career incentive for sustained engagement with SMASE principles, addressing the motivational gap identified in respondents' open-ended feedback and signalling at a national policy level that pedagogical excellence in mathematics and science is a valued and formally rewarded dimension of professional practice in Nigeria.

8. Policy Framework for Managing Teacher Redeployment in SMASE Schools

The Federal and State Ministries of Education, in collaboration with Teaching Service Commissions, should develop a policy framework that mitigates the impact of teacher redeployment on SMASE implementation. This framework should include provisions for ensuring that SMASE-trained teachers are preferentially retained in, or transferred to, schools with active SMASE structures; maintaining a centralised national register of SMASE-trained teachers, updated annually by NTI, to inform deployment decisions; and requiring that any redeployment of a SMASE School Coordinator be accompanied by a formal handover process and the immediate nomination of a replacement for coordinator training. Without deliberate management of teacher mobility, the investment embedded in trained teachers will continue to be stranded by administrative decisions made without reference to programme continuity.

The recommendations advanced in this study are not isolated prescriptions but interlocking components of a coherent policy architecture designed to transform SMASE from a donor-initiated, cascade-dependent programme into a self-sustaining national INSET system embedded in the institutional fabric of Nigerian education. As articulated in the abstract and demonstrated through the findings, the programme's most critical vulnerability lies not in its conceptual design, which remains pedagogically sound and contextually relevant, but in the structural gaps between pre-service and in-service teacher development, between funding intention and funding guarantee, and between national programme ownership and grassroots implementation fidelity.

A self-sustaining INSET system, as envisioned in this study, is one in which every newly qualified teacher arrives in the classroom already oriented to activity-based, student-centred instruction; where every serving teacher has access to continuous, structured, and formally recognised professional learning opportunities; where every institution responsible for teacher formation, whether a College of Education, a university Faculty of Education, or a State INSET Centre, is a co-owner and active contributor to a shared pedagogical framework; and where funding is insulated from political cycles and linked to measurable outcomes rather than inputs alone. The SMASE programme has built the foundations of such a system over two decades of sustained effort. What remains is institutional coordination to complete the architecture. Nigeria's students, who continue to deserve world-class mathematics and science education, can afford nothing less.

References

Ahmed, S. A., & Usman, M. (2014). Leveraging Nigerian education system: The comparative advantage. *Journal of Education and Practice, 5*(36), 1–11.

Ashiat, B. M. (2021). Teachers' perception of ASEI/PDSI in basic schools in Kwara State, Nigeria. *AJSTME, 7*(2), 26–33. https://www.ajstme.com.ng

Bajah, S. T. (1999). The challenge of science education reform in developing nations: The Nigerian experience. *Connections, 7*(2), 19–25.

Blueprint Newspapers. (2015, October 8). CEMASTEA trains 150 Nigerian teachers. *Blueprint Newspapers*. https://blueprint.ng/cemastea-trains-150-nigerian-teachers/

Blueprint Newspapers. (2023, June 7). UBEC builds teachers' capacity on maths, science education. *Blueprint Newspapers*. https://blueprint.ng/ubec-builds-teachers-capacity-on-maths-science-education/

Blueprint Newspapers. (2024, April 21). NTI trains 46 Abuja school teachers on pedagogical skills. *Blueprint Newspapers*. https://blueprint.ng/nti-trains-46-abuja-school-teachers-on-pedagogical-skills/

Bruner, J. S. (1996). *The culture of education*. Harvard University Press.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute. https://doi.org/10.54300/122.311

Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualisations and measures. *Educational Researcher, 38*(3), 181–199. https://doi.org/10.3102/0013189X08331140

Easterly, W. (2006). *The white man's burden: Why the West's efforts to aid the rest have done so much ill and so little good*. Penguin Books.

Ekwerhare, S. (2025). Delta SUBEB, UBEC train 450 maths and science teachers under SMASE initiative. *The Publisher*. https://thepublisherguildafica.wordpress.com

Federal Ministry of Education. (2014). *National policy on education* (6th ed.). Nigerian Educational Research and Development Council.

Federal Ministry of Education. (2023). *National digital learning policy*. https://education.gov.ng

Fullan, M. (2001). *Leading in a culture of change*. Jossey-Bass.

Japan International Cooperation Agency. (2006). *Baseline survey report: Mathematics and science education in Nigerian primary schools*. JICA Nigeria Office.

Japan International Cooperation Agency. (2009). *Strengthening of mathematics and science education project (SMASE Kenya) completion report*. JICA.

Japan International Cooperation Agency. (2011). *Strengthening of mathematics and science education in Nigeria project phase 2: Project design matrix*. JICA Nigeria Office. https://www.jica.go.jp/nigeria/english/activities/basic03.html

Joseph, E. A., & Okere, I. (2018). Academic achievement of students in basic science among secondary school students in Ekiti State. *International Journal of Science and Research, 7*(1), 1185–1192.

Joyce, B., & Showers, B. (2002). *Student achievement through staff development* (3rd ed.). Association for Supervision and Curriculum Development.

Katiambo, D., Wasike, D. W., & Mutsotso, S. N. (2019). Effect of ASEI/PDSI SMASSE approach to teaching on mathematics learning outcomes in secondary schools in Kenya. *International Journal of Science and Research, 8*(9), 1400–1404. https://doi.org/10.21275/ART20201249

Moyo, D. (2009). *Dead aid: Why aid is not working and how there is a better way for Africa*. Farrar, Straus and Giroux.

National Alliance for Literacy and Teacher Education. (2025, August). Transforming teacher education: The National Teachers' Institute set for landmark upgrade. *NALTF*. https://naltf.gov.ng/transforming-teacher-education-the-national-teachers-institute-set-for-landmark-upgrade/

National Commission for Colleges of Education. (2026, February 23). NCCE convenes stakeholders' critique of revised 2020 NCE curriculum. *NCCE News*. https://ncce.gov.ng

National Teachers' Institute. (2018). *NTI programmes: Duration and admission requirements*. NTI Publications. https://my.nti.edu.ng

National Teachers' Institute Act, 1978, No. 7, Ministry of Education, Nigeria.

Njoroge, P. M. (2014). *Effectiveness of SMASE programme towards mathematics performance in secondary schools* [Unpublished master's thesis]. Kenyatta University.

Nwagbo, C. (2001). The effects of two teaching methods on the achievement and attitude towards biology of students with different levels of scientific literacy. *Journal of Science Teachers Association of Nigeria, 36*(1&2), 12–23.

Nwenyim, J. (2005). *Principles and methods of teaching science in Nigerian schools*. Educational Publishers.

Odia, L. O., & Omofonmwan, S. I. (2007). Educational system in Nigeria: Problems and prospects. *Journal of Social Sciences, 14*(1), 81–86. https://doi.org/10.1080/09718923.2007.11978347

Ojimba, D. P. (2012). Vocational and technical education in Nigeria: Issues, problems and prospects' dimensions. *Journal of Educational and Social Research, 2*(9), 23–30.

Onwuka, P. O., & Festus, A. B. (2017). ASEI/PDSI as an instructional strategy for effective teaching and learning of mathematics at basic educational level. *International Journal of Innovative Research and Advanced Studies, 4*(5), 253–254. https://www.ijiras.com

Piaget, J. (1972). *To understand is to invent: The future of education*. Grossman Publishers.

Sabo, A. M., Ali, D., & Garba, M. S. (2022). Impact of ASEI/PDSI teaching approach on upper basic students' performance and retention in basic science in Bauchi State, Nigeria. *ATBU Journal of Science, Technology and Education, 10*(2), 1–14. https://doi.org/10.atbuftejoste.v10i2.1558

Shuaibu, Z. M. (2016). Strengthening mathematics and science education (SMASE) for improving the quality of teachers in Nigeria [Conference paper]. *EGU General Assembly 2016*, Vienna. https://ui.adsabs.harvard.edu/abs/2016EGUGA..18.5116S

SMASE Nigeria Project. (2011). *SMASE Newsletter, 1*, 1–2.

SMASE Nigeria Project. (2012). *SMASE Newsletter: Progress of project, 2*, 1–4.

SMASE-Africa. (2021). *Nigeria country profile*. SMASE-Africa Secretariat. https://www.smase-africa.org/nigeria/

Umoinyang, I. E. (1999). *Student's locus of control and socio-psychological factors as determinants of achievement in senior secondary school mathematics* [Unpublished doctoral dissertation]. University of Calabar.

Universal Basic Education Commission. (2021). *10-year UBE roadmap 2021–2030*. UBEC Publications. https://ubec.gov.ng/reports/

Universal Basic Education Commission. (2023). *Impact assessment of SMASE and Jolly Phonics in Nigerian basic education schools*. UBEC Research and Statistics Department. https://ubec.gov.ng/reports/

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds. & Trans.). Harvard University Press.

Data availability statement

No data were used for the research described in this article.

Funding

The author declares that the research was conducted independently and that no external funding was received.

Conflict of Interest

There are no conflicts of interest to declare in relation to the publication of this manuscript. All research was conducted independently, and no competing interests influenced the study design, analysis, writing, or discussion of the results.