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Evaluation of the Pilot Phase of the Nigeria-UNESCO Science & Technology Education Project (STE)

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Abbreviations & Acronyms

ABL	Action Based Learning
ELT	Effective Learning Technique
ESA	Education Sector Analysis
ETF	Educational Trust Fund
FCT	Federal Capital Territory
FME	Federal Ministry of Education
FMST	Federal Ministry of Science and Technology
Government	Government of Nigeria
IBE	International Bureau of Education
IOS	UNESCO's Internal Oversight Service
JICA	Japan International Cooperation Agency
JSC	Junior Secondary Certificate
JSCE	Junior Secondary Certificate Examination
LGEA	Local Government Education Authority
MAN	Mathematics Association of Nigeria
M&E	Monitoring and Evaluation
MBA	Masters of Business Administration
MOE	Ministry of Education
NASENI	National Agency for Scientific and Engineering Infrastructure
NCCE	National Commission of Colleges of Education
NECO	National Examinations Council of Nigeria
NEEDS	National Economic and Empowerments Development and Strategies
NEPAD	New Partnership for Africa's Development
NMC	National Mathematics Centre
ORASS	Operation Reach All Secondary Schools
PMK	Primary Mathematics Kit
Project	Nigeria-UNESCO Special Science and Technology Education Project
PSK	Primary Science Kit
RBM	Results Based Management
ROI	Return on Investment
SMASE	Strengthening Mathematics and Science Education Project
STAN	Science Teachers association of Nigeria
STE	Science and Technology Education
STME	Science Technology and Mathematics Education
SUBEB	State Universal Basic Education Board
TVET	Technical and Vocational Education and Training
UBEC	Universal Basic Education Council
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
WAEC	West African Examinations Council

1. EXECUTIVE SUMMARY

The Nigeria-UNESCO Special Science and Technology Education Project ("Project") distributed mathematics and science kits to an average of ten schools in each of Nigeria's 36 states, as well as to the Federal Capital Territory, and equipped 435 secondary schools and 102 unity schools with micro-science kits. The Project also included the training of 1,480 primary mathematics and science teachers and 1,740 secondary school science teachers in the schools that received the mathematics and science kits. Teachers were trained in Action Based Learning (ABL) techniques[1] that are recognised as effective for teaching science and mathematics to primary and secondary level students. In addition, the Project included the training of approximately 230 Federal and State Inspectors, shifting their profile toward one that enabled teachers to improve their skills and the ways in which they used the materials and their training.

Achievements

The Project provided teachers with training in common teaching techniques and materials which have enabled students to recognize science, mathematics, and technology as directly relevant to their lives and led then to consider pursing these fields of study as educational careers.

Most importantly, this evaluation provides evidence that the Project had a demonstrable impact on teachers and students. Teachers repeatedly expressed an appreciation of the new learning techniques, techniques that, as they said, not only proved to be more effective for teaching but that also made science, technology and mathematics "come alive" for students. Surveyed student and teacher records indicate improvements in students' performance in related subjects, and demonstrate a more rounded understanding of relevant theories and formulas.

As this evaluation demonstrates, much of the positive impact on teachers and students stems from a combination of several elements that should remain a focus going forward. This includes the Effective Learning Technique (ELT) pedagogy[2], the training of teachers in dedicated and professional settings with the encouragement of train-the-trainer schemes, the regular and substantive visits by Federal and State inspectors, and the provision of materials and kits that can be used for demonstrations and practical learning.

The evaluation demonstrates that the combination of these elements leads to the Project's success— if one was substantively absent from any school, the Project tended not to meet stated objectives.

In schools where all elements were in place, the evaluators found evidence of increased teacher and student performance. Improved teacher performance was shown by evidence of a deliberate and active use of new teaching techniques as well as openness to experiment with similar and complimentary techniques. Improved student performance was demonstrated by higher test scores, an appreciation of the science and mathematics subjects and how they relate to their day-to-day lives, as well as by increased enrollments in secondary and tertiary schools and clubs in the related subjects.

[1] Widely recognized in the field of learning, ABL is an experiential based pedagogy that includes a practical, "hands-on" approach for learners.

[2] This pedagogy, developed by the FME, UNESCO, and others, is based on ABL and includes elements that are relevant to Nigerian educators and learning, e.g. gender equal approaches.

When any of these four elements was not present, there was scant evidence of these improvements. Thus, the successes to date and future success depends on strengthening these four elements.

Challenges

While there is evidence that the Nigerian Government is committed to the Project's next phase, it must carefully consider some key areas regardless of how those plans manifest:

- **Effective Management for Scaling-up:** The plans for scaling-up the Project, regardless of their eventual actual scale and costs, will require management structures and systems for ensuring quality, sustainability and impact.
- **Training of Teachers and Inspectors:** Systems should be in place to ensure that the training of teachers and inspectors maintains the highest quality standards and that there are sufficient Monitoring and Evaluation (M&E) systems in place.
- **Kit Suitability:** The materials in the kits should be reviewed for their suitability, using plastics and calibrations and ensuring regular replenishment of consumables.
- **Costs:** The current costs of the science and mathematics kits are not competitive. This remains so even after the re-negotiated prices for the kits. The Nigerian Government must make every effort to ensure that these costs are reduced.
- **UNESCO's Role:** UNESCO's expertise in science and education and its partnership with the Federal Ministry of Education (FME) have proven to be important attributes of the Project. Both parties should seek to strengthen this partnership going forward and to ensure that both are playing roles that are aligned with their mandates and core competencies.
- **Resource Mobilization:** Given the significance of resource mobilization and broader agreements, like the Paris Declaration, the Nigerian Government will need to lead all resource mobilization efforts and draw on the range of sources it has already identified.
- **Serving the Public:** The Project will surely benefit from continued public relations and other public education initiative that inform the public at large of the Project's activists and benefits. The Project may continue to use the short films and other advocacy materials to ensure that the general public, teachers, and students across the country understand the Project's goals and the benefit it will have for Nigeria as a whole.

Key Recommendations

In addition to all of the recommendations noted in this evaluation, the following are particularly critical. Nonetheless, all of this evaluation's recommendations should be carefully considered.

1. The Nigerian Government, and particularly the FME, should ensure that appropriate needs-based analysis is conducted for the Project going forward which is separate from any current strategy or related project documentation. This analysis should demonstrate actual needs and can thereby provide the basis for systematic and objective design, planning, and implementation going forward.
2. There must be a clear strategy and management scheme for ensuring that the Project maintains quality assurance (especially with regards to the training of teachers and State and Federal inspectorates) and that impact is effectively measured going forward.
3. Given that this evaluation demonstrates the need of effective State and Federal inspector visits to participating schools, there should be a standardised process, manual, and affiliated records for what the inspectors do during their school visits.

4. The Nigerian Government must make every effort to ensure that the costs of the science and mathematics kits are reduced and made competitive.
5. UNESCO should undertake work that is consistent with its mandate in education and science, e.g. teacher training, curriculum development for teacher training and STE in schools and colleges, etc.
6. UNESCO should refrain from acting as a sponsor or other agent for resource mobilization. This falls beyond UNESCO's mandate and should more aptly be placed with the Nigerian Government.

2. PROJECT DESCRIPTION

The Nigeria-UNESCO Special Science and Technology Education Project originated from high-level political commitment for promotion of Science and Technology Education (STE) as a tool for sustainable economic growth and development. As the FME describes, STE is central to development and key to attaining sustainable economic growth. It is in this context that the Government of Nigeria relates STE to initiatives for transforming the society as enumerated in National Economic and Empowerments Development and Strategies (NEEDS) and Vision 2020.

The Project's immediate objectives are to: [3]

- Rebuild science education in Nigeria by improving the capacity of primary and secondary schools teaching and learning of science and technology through the revitalization of laboratories which are fully furnished with science learning equipment.
- Building a critical mass of science educators at the primary and secondary levels who are able to teach science in the class in a way that links the subjects learned with the real world experiences of the students.
- Progress is made in popularizing the nature and advantages of active learning among teachers, science and technology educators generally, and particularly toward sustaining lifelong learning.

The Government of Nigeria requested UNESCO to partner with them in achieving these objectives. In particular, UNESCO provided technical support for the capacity building of both teachers and inspectors, coordinated the activities of all stakeholders involved in the Project, and designed and implemented a range of advocacy initiatives.

UNESCO and the FME agreed to use ABL as the foundation for teacher training. This is an internationally recognised teaching pedagogy and one particularly suited to science and mathematics teaching. UNESCO and the FME also went further and designed an ELT that incorporated the primary components of ABL with methodologies and approaches that were particularly suited to the needs of Nigerian teachers and students.[4] Indeed, the FME and UNESCO are now going further, encouraging teachers to deploy a range of leading pedagogies.

The pilot phase started on the 29th of September 2005 and project field work was completed on the 9th of August 2007. The pilot phase involved the supply of science and mathematics kits to

[3] "Project Document: The Design & Implementation of an Initiative in Science and Technology Education for Primary & Secondary Schools and Colleges of Education." 2005.

[4] It should be noted that while this evaluation demonstrate the value of ELT, very few teachers were able to actually site the primary pillars of this methodology; instead, they demonstrated considerable knowledge and comfort with basic ABL techniques. Given that ABL is an internationally recognized pedagogy, we have therefore generally referred to it rather than the ELT. Furthermore, ELT is being examined by international experts in pedagogy in consultation with UNESCO's Education Sectors and IBE to fully understand any "proprietary" qualities and potential disputes relating to copyright.

selected schools, training of teachers in a new pedagogy and building the capacities of Federal and State inspectors in the monitoring of the project going forward.

The planned budget for the Project, including all material, human and direct and indirect costs, was 409,760,480 Naira, or US$3,179,979. Based on a review of project documents but not audited accounts, the Project did not exceed this budget.

3. EVALUATION PURPOSE

An external evaluation was commissioned with the objective of informing stakeholders on the successes, challenges and recommendations on strategies to be adapted for the next phase of the Project. In particular, the evaluation reviewed the following:

- The successes of the pilot phase of the Project;
- The major achievements of the Project;
- Factors responsible for the achievements;
- The challenges faced in the design, planning and implementation of the Project;
- The quality of organizational management, programme implementation systems and associated resource allocation;
- Lessons learned and the implications for replication in other countries and scaling-up.

4. EVALUATION METHODS

The evaluation adopted the following methods:

- Desk study of relevant documents, including:
  - Project documents
  - Relevant national policy and strategy documents
  - Documentation on micro-science and mathematics kits
  - Minutes of MDE committee
  - M & E reports
  - Documentary on improvement of secondary science training.
  - International best practices
- Interviews with major stakeholders including but not limited to:
  - FME
  - UNESCO
  - Multilateral Organization
  - Kit suppliers (NASENI, MMC, SKILL-G)
  - Universal Basic Education Commission
  - SUBEB
  - Ministry of Education Officials
- Collaborative discussions with selected UNESCO staff (Director of Abuja Field Office, Project Coordinator and IOS staff)
- Visits to selected schools across the six geo-political zones: an unstructured questionnaire collected information from Principals, Head Teachers and Teachers and observations and interviews were conducted with some of the students in benefiting schools.
- Visits to international suppliers of science kits with the aim of evaluating suitability, and cost effectiveness of the kits.

5. LIMITATIONS

While the following limitations should be considered, these do not detract from the observations and recommendations included in this evaluation.

Sample Size
The primary limitation to this evaluation is the number of schools visited. Twenty-six schools were visited spread amongst 15 states in the north and south of Nigeria were visited by the evaluation team.[5] Given that the Project trained over 3,000 teachers in all of Nigeria's states, this is a small sample.

Interview Subjects
In many cases, those interviewed at schools expressed a perception that the evaluation team could be instrumental in providing additional resources. While the evaluation team took every precaution to ward against this perception and addressed it directly when encountered, this perception may have affected the validity of information provided. This was addressed by using "open-ended" and other questioning techniques that enabled interviewees to provide clear factual data rather than their opinion. Opinions were appropriately discounted.

Project Documentation
While the project documentation kept by the Project itself was good, there were some inconsistencies in data available at schools. Teachers and headmasters did generally keep lesson plans but the information contained in these was inconsistent. There were also few records regarding student testing and other qualitative data related to actual student performance. This hindered the evaluation's ability to identify clear performance improvements. However, tangential evidence, like the increased enrollment of students in science and math clubs, as well as indications by teachers, suggests some improvement in student performance.

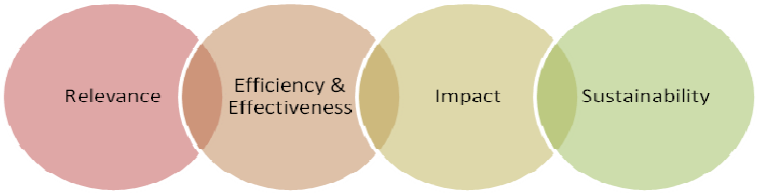
Evaluation Timing
The school visits by the evaluation team coincided with end of term examinations in some cases. This prevented the evaluation team from interviewing students in these schools.

[5] See Map of Schools Visited/Country Coverage in Annex V.

6. MAJOR FINDINGS

This evaluation is structured around the five evaluation criteria, namely, relevance, efficiency and effectiveness, impact and sustainability. These are included in the "Evaluation Matrix" in Annex VII.

By using a results-based approach, this evaluation focuses on establishing the overall value of the Project as well as recommendations for moving forward. This not only provides an opportunity for understanding what worked and what didn't but also what changes or new strategies should be adopted going forward.



6.1. Relevance

6.1.1. How and when were the STE needs and baselines established?

For a project of this nature, it is expected that the Nigerian Government would have created baselines and conducted needs analysis to ensure that the Project delivered expected results. However, there is little evidence that sufficient baseline or needs assessments were conducted by the key stakeholders

UNESCO has established that science and technology are critical to a country's economic and overall development. The Task Force on Science, Technology & Innovation of the Millennium Development Project highlights the importance of knowledge and development in these areas to a country's capacity to respond to economic productivity, agriculture, education, gender, health, water, sanitation, environment, and participation in the global economy.
The New Partnership for Africa's Development (NEPAD) also states that scientific advances and technological innovation are the main drivers for economic growth and development. Moreover, this Project relates to the global vision of transforming the society, defined in the National Economic Empowerment Development Strategy (NEEDS).

Challenges
The evaluation has identified the need for an appropriate needs-based analysis to be conducted. Such an analysis would demonstrate actual needs and can thereby provide the basis for systematic and objective design, planning, and implementation going forward. In its most basic form, the analysis may begin with an estimate of the number of trained scientists, across

disciplines, fields and professions that will be required to support the nation's economic and developmental goals, amongst other necessary needs-based analysis. With this analysis in place, the Nigerian Government could demonstrate that by schools in each state participating in the scaling-up of the Project (as stated in the scaling-up plans[6]) the Project will be supporting the overall training and education of a sufficient number of students to achieve these goals.

Nigeria-UNESCO should also investigate the benefits of focusing on science and technology as a means of supporting studies in other fields. Comparative and best practice evidence should demonstrate that the focus on STE has additional benefits to how students perform overall.

6.1.2. Was the approach adopted consistent with an overall operational national policy and/or strategic framework and STE curricula?

The Project originated from a Nigerian Presidential initiative aimed at achieving national economic and human development using STE. The Project addressed these issues by supplying micro-science kits to primary and secondary schools and by training teachers in leading ways of teaching science effectively. This included strengthening Federal and State inspectorates in monitoring and evaluating the teachers and schools involved in the pilot.

Originally, the kit materials were not related to STE curricula for Senior Secondary School Certificate Examinations and so did not provide the needed hands-on experiments for the students preparing for these examinations. According to the FME, this has been remedied through a series of workshops that analyzed the kits in line with the Senior Secondary School Science curricula. It is expected that the impact of the teaching techniques will improve overall student performance in examinations.

While the kits motivated teachers and learners in both primary and secondary schools, they were not provided in sufficient numbers to ensure the hands-on experiences demanded by ABL. Moreover, teachers in senior secondary schools explain that kits are most useful for demonstrations of basic science concepts which lead to easier and faster assimilation. To meet the STE curricula needs and broader strategic frameworks, more materials should be provided across all pilot schools (as well as those targeted in the Project's "scaling-up" phase).

Challenges

Based on interviews with key stakeholders, including the Federal Ministry and ETF, there is a recognized need to have a more practically based strategic framework for the Project's scaling-up. This should include the formation of a standing committee and better linkages between the Federal and State ministries, international agencies (including those beyond UNESCO, e.g. JICA, World Bank, etc.), and other key local and national stakeholders.

[6] "Strategy Note on Scaling Up The Science, Technology and Mathematics Project, 2007 – 2015," FME. It should be noted that this "Strategy Note" lacks the very same analysis that this evaluation recommends, mainly the identification of clear needs, initial baselines for achieving objectives, and any rigorous plan for implementation. Thus, while it may be laudable for the Nigerian Government to seemingly "commit" to implementing the initiative in 50% of all schools, there is no evidence as to why this "50%" is the correct figure nor on what evidence this is based. Indeed, it must be further noted that there is no evidence that this document was prepared with due consideration with experts in science, mathematics and technology education in Nigeria. Nevertheless, it was presented to the evaluation team as a formal plan as set forth by the FME. Therefore, it is reasonable to consider it as a primary source regarding the Government's plans going forward.

In interviews conducted during this evaluation, however, these same stakeholders were unable to site a clear strategy for how to develop and implement the standing committee alongside a management scheme for ensuring that the Project maintains appropriate quality assurance, especially with regards to the training of teachers and State and Federal inspectorates.

6.1.3. Was the design of the Project the most appropriate in the Nigerian context for improving the quality of Science and Mathematics education in Nigerian schools?

In the absence of base line studies and without a clear and practical framework that links the Project to broader government policies and initiatives, it is not clear that this was the most appropriate Project. Nonetheless, the project design was appropriate for improving the quality of STE—it is simply not clear if it was the *most* appropriate.

By using established and commonly used ABL Techniques, the Project did draw on leading methodologies to train teachers. These techniques include investigative work, small group discussion/work, problem identification and problem solving, asking and answering questions, hand-on-minds-on activities. This corresponds to best practice in education and childhood learning.[7]

In addition, the supplied science and mathematics kits worked well as teacher demonstrations and for "hands-on" learning by students. While there was inconsistent evidence regarding how often the kits were used, teachers and students used the kits for different learning activities.

6.1.4. To what extent were the activities undertaken by UNESCO consistent with its mandate, functions, and capacities?

As based on project documentation from UNESCO and the Nigerian Government, the President of Nigeria, Chief Olusegun Obasanjo made a formal request to the UNESCO Office in Abuja to assist the Government of Nigeria in designing and implementing an initiative in science education for primary and secondary schools. UNESCO agreed to provide:

1. Experience and expertise in STE around the world at primary and secondary levels;
2. Co-ordination arrangements, in particular to act as coordinator between the various State and Federal Committees established as part of the Project;
3. Assistance in formulating the longer-term sustainability of the Project, including the phasing out of external assistance in favor of gradually increasing responsibilities for national institutions, wherein the Federal Government requested UNESCO to assist in resource mobilization.[8]

As the Project was implemented, UNESCO provided council on science and education (two of UNESCO's sectors) and used this comparative advantage to focus on the substantive issues of the Project (as compared with the actual supply of kits). This role seems consistent with UNESCO's mandate, functions and capacities and its agreement with the Government.

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[7] The literature on this subject is vast. For a good summary with case studies related to science and mathematics, see, *Increasing Teacher Effectiveness,* Lorin W. Anderson. UNESCO: International Institute for Educational Planning, Paris 2004. Also see "*Critical Management Education and Action Based Learning: Synergies and Contradictions,*" Michael Reynolds & Russ Vince. *Academy of Management Learning & Education*, 2004, Vol. 3. No. 4. provides an overview of current research on the subject as does *Learning in Action*, by David A. Garvin (Harvard University Press, 2000.) Also see, Richard Klimoski, *Introduction: Promoting the "Practice" of Learning from Practice*. Academy of Management Learning & Education, Dec. 2007, Vol. 6 Issue 4; Donna Mathews, "*Action Based Learning Environments*." Social Studies Review, v32 n3 p17-20 Spring 1993.

[8] "Project Document: The Design & Implementation of an Initiative in Science and Technology Education for Primary & Secondary Schools and Colleges of Education." 2005.

As based on interviews with the Project Coordinator and other key stakeholders, UNESCO broadened its coordination function, as noted above, to manage various facets of the project either directly or through reporting to the FME and others. This included an active role in the selection of the foreign consultants who conducted the initial teacher trainings, the oversight of these and the subsequent train-the-trainer courses, and other facets of the Project that fell beyond the actual provision of the kits.

UNESCO's role thus necessitated ensuring that the design and implementation, in the first case, were sufficient enough to meet stated needs and that they could provide a suitable foundation for the subsequent scaling-up of the project. In close collaboration with the FME, UNESCO supported and continued to advocate for three key programme elements:

- The emphasis on an ABL pedagogy and the subsequent development of a related learning technique, the ELT that serves the particular needs of Nigerian educators and students;
- The coordination and support of M&E, especially the training of 94 inspectors at the primary school level (nearly triple the number envisioned in original project documents) and 148 inspectors at the secondary level. As noted elsewhere, the role of the inspectors has proven critical to the pilot's success and will remain so going forward.
- For working with key stakeholders and suppliers to ensure that the unit cost for the primary science and mathematics kits and for the secondary level micro-science kits was largely reduced.

The FME stated during interviews that UNESCO has performed well in its role of coordinating the Project overall. Some stakeholders, in particular ETF, stated that they expected UNESCO to play more of a role in resource mobilization. While this evaluation cannot comment on every way that UNESCO fulfills its mandate around the world, the request by the Nigerian Government, in the original planning documents and as quoted above, as well as other requests to assist in resource mobilization does seem to lie beyond UNESCO's general mandate.

While UNESCO may play a critical role in advocacy and in bringing various partners together, actual resource mobilization may fall beyond UNESCO's mandate, functions and capacities. As based on international agreements and principles, like the Paris Declaration, and to ensure appropriate commitment and ownership, it must be the Nigerian Government that acts as the primary player in resource mobilization at all levels.

In addition, it is not clear that UNESCO's expertise and experience in the Education and Science sectors was drawn upon to its fullest extent possible. Various UNESCO projects have come to light during this evaluation that could have proven instrumental to the Project. For instance, the Project could have been influenced by UNESCO's project (2001-04) in "Support of Revitalising Technical Vocational Education in Nigeria Phase I" (552NIG1011). At a project cost of US $2.36 million funded in part by the Nigerian Government and UNESCO, the project was implemented by the education sector at HQs in cooperation with the FME and the National Board for Technical Education (NBTE).

Furthermore, there were comparative costs available for the kits both from UNESCO, in a similar project implemented in Pakistan[9], and in other agencies, like UNICEF that has tried to standardize the cost for these types of learning materials.[10]

[9] "Quality of Primary Education in Pakistan," Ministry of Education for Pakistan, UNESCO. Prepared for Ministerial meeting of South Asia EFA Forum, May 2003.
[10] See UNICEF procurement website for education supplies: http://www.unicef.org/supply/index_education.html

Successes
UNESCO provided key guidance and expertise on the design and implementation of the Project ensuring that the design deployed effective pedagogies and that the implementation included a strong M&E component.

Challenges
UNESCO must now reconsider the best way it may serve the Project going forward. It should, firstly, continue to provide expertise and guidance on learning techniques and other areas of expertise that are directly aligned with UNESCO's mandate.

UNESCO may also continue to serve in a role of coordination amongst the various partners and committees involved. In particular, the Project will require that one institution acts as primary interlocutor and facilitator between the growing field of international agencies and others that may be involved going forward. Given UNESCO's knowledge of the Project, of the other stakeholders, and its demonstrated success in this area, as well as its effective partnership with the FME, it may serve in this role going forward. However, the Project's next phase will require more advanced planning, implementation, and project management skills and techniques than have been required to date. UNESCO should not attempt to serve this role. UNESCO should, as much as possible, refrain from acting as a sponsor or other agent for resource mobilization. As stated, this falls beyond UNESCO's mandate, core skills, and should more aptly be placed with the Nigerian Government.

6.1.5. To what extent were the activities undertaken gender-sensitive?

The ELT, developed in coordination with the initial training consultant and with teachers and other stakeholders, does hold gender sensitivity as a primary pillar. However, evidence drawn from school visits indicates that the training here could be improved.

Of the 26 schools visited by the evaluators, only four teachers were able to site ELT techniques used to ensure that boys and girls participated equally in lessons. (Four of these schools were all boy and all girls' schools). In five mixed schools visited, boys were seated separate from girls as a rule. Obviously gender stereotyping is still prevalent in the Nigerian society and will for a long time influence girls attainment in STE. (Please see the "School Data Matrix" in the Annex.)

As per the training of teachers, documentary and physical evidence drawn from the schools does indicate that appropriate efforts were made to train men and women.

Successes
A few teachers (four) made efforts to ensure gender equity even when the schools they were teaching in were segregated by sex.

Challenges
In some Nigerian states, segregation of learners by sex is enforced so it is difficult to measure gender sensitivity.

6.2. Efficiency & Effectiveness

6.2.1. To what extent was the implementation of the Project consistent with the project agreements covering such details as the respective roles of Nigeria and UNESCO, resource motorization, etc? Which aspects were successfully implemented and which were not and why?

As based on the Project implementation timeline and the stated budget figures, the FME and UNESCO effectively implemented the Project to plan.

Based on an initial review of project documents combined with on-site school visits, the project implementation is consistent with project agreements. There is evidence that the Project went beyond these stated agreements and trained additional teachers as demand grew and delivered components within or prior to prescribed timelines. For instance, the provision of the kits to the target schools was completed in two years rather than the planned three years. Indeed, the entire pilot was able to thus end a year early, in September 2007 instead of September 2008.

The mobilization of resources for the initial phase was also successful. The total project budget of 409,760,480 Naira, or US$3,179,980, was secured and used according to the Project's budget. This includes financial statements and other records of expenditure reviewed during this evaluation.

Successes

The major successes of the Project include the following:

- Mathematics and science kits were distributed to schools, with an average of ten schools per State while 435 secondary schools including 102 unity schools were equipped with the micro-science kits.
- 1,480 primary and 1,740 secondary school teachers were trained in the use of kits and in ELT. A manual on ELT for Teachers and Reference document for Inspectors has been prepared.
- More than 230 Federal and State Inspectors were trained in M&E of basic and secondary science with the changing profile from Inspector-Instructor to Inspector-Enabler.
- An advocacy tool was designed in form of a documentary that demonstrates STE in Nigeria.

Challenges

One of the major challenges is the provision of auditable accounts for all project expenses, e.g. cost of kits, cost of training grants and cost of replenishment of kit consumables. As noted above, the Project seems to have kept within stated budget constraints. It may be worthwhile to review an audited statement of accounts to better understand all facets of the Project's expenditures.

6.2.2. Were the project management structures (Steering Committee, Implementation Committee, M&E Committees), Project Coordination and the implementation procedures and processes adopted commensurate with the scope and size of the Project?

Based on Project documentation, interviews with the Project Coordinator, FME, and other stakeholders, the evaluation team found that fair management structures were in place. This included a committee-based structure that drew on State and Federal representatives with coordination amongst the Committees facilitated by the Project Coordinator, a UNESCO staff member. Going forward, the State management structure will also be adjusted by using the Commissioners for Education to chair the State Steering committee.

The Project entailed four committee types:

- The State Steering Committee chaired by the Governor
- The Implementation Committee composed of various stakeholders
- The M&E Committee composed of various stakeholders including School Inspectors[11]
- Zonal committees to articulate policy.

State Committees were charged with overall implementation and follow-up, in collaboration with the State inspectors whose role, as demonstrated, was critical to the Project's success. However, this evaluation has found some evidence to indicate that the Committee structure was not as effective as it could have been. For instance, the State Committees, who were charged with ensuring that the kits were received in good order, that a sufficient number of teachers were trained, as well as periodic inspections by State Inspectors, are chaired by the State Governors. There were noted operational difficulties to get these committees to meet. In ten of the 15 states visited, the State Committees were in not functional and had not met in at least a year. Those interviewed stated that this was due to the need for the State Governor to chair the committee who was often occupied with other State and Federal Government matters.

The fact that these State Committees had not regularly met has significant implications on the quality of the Project. As the evidence collected in this evaluation demonstrates, the initiative worked best or even at all in some cases, only when there was an effective combination of teacher training, sufficient training in experiential/ELT methodologies, the supply of kits, and regular, substantive visits by inspectors. These State Committees were critical to ensuring that M&E was taking place and thereby able to make adjustments as necessary. Furthermore, without the regular involvement of the State Committees and, in turn, the State Governor, the States may not be adequately informed of the conditions for the successful implementation of a project of this nature and thereby duly unprepared for any scaling-up that the Nigerian Government foresees.

Similar issues were noted at the Federal level. The M&E exercise conducted by FME took place almost two years after the initial implementation of the Project. Those interviewed said that this simply had to do with how those involved had prioritized their time. While there was only one instance of this type of delay discovered during the school visits, this type of delay surely hampers the Project's potential and should be investigated.

There is also evidence that the Steering Committee, Chaired by the Federal Minister of Education and that acted as the primary oversight for all of the Project's operations, was effective. The organization of the first Steering Committee meeting took place in November 2005, a month after the official inauguration of the Project. While some of the Committee members interviewed stated that they thought the Steering Committee could have met more often, they do seem to have carried out their duties diligently given that the Project was implemented on time and within its budget. The Steering Committee met as follows:

- 1st Steering Committee meeting was held on Tuesday 22nd November, 2005.
- 2nd Steering Committee meeting was held on Thursday 7th November, 2006.
- 3rd Steering Committee meeting was held on Thursday 1st March, 2007.

[11] UNESCO's related audit report states that: "Given the fact that both the Implementation Committee and the M&E Committee were headed by the same person, the M&E Committee could not have been expected to provide an independent evaluation." While this may be true, this evaluation did not discover evidence that would demonstrate this.

In between these meetings, other meetings with the Chairman of the Steering Committee were held as follows:

- Meeting with Chairman of Steering Committee with stakeholders on improving performance in Mathematics and Science was held on March 16th, 2007.
- 2nd meeting at which the Steering Committee Chairman was represented by Director Basic and Secondary Education with stakeholders for improving Mathematics and Science was held on 20th March 2007.
- 3rd meeting chaired by Director Basic and Secondary Education Mathematics Improvement Project was held on 23rd March 2007.

However, given that there may has been less consistent performance at the State Committee level, where the most critical Project components were implemented, the Project should review the reporting mechanisms between the Committees to see if the Steering Committee could have done more to ensure consistent performance at the State Committee level.

Finally, the overall structure and composition of these Committees was found to be disorganized- there were simply too many, all of which, as based on documentary evidence and interviews, had either unclear or overlapping roles and responsibilities (or both). As per one example, the Project Implementation Committee at Federal Level has over 30 members, meets irregularly and often with little notice or planning, and yet is charged with representing key stakeholders and for making decisions that have direct impact on the fundamental elements of the Project, namely, the ELT pedagogy, training of teachers with the encouragement of train-the-trainer schemes, regular visits by Federal and State inspectors, and provision of materials and kits.

Successes
The management structures have contributed positively to the achievement of Project results. The M&E exercise proved to be an important activity for the Project implementation's results-oriented focus.

Challenges
Committee management at the Federal and State levels has led to some delays and may have created a level of management that prevented school committees and others from having appropriate managerial autonomy.

6.2.3. How well did the structures, procedures and processes function at Federal and State levels?

Based on a review of the documentation, interviews with stakeholders, and an evaluation of the impact at the school level, the Project's structures, procedures and processes were generally adequate. This is based primarily on the fact that the targeted teachers and inspectors were trained and the targeted schools received science and mathematics kits. As noted in the previous section, the primary constraint was the Committee structure, wherein the evidence suggests inconsistent performance at the State level committees.

6.2.4. What were the quality assurance mechanisms put in place to cover details such as:
- Suitability of the kits, delivery, storage, maintenance and repair, replenishment of consumables
- Teacher training, design and delivery, content, pedagogy availability and suitability of material.

The majority of teachers, principals and students interviewed said that the kits included equipment that was appropriate to standardized curriculum and other subjects. Nearly all

teachers interviewed did say that they found the manuals that accompanied the kits useful in providing clear step-by-step procedures for demonstrating various subjects and concepts. The use of such demonstrations had enhanced interest and motivation which is significant among the teachers and students. However, due to the short supply of kits and high cost of replenishment of consumables, the secondary school kits do not provide students the hands-on experiences necessary for the acquisition of the science process skills which are often tested for in WAEC and NECO examinations.

All the schools that were listed received kits; however in some states (e.g. Lagos state) some LGEA spread the kits to more schools by giving selected schools primary schools either of the Primary Mathematics Kit (PMK) or the Primary Science Kit (PSK) instead of both. The kits were found to be generally durable, except that the spring balance and hammer in the PSK were of inferior quality. Moreover, if pupils are left unsupervised in the use of primary school kits they might be injured since these included glassware and sharp edged plywood.

The primary school kits were generally stored in the head teacher's office. The teachers signed and collected them for use when needed. Secondary school kits were generally stored in the relevant laboratories, however many of the schools left them in cartons because did not have appropriate shelves for their display and access.

Very little breakage of the kits was witnessed during the visits. It is difficult to attribute this to durability of the kits since the students do not have free access to these materials. There was no provision made for regular replenishment of the consumables in the Project. The feedback from head teachers indicates that schools are not given running costs to provide for such consumables.

The success of the teacher training can be gauged from the excitement and interest the majority of the 'trained teachers' exhibited during the visits. Moreover, 12 out of the 26 schools visited demonstrated effective ways to improvise with the help of the students for additional teaching materials. Some of the trained teachers not only trained others in their schools but went beyond to organize and train other teachers in their area.

Based on a review of project documentation as well as in interviews with key teachers, the design of the teacher training was effective. It drew on leading experiential methodologies which have been proven by substantive research to be effective in improving student comprehension and retention, as well as engendering an interest in science and technology related subjects.

The other effective design feature involved the use of expert consultants in the field of ABL techniques to conduct training workshops for NCCE's national trainers. NCCE's trainers were thus able to incorporate the key ABL techniques into their curriculum. In this way, the design not only proved to be effective for imparting critical teaching techniques but also adaptive enough to accommodate the needs of Nigerian teachers.

Successes

Teachers in 20 of the 26 schools visited demonstrated proficiency in ABL techniques and had integrated this methodology into their lesson plans and other activities.

Challenges

- Kits are good for demonstration but not for actual measurements. They need to be calibrated. Calibration is possible with redesign.

- For every experiment there is only one packet of consumables so the experiment can only be performed by the teacher. Schools are only able to maintain simple everyday consumables, e.g. salt, sugar, candles etc. There is a need to supply more of the consumables that come with kits so that after the teacher demonstrates, pupils can perform the experiment themselves.
- The training on trainers by STAN, MAN, NMC, and SKILL-G should be authenticated by involvement or UBEC as a major Stakeholder in Basic Education Training. UBEC prefers to use Colleges of Education as a source for resource persons to ensure transparent resource personnel selection.

6.2.5. To what extent did the Project implementation encompass sound Results Based Management (RBM) principles?

No evidence was discovered that indicated that the Project drew directly from sound RBM principles. Nonetheless, the Project was focused on results in the sense that its primary activities focused on the Project's stated objectives.

While the Project's success in this regard is positive, it would have benefitted from a RBM framework with quality assurance standards to be used for monitoring the performance across the Project.

6.2.6. How facilitating were the procedures and processes in the UNESCO Abuja office in the implementation of the Project?

UNESCO was requested for collaboration by the Nigerian Government to help achieve the objectives and resource mobilization for the execution and implementation of this self-beneficiary trust fund project. The procedures and processes agreed upon and established in the project document have been well facilitated. Please see Section 6.1.4 for more detail regarding this evaluation question.

6.2.7. How many teachers were trained in the use of the kits and ELT through the Project and how many more were trained at school and state levels at their own initiative or cost?

According to project documentation, the following numbers of teachers were trained:

- 1,480 Primary Science and Mathematics Teachers
- 1,740 Secondary Science Teachers

No evidence was discovered that would cast doubt on these numbers. In fact, these numbers may be conservative given evidence that many trained teachers trained other teachers in their schools. Project documentation alone states that over 3,000 more primary and secondary teachers were trained. While this number may be slightly exaggerated, the additional number of teachers trained through train-the-trainer schemes was most likely significant.

Successes

The trained teachers are equipped to train their colleagues, especially on the use of kits and ELT. Teachers who were successful in training their colleagues could be used as resource teachers in scaling-up of the Project.

6.2.8. How many schools and colleges received kits and how many schools and colleges procured additional kits at their own initiative or cost?

According to project documentation, the following numbers of kits were delivered:

- 961 secondary science kits
- 740 primary science kits
- 740 primary mathematics kits

It should be noted that while all the secondary schools visited had received at least one of the secondary science kits, the provision of primary science and mathematics kits was sporadic. This was the case in seven of the 14 primary schools visited, half of all schools.[12] In one of the schools, the math kit delivered to the Department of Education at the University of Jos was still lying in the University stores under the Bursar's Office without the knowledge of the target beneficiaries.

FCT, Sokoto, Benue and Kogi states bought more science and mathematics kits for their schools. Katsina, Adamawa, Akwa-Ibom and Kwara states had made proposals in their 2007 budgets to purchase more kits for their schools. Kogi state had trained more teachers than any other state.

Successes

Based on the Project documentation and fairly substantiated through the school visits, the projected number of science and mathematics kits was delivered.

Challenges

At the primary school level, half of the visited schools had received only one of the primary kits, either a science or mathematics kit.

6.2.9. To what extent did the M&E undertaken help to steer the Project?

M&E stand as key factors enabling the achievement of the expected outcomes. The basic strategy used is based on the fundamental responsibilities of the Universal Basic Education Commission (UBEC) and the Federal Inspectorate Service, both institutions in charge of M&E of Basic Education and Secondary Education respectively. The process has been strengthened by the availability of new instruments relating to the new approach to science and technology learning through the ELTs.

The setting up of the M&E Committee regrouping various stakeholders at state, senatorial District and local government levels has contributed to the enhancement of ownership and sustainability. The continuing process of M&E will play a central role during the scaling-up phase.

Due to the impetus of the various M&E committees the following was brought to the fore:

- Procurement of more kits and training of more teachers in the schools.
- The need for more science and mathematics based teachers to primary schools.
- The need for building of more science/mathematics rooms or laboratories for every primary school.
- The need to involve the PTA, Professional organisations (STAN/MAN, etc.) and private sectors in the improvement of facilities in schools.
- The need for improvements in the activities of the state steering and implementation committees in order to accept the ownership of the Nigeria-UNESCO project.

[12] See the School Data matrix in Annex VI.

Of the 26 schools visited, 21 had had had between one and three inspector visits in the last two years.[13] However, there was a noted inconsistency in inspectorate activities and the number of their visits to schools. Only 14 of the schools that had inspector visits could site substantive activities conducted by the inspectors.

The inspectors are responsible for not only assessing the status of the kits and having relevant teachers complete the assessment questionnaire, but also with observing teachers during relevant lessons, interviewing students, and providing immediate feedback on what the teachers could do to improve their teaching skills to ensure the maximum benefit from action based/experiential techniques and the ELT. However, of the schools visited, only one school had received this type of participatory and performance based evaluation. In addition, the number of visits was erratic.

Evidence suggests that the maximum benefit of the initiative is achieved when there is sufficient training of the teachers combined with regular and effective inspectorate visits. Inspectorate activities should be strengthened to not only ensure that these facets are covered by inspectors, but that they also promote and facilitate train-the-trainer efforts, advocacy amongst other schools, and counsel on how best to engage and work with state and federal ministries.

Successes:

- The development of an instrument for monitoring and evaluation of Basic and Secondary Science Teaching and Learning. This will prove to be a useful tool for inspectors, UBEC monitoring officers, head teachers and course teachers themselves.
- The various M & E teams succeeded in initiating school-based implementation and project committees. A majority of the schools with such committees had implemented them only after they were visited by the M&E team.

Challenges:

- The monitoring and evaluation exercise should be conducted for a minimum of two weeks and within the period when teaching and learning processes are taking place in schools.
- Both the FME and SUBEB should be thoroughly briefed on the need for their collaboration. The different roles and responsibilities between SUBEB and MOE in many states created some setbacks during implementation.
- Changes of MOE and SUBEB political office bearers create gaps in communication and should be avoided where possible. Alternatively, desk officers should be appointed for the project in all the MOE and SUBEB offices.

6.2.10. Considering the Project's results, could the same results have been achieved at lower costs using suitable alternative strategies and/or design and/or other programme delivery mechanisms including cost effectiveness?

Training Costs

Based on Project documentation, the basic unit cost for a four-day workshop for both teachers and inspectors was budgeted at US$400–US$800 per participant.[14] The final cost was maintained at US$400 per participant. While it is difficult to ascertain substantive comparatives for professional training costs, especially given the generally high costs of non-formal education and

[13] See the School Data matrix in Annex VI.

[14] UNESCO reduced the financial allocations from the Project budget and initial work plan from US$600 – 800 to US$400 per participant for a four-day workshop. Workshop was also facilitated by STME professional associations who assisted with the organization of workshops at decentralized locations around the country.

Technical and Vocational Education and Training (TVET), some comparative data should be reviewed.[15]

The recurrent public expenditure per student for higher education in Nigeria varies between US$24,800 (Kwara) and US$27,000 (Kaduna) per State.[16] This equates to approximately US$185 per day, based on a typical Nigerian higher education school year.[17] Thus, the Project's four-day workshop budget (US$400 – US$800) is within this comparative range.

In a widely used comparative for professional development, a Masters of Business Administration (MBA) programme at INSEAD costs US$748 per day, including tuition and accommodation. In another comparative, the American Society for Training & Development includes analysis on average annual expenditures for learning and development. Their 2005 "State of the Industry" report determined a range of US$955 to US$1,554 average annual expenditure per employee.[18] Thus, at US$400 for a four-day workshop, or US$100 per learning day, these costs are reasonable. Nonetheless, these are rather blunt comparatives and the actual linkages between these costs and the training of teachers in Nigeria are hardly adequate.

Given this deficiency, the FME and others should conduct more sufficient cost analysis as part of the broader recommendation in this evaluation for sufficient needs-based analysis and project planning. For instance, it has been indicated that the training costs of teachers in the UNESCO-supported TVET project and/or the JICA-supported SMASE project in Nigerian states may provide worthy comparative costs.

Unfortunately, despite requests for comparative evidence and information on similar projects in Nigeria, documentation from these projects was not available for this evaluation. This does support this evaluation's general conclusion that UNESCO's Nigeria country office could have been better at seeking and leveraging expertise and information across UNESCO. Indeed, the fact that such similar projects exist in the same country context indicate an insufficient utilization of these important resources that are also part and parcel of UNESCO's mandate.

Unit Cost for Kits

An initial review indicates that the cost of the kits was not competitive. Comparative evidence reveals that similar materials could be procured at significantly lower costs. The unit cost for the kits was as follows:

	Naira	USD
Primary Science & Mathematics Kits	500,000	4,244
Secondary Micro-Science Kits	2,000,000	16,978

This cost exceeds reasonable comparatives, even with the revised rates, as described below. For instance, a similar approach was undertaken with Ministry of Education in Pakistan, also in collaboration with UNESCO. This project also focused on the training of teachers in action-

[15] For a more information, resources and publications on TVET, please see the UNESCO/UNEVOC website at http://www.unevoc.unesco.org

[16] "State Education Public Expenditure Reviews," (Draft Report), World Bank, 2007.

[17] World Higher Education Database. Also see, "Nigeria 10-year Strategic Plan for Education: Policy, Cost & Financing Assumptions and their Implications (Working Document)", Gwang Chol-Chang. Education Sector, UNESCO, March 2007. (ED/EPS/2007/PI/1)

[18] "ASTD 2005 State of the Industry: Trends in Workplace Learning & Performance," B. Sugrue, R. J. Rivera. ASTD (www.astd.org), 2005.

based experiential learning techniques for science and technology and included the provision of kits with relevant materials for students and training manuals for teachers. The kits cost PKRs 3,000 each, with a supply of supplementary readers (100 titles with five copies each) at PKRs 4,000, for a total cost of PKRs. 7,000, or approximately US$115.17.[19]

UNICEF also regularly procures and provides similar science and mathematics kits for Member States. As part of a large Procurement Services project on behalf of the Ministry of Education in Rwanda, UNICEF supplied 30 secondary schools with micro-scale science kits plus teacher and student manuals, microscopes and supporting didactic materials in French and English, such as overhead transparencies, video cassettes and posters. While the precise costs for these are not immediately available, a price range was provided of between US$200 and US$500.[20]

In a rather crude summary but one that also puts this issue in perspective, a review of on-line suppliers of primary and secondary educational science kits revealed that a range of kits could be had for between US$12.95 for a Solar Science Kit to US$275 for an Electronics Project Lab.[21]

As based on an interview with the Project Coordinator, UNESCO recognized this costing issue and worked with the Nigerian Government and other stakeholders to substantially reduce the cost of the kits for any future procurement. These revised costs are as follows:

	Naira	USD
Primary Science & Mathematics Kits	100,000	849
Secondary Micro-Science Kits	450,000	3,820

However, even with the unit price reductions, the stated costs of the kits remain uncompetitive. According to the Project Coordinator and existing documentary evidence, no kits were procured at these new prices. Given this, every effort should be made to re-negotiate these prices so that they are competitive, as based on relative comparisons and basic cost benefit analysis. According to interviews with UNESCO's project coordinator and others, efforts have been made to address this issue.

Other Cost Considerations

The Project has emphasized train-the-trainer activities for the teachers and Federal and State inspectors. While this is generally perceived as a cost effective strategy, it must be supported with effective M&E systems. Inevitably, train-the-trainer schemes result in some dilution to the training curriculum and so robust M&E systems need to be in place to ward against this dilution. Therefore, analysis should be conducted to ensure that the train-the-trainer scheme, as supported by effective M&E, is more cost effective than direct training.

If this proves to be the case, the FME may also seek to implement teacher certification as based on their participation in direct training activities and thereby be able to have less elaborate follow-up M&E systems, e.g. they could simply administer periodic examinations and other performance based evaluations.

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[19] "Quality of Primary Education in Pakistan," Ministry of Education for Pakistan, UNESCO. Prepared for Ministerial meeting of South Asia EFA Forum, May 2003.

[20] See UNICEF procurement website for education supplies: http://www.unicef.org/supply/index_education.html

[21] The following link contains a comparative of the types of primary education science kits that are available on line as well as their stated costs: http://www.physlink.com/estore/cart/ScienceKits.cfm. Obviously, these may not be suitable to stated needs and the cost could be more given transportation, storing, and other affiliated costs.

Successes
The overall design, training and administrative costs are within best cost comparatives. In fact, the Project sought and found further cost reductions as based on the initial project plan. The FME with UNESCO implemented project components one year ahead of the original plan, ending in August 2007 rather than the projected 2008. This included training more than the projected number of teachers with Kogi State training an additional 1,440 primary science teachers in Kogi and Jigawa states and another 1,300 secondary science teachers in Anambra, Kwara, and the Federal Capital territory, as based on Project documentation.

Challenges
The fact that the costs of the kits remain uncompetitive could have negative ramifications on the initiative, its stakeholders, and its benefactors. Every effort should be made to negotiate more competitive prices. While it is laudatory to move wholly toward Nigerian suppliers, the cost issue may necessitate a regional or international bidding for future procurement.

The FME has recently stated that: "The Project was financed fully by the Nigerian Government and will be limited to national bidding except if funds are obtained from international bodies, in which case it will be opened to international bidding."

6.3. Impact

6.3.1. How has the training of teachers on the use of the kits and ELT affected the teaching and learning of Mathematics and Science in the schools and colleges concerned?

Based on school visits that included, where possible, the review of school records, training of the teachers and provision of the kits has provided teachers with a proven tool to increase student comprehension and retention in STE subjects. Comparative evidence suggests that action-based and experiential learning techniques have demonstrable impact on student learning.

Many teachers stated that they found the new pedagogies not only more effective but also easier—they were putting a great deal of the burden for learning on the students themselves rather than having to prepare and deliver lengthy lectures and lead students in traditional memorization techniques. They said that they were also relying heavily on questions to facilitate student learning, another useful and participatory–based form of learning.

One may infer from these statements and other evidence, that teachers have not only increased their repertoire of teaching tools but have also developed a teaching approach that puts the student at the center of the learning so that the teacher can act as facilitator—again, a key part of the training and an intended positive outcome. As noted above, teachers in 20 of the 26 schools visited could demonstrate a proficient knowledge of the ABL techniques and had integrated these into their curricula.[22] As a result, teachers-as-facilitators are able to give more direct and personal attention to individual students who may be facing additional constraints to their ongoing learning.

As many teachers and students alike stated, the new pedagogy "made science real." By conducting "live" demonstrations and experiments, students are able to "see" science and immediately relate it to the real world around them. Of course, not all scientific concepts and theories lend themselves to this type of physical demonstration. However, most core subjects

[22] See the School Data matrix in Annex VI.

generally do and by eliciting student interest and curiosity, educators are creating the foundation from which students may then investigate more complex and theoretical concepts.

Successes
The ABL pedagogy was effective, as based on the evidence collected during school visits. All interviewed teachers were questioned, using open-ended interviewing techniques, and of 38 interviewed teachers 26 demonstrated a "good" to "very good" grasp of ABL techniques, or about 68% of the interviewed teachers.

These teachers were able to site key ways they have included the pedagogy in lesson plans and there is a discernable improvement in student performance, as based on increased membership in science clubs (Jets Club), the formation of other science and mathematics clubs, increased enrolment in science and mathematics streams at the secondary and tertiary levels, and general evidence of increased retention and comprehension levels among students in key subjects.

Specific results sited by teachers include:

- Teaching of science and mathematics has become easier.
- Teaching and learning has become student/pupil-centered.
- Science and mathematics are no longer abstract as students/pupils are able visualize most concepts in terms of real life situations.
- As noted in the interviews with teachers, principles, and others, teachers have expressed a "renewed interest" and more "energy" and "commitment" for teaching STE, largely due to the ease of the pedagogy and the positive response by the students.
- Training has created resourcefulness in the use and improvisation of other scientific equipments and materials.
- Learning / teaching becomes actions based and student–centered.
- Students link STE to noble professions e.g. medicine, engineering, architecture etc.
- Student's interest in science and mathematics has increased.

These are each substantiated in the evidence collected from school visits and represented in the School Data matrix included in Annex VI of this report.

Challenges
There was difficulty in separating the new pedagogy encapsulated in ELT with known ABL techniques. While teachers in 20 of 26 visited schools could demonstrate a proficiency in ABL techniques and had integrated these into their lesson plans, only six of 40 interviewed teachers could demonstrate an equal knowledge of ELT which had been adapted specifically for the Project and for educators and students in Nigeria. Thus, there may be a need to develop mechanisms for monitoring ELT to ensure that the various pillars are implemented by trained teachers.

6.3.2. To what extent are there traceable improvements in the performance of the students in the schools and colleges involved, in such areas as: examinations, enrollment in science streams at tertiary institutions, the use of science and mathematics in project development?

As noted in the "Limitations" section above, this evaluation is limited by the lack of documentation regarding actual student performance on STE examinations and other related

data. Nonetheless, the evaluation was able to discern evidence of increased performance in a number of areas, including:

- Increased number of students passing science and mathematics in some schools in both terminal and JSC Examinations. This is based on interviews with teachers. Of the 38 teachers interviewed, over 75% stated that they believed that their students had performed better on these examinations.
- Membership increased in science clubs, e.g. Jets Club, as well as the creation of new Jets Clubs and Mathematics Clubs. This was the case in 12 of the 26 schools visited.
- Students and teachers demonstrated initiative by creating additional materials and teaching tools. For instance, they used common household or natural materials or created posters that illustrated key STE concepts. This was more often the case in secondary schools where eight out of ten, or 80% of visited schools demonstrated such initiative. In primary schools, this was less often the case. Only six of 14 primary schools demonstrated similar initiative, or 43%.
- One school stated that their students are leading the state in science and mathematics examinations- a notable increase since the start of the Project; the same school has seen over 80% of students enter science streams at secondary school, up from about 50% in previous years.

There is evidence in education that ABL techniques have a positive impact on student comprehension and retention, especially in science and mathematics. Given the training of teachers in this pedagogy, one would expect noted increases in student performance.

Successes

- Increased number of students passing science and mathematics during terminal examination, passing science subjects in JSCE and passing Senior Secondary Certificate Examinations.
- Performance of participating schools in science and mathematics quiz has increased significantly in some schools.
- Membership increased in science clubs e.g. Jet Club, as well as the creation of new Jet and mathematic clubs
- Students demonstrated initiative by creating additional materials and teaching tools.

Challenges

There is limited documentary evidence on improvement of test scores or other clear performance indicators.

6.3.3. In what way has the Project influenced schools and colleges that did not participate in the pilot phase?

Limited evidence was found about how the Project may have influenced additional schools and colleges. However, there is some limited evidence that there has been some "ad hoc" involvement of additional schools and colleges.

Some schools had sought to borrow the kits for the use of students at other schools, or had taken their students to attend practical work at participating schools. In a few cases, the mathematics kits were replicated. However, it was evident that only a few schools in the neighborhood of the participating schools are aware of the project and little effort was made by trained teachers to share knowledge with teachers from other schools.

The initial concept of train-the-trainer was meant to include non-participating schools in the neighborhood as well. However, it is not clear that this was emphasized in the training.

Challenges
Advocacy needs to be improved as it will spur interest in non-participating schools and teachers. The train-the-trainer concept should include non-participating schools and proper guidelines and mechanisms should be put in place.

6.3.4. How has the Project influenced national STE policies and actions?

In general, there is little evidence that the Project has influenced STE policies and actions beyond that tangential evidence that the Nigerian Government is seemingly poised to begin to make the links between broad policy statements and real actions. This is an interesting facet of this Project—while there is scant evidence that this Project will fulfill, in real terms, some of the Government's broader policy statements, one could safely assume that they will have some contribution. However, to ensure the successful continuation of the Project, the Nigerian Government will need to invest in sufficient needs-based analysis, establishment of comparative baselines, and detailed project plans for future implementation. Without these, all evidence will be tangential and the various interested stakeholders will find it difficult to adequately explain decisions and defend the Project overall.

Nonetheless, some of this tangential evidence is worth noting. Economic development and, to a certain extent social development, are based in large part on a country's capacity to adapt to changing political, economic, and social conditions within its borders and beyond. Thus, a country's capacity to respond and adapt to these influences is critical. As stated by the FME, UNESCO, and other key stakeholders, this context necessitates "scientific advances, technological changes and innovation" to ensure economic performance. As one of the initial project documents states: "The ability to harness the potential of new scientific and technical knowledge and to diffuse such knowledge widely has become a major source of competitive advantage, wealth creation and improvement in the quality of life."[23]

UNESCO has established key studies and projects that illustrate that science and technology are critical to a country's economic and overall development. The Task Force on Science, Technology & Innovation of the Millennium Development Project highlights the importance of science and technology to a country's capacity to respond to economic productivity, agriculture, education, gender, health, water, sanitation, environment, and participation in the global economy. NEPAD also states that scientific advances and technological innovation are the main drivers for economic growth and development. These are but two examples from a plethora of research and practical experience.

Even given this broad identification of need, the FME may reconsider these needs and try to create the links between the target schools, broader Federal strategies, like "Education for All by 2010," and the target of "Five million highly qualified engineers, technicians and scientists by 2015." [24]

[23] See Project Document: "The Design and Implementation of an Initiative in Science and Technology Education for Primary and Secondary Schools and Colleges of Education," FME.
[24] "Strategy Note on Scaling Up The Science, Technology and Mathematics Project, 2007 – 2015," FME.

This is especially relevant given the planned scaling-up of the Project. The FME's intent is to scale up the Project over the next three years to capture half of the schools in every local government of every State of the Federation. This target includes:

- 30,000 primary schools
- 4,000 junior secondary schools
- 4,000 secondary schools
- 2,322 non-formal education centers
- 258 science, technology & mathematics educational resource centers

This is nothing less than a dramatic increase from those schools and teachers that were included in the pilot. It will also meet a critical need by, as stated in the FME's "Strategy Note" on scaling-up, creating "five million highly qualified engineers, technicians and scientists by 2015."

6.3.5. How has the Project influenced relevant policies and actions of entities in both the public and the private sectors and also international agencies?

There is a clear desire by more agencies of Government to contribute to the development of STE. This is manifested in the readiness of such agencies as the ETF, UBEC to make funds available for the scaling-up. In fact, the good intention of UBEC to reward states that are buying-in to the scaling-up is worth mentioning.

There is also evidence that some suppliers of kits are trying to build infrastructure to support the production of kits. Some organizations have even commissioned consultants to study curriculum related issues (NASENI). Nonetheless, given the costs of these kits and the related interest by suppliers, this type of commitment would not be surprising. Indeed, while not enough evidence was collected during this evaluation to determine whether an "equipment-led" initiative of this nature where there is a clear benefit to commercial and quasi-commercial suppliers is the best strategy, it is clear that the costs charged by these suppliers are not competitive regardless of whatever efforts they may make toward building a better delivery infrastructure.

Successes

- There is a commitment by Government agencies such as ETF and UBEC to promote STE
- Kit suppliers have initiated the building infrastructure in the country
- Government agencies are developing mechanisms to encourage states in the scaling-up
- Multilateral agencies are becoming more committed in the STE project in the country

Challenges

- The Project has no built-in transition strategies
- The policies and actions of the Government and other agencies need to be harmonized so that this Project can be seen as a component of a broader strategy
- Kit suppliers should not have the impression that they are predetermined

6.4. Sustainability

6.4.1. To what extent were transition strategies, from the viewpoint of UNESCO and/or Nigeria, built into the original design of the Project?

In general, UNESCO did not focus on transition strategies in the original design or thereafter. As a focus for sustainability, "transition" entails sufficient planning, M&E, resource mobilization, and stakeholder commitment, among other measures, to ensure that the pilot serves as an

adequate foundation for scaling-up the Project. As described in the next section, these were largely absent from the Project.

Nonetheless, the Nigerian Government has stated in the "Strategy Note on Scaling-up of The Science, Technology and Mathematics Project, 2007 – 2015, FME" that there is a commitement to provide sufficient resources for the Project's next Phase. According to this document and as confirmed by interviews, the FME has already committed US$387 million for Phase 1 of the scaling-up. According to the documentation and as substantiated in interviews, this amount will be matched by State ministries and other Federal actors. While the same project documents say that other stakeholders may fill part of the remaining gap, this leaves a significant gap in funding for the scaling-up of the Project.[25]

In its most basic sense, sustainability not only means that the Project will be "sustained" over time but that it actually has a sufficient structure to ensure that it continues to meet original needs of the target population. It should also be flexible enough to respond to new needs and/or constraints.

This evaluation maintains that, while immediate issues of sustainability were appropriately addressed in the pilot, the FME and related stakeholders, including UNESCO, should invest considerable resources to ensure that there is a suitable foundation in place enabling the Project to be sustainable in the future. This will include a focus on needs-based analysis, stakeholder commitment, design issues, resources, audience commitment and a "phased" implementation.

Stakeholder Commitment

The FME has been effective in involving stakeholders in various aspects of the Project. The most critical stakeholders going forward will be those who can provide effective management skills and project planning. These individuals should not only be deployed at the Project level but seasoned professionals of this caliber should serve on standing and steering committees. They will be the ones who will help to refine plans, identifying where they are either under or over ambitious, and will provide counsel on how and when to deploy resources. Of nearly equal importance will be those who will provide the resources.

This group will not only include the Government/ETF, as envisioned, but other international agencies, like the World Bank, JICA, and others.

The FME should also identify and engage stakeholders who yield considerable influence. Of course, the FME has already succeeded in large part by aligning the Project to broader Government policies and needs. This builds on that and identifies others who may recognize the importance of the Project and act at key moments to ensure that critical decisions are made and that action is taken.

Finally, it should also include persons, groups or institutions within the Federal and State Government who are clear supporters of the concept and who will

[25] It should be noted that while the evaluation team did their best to confirm these figures, without official written documentation to this effect one must treat the figures as "general" commitments. Actual commitments may vary significantly. Furthermore, this evaluation illustrates that this same "Strategy Note" is not based on appropriate needs-based analysis, comparative baselines, or detailed project plans for implementation. Therefore, these figures must be held also as fairly unreliable given the lack of analysis to justify this cost.

be “champions” for the Project going forward. They may be given opportunities to attend training workshops, meet with other stakeholders to espouse the benefits of the concept, work with teachers, etc.

Resources

As stated above, 62% of the total budget for the next phase has been committed by the FME and State Ministries. This is a considerable resource, and there are plans in place to close the remaining gap. However, resources also include human expertise that will need to be leveraged toward the ambitious scaling-up strategy. This is especially so with regards to planning and management.

Promotional Materials

To further raise awareness and funding for the Project, two complementary films were produced. Based on a review of their content, they describe the Project, its purpose and goals, well. These are well suited for a broad audience. These should be circulated as widely as possible, as well as provided to Nigerian television for inclusion in other programmes or as stand-alone products. The FME could also seek celebrities to endorse and act as spokespersons for the Project.

Needs-based Analysis

The Nigerian Government, and particularly the FME, should now ensure that appropriate needs-based analysis is conducted for the Project going forward and quite separate from any current strategy or related project documentation. This analysis should demonstrate actual needs and can thereby provide the basis for systematic and objective design, planning, and implementation.

In essence, this needs analysis should identify the practical and concrete links between the Project and these broader goals. How, exactly, will the Project meet these broader needs? Are half of the schools in every local Government of every State in the Federation a sufficient target? The Federal Government decided that half of schools be included, in order to “fast-track” the Project as agreed in the inaugural meeting in Paris on May 6, 2006, and this was informed by Education Sector Analysis (ESA), Operation Reach All Secondary Schools (ORASS). Will this analysis remain accurate once a broader needs analysis is conducted?

At a basic level, this would require sufficient quantitative analysis as based on known and relative comparatives. For instance, if the Project demonstrates that there is a link between teachers’ use of action based experiential pedagogies and improved student performance, and this is thereby linked to an increase in enrollment in STE fields of study at Nigerian universities, then one can simply work backward from the five million target to ensure that half of all schools is sufficient.

However, the analysis should go beyond this. It should also consider broader economic development needs that would indicate how those five million trained professionals are aligned with national economic development strategies. How many engineers are needed? How many research scientists in which fields? The more in-depth this analysis is, the stronger the position for the Project.

This type of needs-based analysis goes beyond issues of resource mobilization and stakeholder recruitment. It is an essential part of project planning and management, especially for a project of this scale. It forces implementers to delineate each aspect of the Project with clearly established needs. This provides focus, establishing the Project’s core and supplementary elements based on “value” in real terms. This not only facilitates the Project planning but also the implementation.

As new needs and/or constraints arise, the Project team can adapt with a clear sense of priorities based on real-term value.

Design

As based on this evaluation, the FME in collaboration with others should review the design of the following key components:

- **Train-the-trainer initiatives of teachers and Federal and State inspectors.** The FME will need to carefully analyze the cost/benefit of train-the-trainer schemes. In many instances, these prove to be of equal or more cost to direct training as more must be invested into M&E systems to ensure appropriate quality.
- **The use of ELT as a pedagogy developed specifically for the Project as compared with standard ABL techniques**. Given the wealth of information, training materials, and international standards related to ABL techniques, it may be inefficient and costly to continue with ABL. There was little evidence to suggest that ELT provides significantly more value than standard ABL Techniques.
- **Strengthening of the design for Federal and State inspectors.** This evaluation demonstrates the impact of combining effective teacher training with robust M&E systems, especially through regular and substantive visits by Federal and State inspectors. Given that this evaluation also indicates some variance in the quality of these inspectorate visits, the design of this component should be reviewed and adapted accordingly.

Phased Implementation

Given the ambitious targets for the scaling-up strategy, the FME has rightly structured a phased implementation schedule. This includes a "cascade process" where capacity building will be spread throughout participating institutions. This includes a "national team of trainers, the 3,000 resource teachers trained during the pilot phase, the 600 core teachers of the SMASE—Nigeria Project, the resource persons of the GLOBE Programme and its network of students-teachers and scientists, as well as qualified human resources available in Science, Technology and Mathematics Education." [26]

The FME has also already identified conditions for the selection of schools. These are critical elements to the scaling-up strategy. Beyond these and as related to project planning and implementation, the strategy should also include sufficient milestones, quality assurance measures, and performance indicators for each phase of the implementation. These should be aligned with the needs analysis, as noted above, and be "built-in" to the plan at critical junctures so that the project managers can gauge ongoing strengths, weakness, opportunities, and risks.

An RBM approach should be considered whereby adequate and periodic evaluations of the strategy's continued relevance, impact, efficiency and effectiveness, and sustainability are conducted. This is but one example of many project management tools that could be used.

Successes

The pilot has been successful in highlighting the need, concept, stakeholder commitment, and design. It has also provided sufficient resources for the pilot and has commitments for the scaling-up strategy.

As implied throughout, the FME and UNESCO have formed an effective partnership that has been instrumental to the pilot's success. This relationship should continue and be strengthened to respond to the needs of the scaling-up strategy.

[26] See "Strategy Note on Scaling Up The Science, Technology and Mathemtaics Project, 2007 – 2015," FME.

Challenges
More consideration should be paid to the implementation of the scaling-up strategy especially as it relates to project planning, project management, quality assurance, and performance indicators. This should be based on an in-depth needs analysis.

6.4.2. To what extent were the teachers who were trained retained in their respective schools?

Teacher retention, in general, and the retention of trained teachers more specifically, does not seem to be a primary issue for the Project. Based on school site visits, nearly all of the trained teachers have been retained. The only noted instances of attrition were due to family issues or other opportunities. Of the 26 schools visited, there were only four noted instances when trained teachers had moved on to other posts. In fact, Nigeria seems to have a good system for teacher retention in place, keeping most teachers on four-year contracts that most fulfill.

Successes
Not only have teachers been effectively retained, there is an indication that the teachers are training others, thus sharing their knowledge throughout their schools.

Challenges
It may be useful to track teachers who have been trained and transferred to other schools. If they are transferred to schools that are not targeted in the scaling-up, it may be beneficial to enlist them to provide some train-the-trainer services in their new schools. However, given that, of the schools visited there were 138 teachers trained in total and only four noted instances of teachers who had moved to new posts, these cases may be too few to devote necessary resources.

6.4.3. To what extent has ELT added value to efforts for improving STE in Nigeria, and what are some major implications of the concept for the work of UNESCO?

ELT is, in essence, an adaptation of ABL techniques. It builds on ABL and includes issues like gender equality that are not directly related to ABL pedagogies. Thus, ELT conforms to the international standards associated with ABL pedagogies, which are proven methods for teaching abstract and other concepts for all age groups. The use of this pedagogy has demonstrated a substantive increase in learner comprehension and retention rates. Given this, the pedagogy was particularly effective for STE.

While there is some value in developing a pedagogy that is tailor-made to specific needs, like ELT, it may also hinder trained teachers' capacity to further develop their skills through other learning institutions. Using ELT may also have potential cost implications of additional teacher training. Given this, the Project should carefully consider the value of the ELT pedagogy.

Successes
- While the impact of ELT is not apparent in practical teacher pedagogies (where action-base and experiential techniques have been demonstrated), ELT is a good adaptation of ABL and addresses the key needs of Nigerian educators and students. Its development is a clear success and should be carefully considered going forward.
- UNESCO should continue to use its exceptional resources, expertise, and leadership in both the fields of education and science—two key UNESCO sectors. Its combination of research and best practice will prove to be especially relevant to ensure that curriculum design, be it for teachers, inspectors, or others, will be aligned with international best practices and leading research.

Challenges

The FME will need to ascertain whether it makes more sense to focus on international standard pedagogies (ABL) or to use a more customized approach (ELT), on the basis of a thorough cost/benefit analysis.

6.4.4. Given the findings of the evaluation, what would be the important design, planning, funding and implementation issues to be taken into account, including the characteristics of Self-Benefiting funds-in-trust projects[27] for scaling-up of the Project in Nigeria?

Please see the "Sustainability Structure" and related analysis above for specific commentary regarding Design, Planning, Implementation, and Funding issues.

The most important need for scaling-up the Project is the creation of a detailed project execution plan that is based on clear needs and other gap analysis. This should include a phased approach to the scaling-up with sufficient quality assurance measures and performance indicators.

In addition to this, the Project's sustainability depends on the training of Federal and State inspectors. According to project documentation, 94 Federal and State inspectors were trained for the primary level and another 148 at the secondary level. These inspectors have also pledged to train other inspectors, using a similar train-the-trainer scheme. Based on the school visits, these inspectors, in the best cases, had a positive effect on teachers' capacities in the area of action based/experiential learning techniques and how they were using kits and other materials. The Project performed best when there was a combination of effective teacher training with regular and substantive inspector visits. In the best cases, these visits included observation of teacher lessons, interviews with students and teachers, and immediate feedback on teacher performance in addition to the review of materials and the completion of standardized questionnaires. It is also important to note that these inspectors were drawn from all of Nigeria's 36 states as well as from Federal and State ministries and institutions. In addition, an M&E instrument is being developed for primary and secondary teaching.

While the training of a core number of inspectors at the Federal and State levels will be critical for the Project's sustainability, additional performance measures will need to be implemented. In particular, there will need to be sufficient quality assurance measures in place to ensure that teachers have a firm grasp of action based/experiential teaching techniques and that these have been successfully integrated into their lessons.

Successes

- The Government of Nigeria has already committed 62% of the projected budget for the scaling-up strategy. This is a clear indication of the Project's priority and the Government's overall commitment to its success.
- The design is effective, given the triumvirate of ABL/ELT pedagogies, trained inspectors at the State and Federal levels who conduct substantive school visits, and the provision of key "hands-on" materials and guidelines in the kits. These three programme elements are core to the design and should remain so.
- The pilot has demonstrated that all related stakeholders can deliver the actions planned within the budget and timeframe. In countless examples, the Project created significant cost

[27] This evaluator is not in a position to effectively evaluate "self-benefiting funds-in-trusts projects."

savings, exceeded the target number of teachers and inspectors to be trained, and delivered ahead of schedule.

Challenges
As noted throughout this section of the evaluation, the challenge will be to build on this success with regard to the planning and implementation of the scaling-up strategy.

6.4.5. Given the findings of the evaluation, what would be the important design, planning, funding and implementation issues to be taken into account, including the characteristics of Self-Benefiting funds-in-trust projects (lessons learned) for replication of the pilot in other Member States?

In addition to a realigned cost/benefit regarding the kits and related materials, the replication of this in other Member States will depend on the development of a detailed project execution plan, as described above. This plan may then serve as a "template" strategy for effective implementation in any other regions of the country.

The value of such a plan should not be underestimated. It is part and parcel of successful franchise operations in the commercial sector. A McDonald's restaurant, for instance, can be (seemingly endlessly) replicated around the world because they have a standard template that details every process, procedure, activity, etc. In the case of Nigeria's STE initiative, this plan must not only detail all aspects of the scaling-up but also incorporate sufficient quality assurance and performance measures, both for monitoring of project implementation, as well as measuring short and long term student performance and other long-term impacts.

Successes
Nigeria has implemented a pilot that may address needs for other Member States wishing to strengthen science and technology education. It is justifiably ambitious and sufficiently daunting. Its success will provide a model and clear lessons for other Member States embarking on similar initiatives.

Challenges
In order for this to be a "template" or even a "franchise" for other Member States, considerable attention must be paid to the planning, evaluation, and other aspects of a detailed implementation strategy. All steps will need to be sufficiently documented with clear step-by-step procedures for critical project elements.

6.4.6. What should UNESCO's role be in the scaling-up of the Project, given its mandates and capacities?
Please see Section 6.1.4 for a detailed response to this evaluation question.

7. RECOMMENDATIONS

These recommendations are organized according to key issues and themes that the FME and UNESCO should consider going forward.

Effective Management for the Scaling-up

Given the stated commitment of the Nigerian Government to scaling-up this initiative,[28] the following recommendations should be considered regardless of the eventual scale or with whom the Nigerian Government chooses to deliver in the actual delivery of such an ambitious project.

1. The Nigerian Government, and particularly the FME, should ensure that appropriate needs-based analysis is conducted for the Project going forward. Such an analysis should demonstrate actual needs and would thereby provide the basis for systematic and objective design, planning, and implementation. The analysis may begin with an estimate of the number of trained scientists, across disciplines, fields and professions that will be required to support the nation's economic and developmental goals, amongst other necessary needs-based analysis.
2. Nigeria-UNESCO should also investigate the benefits of focusing on science and technology as a means of supporting studies in other fields. Comparative and best practice evidence should demonstrate that the focus on STE has additional benefits to how students perform in other subjects. In other words, can the Government not only demonstrate a clear need of particular number of qualified persons in science and technology fields and disciplines, but also that an emphasis on science and technology (and ABL/ELT techniques) may provide a foundation for all fields of study.
3. There must be a clear strategy and management scheme for ensuring that the Project conducts quality assurance (especially with regards to the training of teachers and State and Federal inspectorates) and that its impact is effectively measured going forward. This will require exceptional project and performance management skills. This should be initialed by the FME in consultation with all stakeholders and then vetted and managed by professionals who have the skills and experience to manage projects of this scale. These professionals may be part of the National Project Management Team, described in the following recommendation.
4. A National Project Management Team should be established for scaling-up with strong support from the FME, FMST and other stakeholders. The Team should be charged with implementation and general operations of the Project, as well as reporting to a newly formed Standing Committee comprised of members from Federal and State ministries, international agencies, and other key local and national stakeholders. Depending on the actual scale of the scaling-up, the composition of this Standing Committee may be altered to include only those institutions, agencies, organizations and/or persons who are either directly involved with the initiative or who may provide useful guidance and counsel. The National Project Management Team should be comprised of persons with relevant project management experience and skills and be able to establish effective quality assurance and performance indicators for all facets of the Project's implementation and sustainability. Ideally, this Team will use am RBM approach and tools to guide their work.

Training of Teachers and Inspectors

5. Procedures should be put in place to facilitate knowledge transfer among teachers before they are moved to new schools. This is already emphasized in the teacher training curricula.

[28] "Strategy Note on Scaling Up The Science, Technology and Mathemtaics Project, 2007 – 2015," Federal Ministryof Education.

However, it needs to be further underlined to ensure that not only formal train-the-trainer activities are taking place, but that teachers are also encouraged to share general "know how" and best practices. Ideally, these procedures would include a record of teachers' participation in the training in their official employment records so that when they were transferred to new schools, their new administrators, principles and/or colleagues would know that they had participated in the training. In addition, all schools should be made aware of the Project, its value and its various components, so that they will be aware of the potential benefits of the Project and thereby more inclined to invite new teachers who have participated to share their knowledge and skills. The videos produced for the pilot project may serve this purpose well.

6. Given that this evaluation demonstrates the need for effective State and Federal inspector visits to participating schools, there should be a standardized process, manual, and affiliated records for what the inspectors do during their school visits. These will need to go beyond the simple records currently used and include the more qualitative activities wherein inspectors work with teachers to improve their skills and approaches.

Kit Suitability

7. The component of the micro science kits that requires consumables should come with at least one full school year's supply of the average requirement. This is based on the storage capacities available at most schools visited, with the assumption that this is representative, combined with the inconsistency in actual lesson plans. For instance, some schools may use all of their consumables in October – March while others will use more toward the school term's end. It seems imprudent to attempt to adjust delivery to these complicated logistics when a supply for one school year would suffice. Furthermore, to provide more than one year's supply may raise the risk that these consumables are contaminated, stolen, or otherwise lost.

8. The primary science kits should come with plastic (not glassware), while the primary mathematics kit should be made of fortified plastics for durability and safety and in colors attractive to pupils.

9. Kits should be aligned with WAEC and NECO curricula.

Costs

10. The current costs of the science and mathematics kits are uncompetitive. This remains so even after the re-negotiated prices for the kits. The Nigerian Government must make every effort to ensure that these costs are reduced and that all efforts are made to ensure that procurements are made through competitive and fair practices.

UNESCO's Role

11. UNESCO may wish to emphasize its comparative advantage in science and education, two of UNESCO's sectors. It has the resources (intellectual, in particular) to provide clear guidance on how the Project links with broader governmental policies and initiatives. While the evidence collected in this evaluation is relatively inclusive in this regard, UNESCO may wish to investigate how best its resources in these sectors may be leveraged to facilitate the initiative's objectives, i.e. were the best people, resources and other information fully used, including those from UNESCO HQ and other field offices? This evaluation compared the kit costs to a similar UNESCO project in Pakistan where, as the analysis indicates, the overall cost of the kits was competitive. It would seem prudent that the UNESCO offices in Nigeria work with those in Pakistan to compare best practices, strategies, and other information and guidance.

12. UNESCO should undertake work that is consistent with its mandate in education and science, e.g. teacher training, curriculum development both for teacher training, and for STE in

schools and colleges, etc. In particular, the Project will require that one institution acts as primary coordinator between the growing field of international agencies and others that may be involved in the future. As noted in this evaluation and in related documentation, this is a primary role that UNESCO has served to date and may thus be continued similarly.

Resource Mobilization

13. UNESCO should refrain from acting as a sponsor or other agent for resource mobilization. This falls beyond UNESCO's mandate and should more aptly be placed with the Nigerian Government. This is based on the assertion of some of those interviewed for this evaluation from the FME and other Nigerian stakeholders that UNESCO should act as a sponsor or other agent for resource mobilization. While it is not clear whether any formal request has been made—indeed, there was documentary evidence of such a request—even simple overtures between these parties should be avoided given that this is not part of UNESCO's mandate.

Serving the Public

14. Advocacy activities and sensitization should be intensified at all levels in particular at local government and community levels. This should be conducted primarily by the FME and include a focus on non-participating schools and teachers thus encouraging train-the trainer schemes across regions rather than in selected schools.

Annex I Terms of Reference (TOR) of the Evaluation

A: Introduction

Background

In Nigeria, science education in primary and secondary schools has been hampered by the absence of functional laboratories allowing for practical lessons with the active engagement of students. Science classes in many cases were characterized as lecture-based, teacher-centered, lacking the suitable application of scientific equipment, and involving low female participation. The Nigerian Government decided to address these challenges through the supply of micro-science kits to primary and secondary schools, the training of teachers in innovative ways to teach science subjects, and the strengthening of the Inspectorate Divisions of the Ministries of Education to monitor STE in the federation. To this end the Nigerian Government called upon UNESCO for the design and implementation of a programme for the revitalization of science and technology education. The Project 931/NIR/1000, the Nigeria – UNESCO Special Project on Improvement of STE was thus initiated with a proposed duration of three years. The project was officially launched on 29th of September 2005 by his Excellency President Olesegun Obasanjo, represented by the Honorable Minister of Education.

Main objectives and expected results

The immediate objectives of the project (as given in the project document) are:

- To rebuild science education in Nigeria by improving the capacity of primary and secondary schools teaching and learning of science and technology through the revitalization of laboratories which are fully furnished with science learning equipment; and
- The building of a critical mass of science educators at the primary and secondary levels who are able to teach science in the class in a way that links the subjects learned with the real world experiences of the students.

Results to be achieved (as given in the project document):

- Equipping of Primary, Secondary schools and colleges of Education in states with 961 secondary science kits, 740 Primary Science Kits and 740 Primary Mathematics Kits;
- Training of 1,500 primary school teachers on usage of the kits;
- Training 1,500 secondary school teachers on usage of the kits;
- Training 3,000 primary and secondary school teachers on usage of active learning techniques in science;
- 30 increase in performance and retention of science students in secondary schools within two years;
- Competence in the use of micro-science kits in primary and secondary school levels increased in three years;
- Competence in the application of active learning techniques in the teaching of science subjects by 10,000 teacher instructors and understanding of the application of active learning in primary and secondary school levels in three years;
- 50 percent improvement in a period of five years in the tertiary natural sciences, technology and engineering enrolment;
- 25 percent increase in enrolment for postgraduate degrees in the science and engineering fields;
- Acquisition of skills for self-employment and job creation by 10,000 unemployed youths over a period of three years

Budget
An amount of 409,760,480.12 Naira, equivalent to US$ 3,179,979.96 was made available to UNESCO for the Implementation of the Project over a period of three years, through a self-benefiting funds-in-trust arrangement. The total cost of the project (the pilot phase), estimated at 3,071,760,480 Naira (US$23.84 million) including the costs of the science and mathematics kits was funded entirely by the Federal Government of Nigeria. After two years of implementation, the Pilot phase has been completed and an initial strategy for scaling-up over the period 2007–2015 was designed and approved by the Steering Committee of the project.

B: Purpose of the Evaluation

Overall, the evaluation will seek to establish how successful the 1st phase (pilot phase) of the project has been and what are the main lessons to be learnt, particularly with a view of scaling-up the project in Nigeria, and the replication of the pilot in other Member States.

In particular, the evaluation will inform stakeholders, including the Nigerian FME, the State Ministries of Education, the School Boards | College Boards of the schools and colleges that participated in the pilot phase, NASENI, NMC, STAN, MAN, UNESCO – Nigeria, and UNESCO – Headquarters, on the following concerning the project:

- The results achieved by the project;
- The success factors contributing to the achievement of the results;
- The challenges faced in the design, planning, and implementation of the project;
- The quality of organizational management, programme implementation systems and associated resource allocation.
- The lessons learnt and the implications for replication in other countries and scaling-up in Nigeria.

C: Scope of the Evaluation

Timeframe and geographical coverage of the evaluation
The evaluation will cover the design and planning of the project, and the period over which the pilot phase was implemented, namely 2005 – 2007. Reference to earlier periods may be necessary depending on emerging issues during the course of the evaluation. Site visits to each of the six geo-political zones will be necessary, covering visits to at least three schools and colleges which participated in the pilot phase in each geo-political zone.

Evaluation questions
The following major questions are to be answered by the evaluation. The list given here is indicative, and not exhaustive. Nigeria and UNESCO may propose additional evaluation questions where they are deemed necessary.

Relevance
The extent to which are the stated objectives of the project consistent with the identified STE needs of Nigeria, namely:
- How and when the STE needs were established (base lines)?
- Was the approach adopted consistent with an overall operational national policy and, or strategic framework and STE curricula?

- Was the design of the project the most appropriate in the Nigerian context for improving the quality of Science and Mathematics education in Nigerian schools?
- To what extent were the activities undertaken by UNESCO consistent with the mandate (and functions) and capacities of the organization?
- Where the activities undertaken gender sensitive?

Efficiency and Effectiveness

Quality of organizational management, programme implementation systems and associated resource allocation:

- To what extent was the implementation of the project consistent with the project agreements, covering such details as: The respective roles of Nigeria, and UNESCO, resource mobilization, etc? What aspects were successfully implemented and what were not? Why?
- Where the project management structures (Steering Committee, Implementation Committee, M and E Committee, Project Coordination) and the implementation procedures and processes adopted commensurate with the scope and size of the project?
- How well did the structures, procedures and processes function at Federal and State levels?
- What were the quality assurance mechanisms put in place to cover details such as:
  - Suitability of the kits, delivery, storage, maintenance and repair, replenishment of consumables;
  - Teacher training: design and delivery, content, pedagogy, availability and suitability of material?
- To what extent did project implementation encompass sound RBM principles?
- How facilitating were the procedures and processes in the UNESCO-Abuja office in the implementation of the project (Value addition)?
- How many teachers were trained in the use of the kits and ELT through the project, and how many more were trained at school and state levels at their own initiatives or costs?
- How many schools and colleges received kits, and how many schools and colleges procured additional kits at their own initiative or costs?
- To what extent did the M and E undertaken helped to steer the project?
- What roles did the school inspectors play in the implementation of the project?
- Considering the results achieved by the project, could the same results have been achieved at lower costs using suitable alternative strategies and, or design, and, or programme delivery mechanisms (cost effectiveness)?

Impact

The extent to which the project has induced improvements in the overall actions and state of STE in and for schools and colleges in Nigeria:

- How has the training of teachers on the use of the kits and ELT affected the teaching and learning of Mathematics and Science in the schools and colleges concerned?
- To what extent are there traceable improvements in the performance of the students in the schools and colleges involved in such areas as: examinations, enrolment in science streams at tertiary institutions, the use of science and mathematics in project development?
- In what way has the project influenced schools and colleges that did not participate in the pilot phase?
- How has the project influenced national STE policies and actions?

- How has the project influenced relevant policies and actions of entities in both the public and the private sectors, and also international agencies?

Sustainability

The extent to which the positive effects of the project can be maintained (after closure of the pilot) and the contributing factors thereof:

- To what extent were transition strategies, from the viewpoint of UNESCO, built into the original design of the project?
- To what extent were issues of sustainability, from the viewpoint of Nigeria, built into the design of the project?
- To what extent were the teachers who were trained retained in their respective schools?
- To what extent has ELT added value to efforts for improving STE in Nigeria, and what are some major implications of the concept for the work of UNESCO?
- Given the findings of the evaluation, what would be important design, planning, funding and implementation issues to be taken into account, including the characteristics of Self-Benefiting funds-in-trust projects (Lessons learnt)for:
  - Scaling-up of the project in Nigeria; and
  - Replication of the pilot in other Member States?
- What should be the roles of UNESCO's in the scaling-up of the project, given its mandates and capacities?

D: Evaluation Methods

The External Evaluators will be expected to adopt an appropriate mix of approaches covering / selected from:

- Desk study of relevant documents, including:
  - The agreements, the project document, relevant national policy and strategy documents, project documents of several other projects in the STE sector, documentation on micro science and mathematics kits;
  - Minutes of the various committee meetings, M and E reports, audit reports, reports of training workshops, advocacy and documentaries, and various correspondences pertaining to the project;
  - Documentation on ELT and other related concepts and techniques, STE school and college curricula, and relevant training materials.
- Interviews with major stakeholders, including:
  - Staff from FME, and the State Ministries of Education;
  - Members of the Steering, Implementation, and M and E committees;
  - Head teachers, teachers and some students in the sample of schools that participated in the pilot;
  - Suppliers, and potential suppliers of kits and consumables;
  - Selected national and international agencies; and
  - Selected staff members of UNESCO, including the Director and the Project Coordinator (from UNESCO – Abuja), staff from the Education and Science Sectors, Bureau of Strategic Planning, External Relations and Cooperation, and Internal Oversight.
- Questionnaires and Surveys to some or all the major stakeholders, as appropriate; and
- Visits to and observations of selected schools and colleges.

E: Evaluation Team

The evaluation is to be carried out by an independent team (maximum two national consultants plus two international consultants) of external experts[29]. The team should include members with professional backgrounds and/or extensive experience in/with:

- Programme evaluation: evaluation methodologies and techniques, both qualitative and quantitative;
- International organizations and the UN system;
- Technical competence in STE, specifically in developing countries;

F. Planning and Implementation Arrangements

Management arrangements

The FME and UNESCO-Abuja will cooperate in the preparation and organization of the evaluation exercise and will facilitate the activities of the evaluation team. IOS will have a quality assurance role in the external evaluation. In addition, the implementation of the evaluation will be supported by a small **Evaluation Reference Group** of maximum eight to ten members drawn from relevant stakeholder groups. The Reference Group will provide necessary guidance and will review both the draft and final evaluation reports. The TOR, the evaluation team, and the deliverables will have to be approved by both FME and DIR/IOS.

Timeframe and logistics

The evaluation is to be conducted in the period End of October to end of November 2007. The draft evaluation report is expected by the end of November 2007, with the final evaluation report due at the middle of January 2008.

The evaluation team will be responsible for being self sufficient as regards logistics (office space, administrative and secretarial support, telecommunications, printing of documentation, etc.). However, suitable working space, when necessary, will be provided for the team when they visit UNESCO and other stakeholders. While the evaluation team is primarily responsible for the dissemination of all methodological tools UNESCO P Abuja and FME would facilitate this process to the extent possible (providing contact information, email addresses, etc.). Table 1 shows a tentative schedule for the evaluation. The schedule is to be firmed up in the evaluation plan to be submitted by the lead external evaluator.

Deliverables

Three main deliverables are envisaged from the evaluation, namely:

- The evaluation plan highlighting, among other details, the methods to be adopted by the evaluation team, including an evaluation design matrix indicating the data sources and analyses necessary for answering the evaluation questions, and the time schedule for completing the evaluation. The lead evaluator may have to conduct a logical framework exercise during the initial visit to UNESCO-Abuja to review planning documentation so that the evaluators and FME and UNESCO have a common understanding of the project activities and expected results

- The draft evaluation report, which will be circulated among stakeholders for comments; and

[29] Team should reflect gender balance

- The final evaluation report in which comments submitted by the various stakeholders would have been considered and appropriately incorporated by the lead evaluator. The final report should include, but not necessarily be limited to, the following elements:
    - Executive Summary (maximum 3 pages)
    - Programme description
    - Evaluation purpose
    - Evaluation methods
    - Major findings (given in terms of achievements and challenges)
    - Conclusions and recommendations
    - Lessons learnt/ factors contributing to the achievements (of results) or lack thereof
    - Annexes, including interview list, key documents consulted, itinerary, etc.

The **executive summary**, in particular, should be in a format suitable for direct incorporation into relevant reports on evaluation to the Executive Board. Namely, the Executive Summary should contain the following elements:

- Brief description and background of the programme/projects evaluated;
- Major findings – achievements;
- Major findings – challenges; and
- Recommendations.

Further the recommendations should be practically oriented, and easily aligned or traced to the respective achievements or challenges they are supposed to address.

Table 1: Tentative Schedule for the Evaluation

WHEN	WHAT	WHO IS RESPONSIBLE?
October 2007	Contracting the Evaluation Team	UNESCO - Abuja
October 2007 – November 2007	Briefing of Evaluation Team	FME, UNESCO – Abuja, IOS
	Completion of Inception Report, including Evaluation Plan	Evaluation Team
	Visits, interviews, surveys, analysis	Evaluation Team
15 December 2007	Draft Evaluation Report due	Evaluation Team
15 January 2008	Final Evaluation Report due	Evaluation Team

Annex II: Interview List: Schools / Institutions Visited, Principal / Head Teachers and Teachers Interviewed

1. Olusegun Obasanjo Model Primary School, (Jos)
   Mrs. Rahila Dafes Mwalbish (H/Mistress) and five school teachers
2. Federal Government College, (Jos)
   Mrs. M. A. Kenine (VP1); Mr. Sunday Ogunkule (HOD Dept of Science)
3. GSSS, Dass Bauchi
   Mr. J.J. Rimson (Principal); M. Isa M. Garba (VPA) and Mr. Dennis Joseph (HOD Science)
4. Bakari Dukku Primary School (Bauchi)
   Mrs. Safiya A.B. Mohammed (Head Mistress); Mr. M.B. Usman (Form Teacher)
5. Muazu Primary School (Gombe)
   Mr. Ahmed U Kwami (Head Teacher); Mrs. Haviwa Abdulkadir (Teacher) and Mrs. A. Umar Hassan (Teacher)
6. Government Science Secondary School (Gombe)
   Mrs. Zarah Poloma (VP); Mr. Ezelal Ogunsola (HOD Chem) and Mr. Ali Abdulsalam (HOD Biology)
7. Pilot Primary School (Dutse, Jigawa)
   Mr. Tasiu Guda (Head Master); Mr. Ibrahim Lurwanu (PEO/ERU/UNICEF) and Mr. Abba Abubakar (Deputy Head Master)
8. Government Junior Secondary School (Hadeja, Jigawa)
   Mr. Ibrahim Abudllahi (Head Master); Mr. Muhammad Abba Hassan (Technology) and Mr. Adamu Laker Adamu (Math Teacher)
9. Government Pilot Secondary School (Daura, Katsina State)
   Mr. Muhammad Sani (Principal); Mr. Mustafa Galadims (Physics Teacher)
10. Pilot Primary School (Senior) (Batagarawa, Katsina State)
    Mr. Abubakar Yusuf (Head Master); Mr. Atuba Iliyasu (Math Teacher) and Mr. Dachat Haruna (Science Teacher)
11. Modern Science Primary School II (Garki Village, Abuja)
    Mrs. Agnes U. Gimba (Head Teacher); Mrs. Esther Akenuw (Science Teacher) ands 13 other Teachers
12. Junior Secondary School (Gwarinpa, Abuja)
    Mr. A. M Kusherki (Principal)
    Mr. Aremu J. Adeyemi (VP Admin)
    Mr. Hajin Ibrahim (VP Acad)
    Mrs. Oriaku Chidinmi (HOD Science)
    Mr. Amujo Adekunle Enebezer
    Mr. Oke E. Folorunsu
    Mr. Balo Olufanmilayo
13. National Agency for Science & Engineering Infrastructure, (NASENI)
    Prof. O. O. Adewoye (Director General / Chief Executive)

14. Universal Basic Education Commission (UBEC)
    Dr. Andrew N. Ekpunobi (Director), Planning & Information; Mr. Kelechi (Planning Officer)

15. National Mathematical Centre (NMC)
    Prof. Sam O. Ale (Director General); Mr. Steve Dele Oluwaniyi (Project Oficer PMK)

16. Ministry of Education, Gombe
    Mr. Mohammed Abubakar (Dept. Director Science Education)

Schedule of Visit to Schools and Other Stakeholders

DATE	TEAM A	TEAM B
28/11/2007	• Federal Government College, Jos • Olusegun Obasanjo Model Schools, Jos	• Mafoluku senior Grammer School, Lagos • St. Peter's Anglican Primary School, Ikeja, Lagos. • Wesley College of Science, Ibadan
29/11/2007	• GSSS, Dass - Bauchi State • Bakari Dukku Primary School, Bauchi	• St. Louis Grammar School, Akure • SUBEB Model Primary School, Edo College, Benin • Emotan Primary Schools Benin
30/11/2007	• Government Science School, Gombe • Muazu Primary Schools, Gombe	• Queen of the Rose College, Onitsha • St. Paul's Nursery and Primary Schools. Awka
3/12/2007	• Government Junior Secondary School, Gamuwa, Hadeija. • Dutse Pilot primary School, Dutse	• CSS Rumuekini Community Schools, Rumuekini • St. Mary's State School Port Harcourt
4/12/2007	• Government Pilot Secondary School. Daura Katsina State • Pilot Primary School, (Senior) Batagarawa	• Ibeku High School, Umuahia • Urban School Primary School 1 Umuahia
5/12/2007	• Junior Secondary Schools Gwarinpa • Model Science Primary School 2, Garki Village Abuja	• Federal Government College, Enugu • Community Primary School, Enugu

TEAM – A: Prof Mutale Chanda, Mr. A.S. Mohammed, Mr. Chimezie Aguiyi
TEAM – B: Dr. (Mrs.) J. N. Ogwo, Dorian LaGuardia White, Mrs Tina Eyaro.

Annex III: List of Sources

Project Documents

- "Project Document: The Design & Implementation of an Initiative in STE for Primary & Secondary Schools and Colleges of Education." FME, 2005.
- UNESCO memorandum, "NIGERIA-UNESCO Science and Technology Education Project," 931/NIR/1000
- Mission Reports from Supplementary Training Workshops.
- Minutes from MDE Committees
- M&E Reports
- Documentation on micro-science and mathematics kits
- Documentary of improvement of secondary science training

Relevant National Policy and Strategy Documents

- "Nigeria 10-year Strategic Plan for Education: Policy, Cost & Financing Assumptions and their Implications (Working Document)", Gwang Chol-Chang. Education Sector, UNESCO, March 2007. (ED/EPS/2007/PI/1)
- "State Education Public Expenditure Reviews," (Draft Report), World Bank, 2007.
- "Strategy Note on Scaling-up The Science, Technology and Mathematics Project, 2007 – 2015," FME
- UNESCO/UNEVOC, http://www.unevoc.unesco.org.

International Best Practices

- *Increasing Teacher Effectiveness,* Lorin W. Anderson. UNESCO: International Institute for Educational Planning, Paris 2004.
- "Critical Management Education and ABL: Synergies and Contradictions," Michael Reynolds & Russ Vince. *Academy of Management Learning & Education*, 2004, Vol. 3. No. 4.
- *Learning in Action*, by David A. Garvin. Harvard University Press, 2000.
- "Introduction: Promoting the 'Practice' of Learning From Practice;" Richard Klimoski. *Academy of Management Learning & Education*, Dec. 2007, Vol. 6 Issue 4
- "ABL Environments," Donna Mathews. *Social Studies Review*, v32 n3 p17-20 spring 1993.
- "Quality of Primary Education in Pakistan," Ministry of Education for Pakistan, UNESCO. Prepared for Ministerial Meeting of South Asia EFA Forum, May 2003.
- "ASTD 2005 State of the Industry: Trends in Workplace Learning & Performance," B. Sugrue, R. J. Rivera. ASTD (www.astd.org), 2005.

Primary Sources

- **FME**
- **UNESCO**
- **Teachers, Students and Administrators**
- **Trainers**
  - NCCE
  - Skill G
- **Teachers Associations**
  - STAN
  - MAN
- **Other Suppliers**
  - Skill G
- **Institutional**
  - NCC
  - ETF
  - Academia
  - State Ministries
  - Regional Governors
  - Federal Science Equipment Centre
- **Partners**
  - JICA
  - World Bank
  - UNICEF

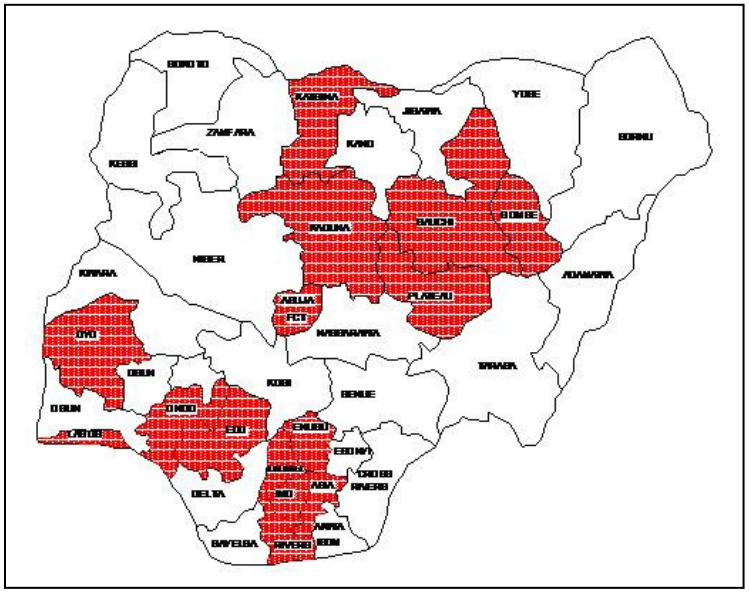
Annex IV: Standardized Questionnaire used during School Visits

The following questionnaire was used by the evaluation team during their school visits. This corresponds to the evaluation level questions. It should be noted that this questionnaire served as a general guide for interviews. Evaluators also explored other issues as relevant.

1. **Impact**
   - How has the training of teachers on the kits plus ELT affected the teaching and learning of Mathematics and Science?
   - To what extent are there traceable improvements in the performance of the student in the schools: Examinations, Enrolment in science at tertiary institution, the use if science plus mathematics in project development, etc?
   - In what ways has the project influenced schools and colleges that did not participate in the pilot phase?
   - If you had other equipment for integrated science, has the ELT training or other aspects of the programme motivated you to use that other equipment?
   - Where did the other equipment come from?
2. **Efficiency and Effectiveness**
   - What aspects of the project were successfully implemented and which were not and why?
     - Training of Teachers
     - Kits
     - ELT
   - What were the quality assurance mechanisms in place to cover:
   - Suitability of the kits, delivery, storage, maintenance, repair, replenishing, etc
   - Teacher training: design and delivery, content, pedagogy, availability and suitability of materials?
3. **Relevance**
   - Where the activities undertaken gender sensitive?
   - How did boys and girls interact with the science and math kits?
   - If there was fair gender equality, how did the teacher facilitate this?
4. **Sustainability**
   - To what extent were the teachers who were trained in their respective schools?
   - To what extent have teacher and others shared knowledge and experience with colleagues from other schools?
   - To what extend has ELT added value to efforts for improving STE in Nigeria?
   - What should we know about the design, planning, implementation and other issues about the project especially as they relate to scaling-up the project?

Annex V: Map of School Visits/Country Coverage

The following map illustrates all of the States that were visited as part of this evaluation's data collection phase.



Annex VII: School Data

	Mafoluku Senior Grammar School, Lagos	St. Peter's Anglican Primary School, Lagos	Wesley College of Science, Ibadan
Students (total #)	1450	600+	1550
STE Streams/ Subjects/ # Teachers	Chemistry (1) Physics (1) Biology (4)	Mathematics (1) Science (1)	Math (6) Agric. (4) Biology (4) Chemistry (5) Physics (4) Other Technical (3)
STE Teachers (#)	6	2	26
Trained Teachers (#)	While kits were received, no training occurred	3 (1 teacher left)	3
Exhibited Knowledge of Action/ Experiential Pedagogy	Limited--use kits primarily for presentation/demonstration; little practical "hands-on" training for students	Some exhibited knowledge of pedagogy--stated that they use kits for demonstration and some limited hands-on activities; mentioned that they use many more questions during lessons	Exhibited knowledge of pedagogy--sited that they are much more practical in lesson plans; lots of hands-on activities for students; "let the students lead the lessons"
Exhibited Knowledge of ELT Pedagogy	No exhibited knowledge	No exhibited knowledge	Limited knowledge of ELT--could site five pillars when prompted
Others Trained (Train the Trainers)	None	10 other teachers trained; Trained teachers held a workshop where they shared knowledge of approach; all science teachers attended	None--took no initiative to train others
Other Schools--Advocacy & Training (#)	None	None	None
Kits in Use (Type)	Primary Science Kit, Micro Science Kit	Mathematics Kit	Science Kit Micro Science Kit
Frequency of Use	Once month or less; used for demonstration	Regular use	Not used often--used for demonstrations; not for day-to-day
Kit Status (Storage, Maintenance)	Kept in principle's office in original containers; checked out by teachers	Kept in school library; readily available to students and teachers	Kept in storage room for each department; not easily accessible; no M&E system
Other Materials Used	None	Sufficient improvisation--students built abacus; have sought local suppliers to make some of the mathematics materials	Trained teachers encouraged improvisation; used many other materials from water bottles to detailed and colorful posters made by students for biology
Student Improvements	See some changes in students--use equipment for demonstration; Some students executive members of school's JETS club) took initiative to teach other students--a student-to-student knowledge exchange	Created a new Jets Club and a separate Mathematics Club; have seen membership increase	Students have showed exceptional initiative in their various classes in creating additional materials and teaching tools, e.g. the posters used for biology that were created by students; no other discernable evidence of improvements
Federal Inspectorate Visits (#)	None	2 visits	2 visits
Federal Inspectorate Activities		Reviewed materials (photos); asked teachers to complete questionnaire	Reviewed materials (photos); asked teachers to complete questionnaire
Other M&E	None	None	Principle had good records of school, teachers activities in project
Exhibited Gender Sensitivity?	Interviewed teacher unaware of techniques to ensure gender sensitivity	Interviewed teachers unaware of techniques to ensure gender sensitivity	Use mixed groups to promote equal participation although teachers showed few other techniques for gender sensitivity
Other	Record keeping relatively poor with little written evidence of student performance		

	St. Louis Grammar School, Akure	Queen of the Rosary College, Onitsha
Students (total #)	1000+	2000+
STE Streams/ Subjects/ # Teachers	Math (4) Biology (2) Chemistry (2) Physics (2)	Biology (4) Chemistry (3) Physics (2)
STE Teachers (#)	10	9
Trained Teachers (#)	2	2
Exhibited Knowledge of Action/ Experiential Pedagogy	Exhibited knowledge of pedagogy--Students now regularly perform experiments and other activities themselves; students are able to "actually see" science principles; solid hands-on activities; Use many more follow-up questions; Teachers claim that it makes science easier to teach; Found supplementary manuals with kits quite useful; Equipment is easy to use for teachers and students	Exhibited knowledge of pedagogy--students use equipment in lessons and have a much more practical orientation to lessons; students contribute to how they learn; ask many more questions
Exhibited Knowledge of ELT Pedagogy	None	None by biology teacher but physics teacher showed knowledge of ELT
Others Trained (Train the Trainers)	10--trained all other science teachers in school; held a workshop for all and then had one-to-one sessions for a few hours	None
Other Schools--Advocacy & Training (#)	Did meet with other teachers at trainings but have not followed-up	None
Kits in Use (Type)	Micro Science Kit	Micro Science Kit
Frequency of Use	Regular use in conjunction with other materials	Evidence of regular use but encouraged to keep records with dates
Kit Status (Storage, Maintenance)	Kept in labs; stored with other equipment on shelves	Kits kept in relevant labs; some materials were stolen
Other Materials Used	The school had an abundance of other materials--the kits supplemented existing materials; still encouraged students and teachers to improvise--that "science was everywhere" and they could use found materials	Good inventory lists showing that the kits are used regularly
Student Improvements	Students test scores have improved in related subjects (although actual records of these were not available); teachers note a higher retention rate--exhibited by the periodic test questions they ask students after subject lessons (as supplied in the kit manuals); students demonstrate a new eagerness and interest in science--much more than previously;	Used kits to produce rechargeable lanterns
Federal Inspectorate Visits (#)	2 visits	1 visit
Federal Inspectorate Activities	Reviewed materials (photos); Observed teaching techniques; Asked questions of teachers and students; provided some immediate feedback to teachers; asked teachers to complete questionnaire	Reviewed materials (photos); asked teachers to complete questionnaire
Other M&E	Principle was aware of all aspects of project in initial interview and stated that he is encouraging teachers to take advantage of training	Reviewed materials (photos); asked teachers to complete questionnaire
Exhibited Gender Sensitivity?	All girls school	All girls school
Other	Some kits are fragile and very minute for demonstrations	ELT should be extended to other subjects; kits not relevant to SSCE curriculum; Difficulty in replenishing consumables

	SUBEB Model Primary School, Akure	Edo College, Benin	Emotan Primary School, Benin
Students (total #)	800+	600+	750+
STE Streams/ Subjects/ # Teachers	Science (2) Mathematics (2) Biology (2)	All science school	
STE Teachers (#)	6	18	6
Trained Teachers (#)	4; (2 teachers took postings elsewhere)	2	2
Exhibited Knowledge of Action/ Experiential Pedagogy	Limited knowledge of pedagogy; used primarily for demonstration---little student interactivity	Exhibited knowledge of pedagogy; Teachers talk far less and get students doing much more; using paper to make 3-dimensional shapes quite effective; Asks many more questions--teachers practically rely on only questions during lessons; "Links students to practical world;" Materials easy to use and manipulate; manuals useful and easy to follow	Exhibited knowledge of pedagogy--practical experience of experiments/lessons; "makes it real"; also used to illustrate key subjects/concepts; ask more questions
Exhibited Knowledge of ELT Pedagogy	None-No training was given them on ELT	Limited knowledge of ELT--could site five pillars when prompted	Minimal recognition of ELT
Others Trained (Train the Trainers)	None--took no initiative to train others	Held workshop and shared knowledge ad hoc	None
Other Schools-- Advocacy & Training (#)	None	Organized workshop and training for 40 teachers from neighborhood schools at the instance of the Principal	None
Kits in Use (Type)	Primary science and Primary Mathematics kits	Micro Science Kit	Science Kit
Frequency of Use	Regular use in conjunction with other materials	Regular use of kits--at least twice a month	No evidence of regular use
Kit Status (Storage, Maintenance)	Kits not complete--science kit missing key parts; kept in storage room and checked out by use	Regular use of kits--at least 2x a month	Kit kept in teachers room; not easily accessible
Other Materials Used	The teachers encouraged improvisation with found materials and to recognize science as something that can be used/applied everywhere	Kits kept in related laboratories; easily accessible to teachers and students	None
Student Improvements	Students are leading state in science and mathematics examinations--notable increase since programme; (3rd place in State science competition); +80% of students enter science streams at secondary school (Especially St. Louis School, another visited school (65 this year)); Students eager to participate in science fairs;	Teachers have used cardboard and other materials to supplement kits	No records or students available for review
Federal Inspectorate Visits (#)	4 visits	1 visit	3 visits
Federal Inspectorate Activities	Reviewed materials (photos); Observed teaching techniques; Asked questions of teachers and students; provided some immediate feedback to teachers; asked teachers to complete questionnaire	Reviewed materials (photos); asked teachers to complete questionnaire	Reviewed materials (photos); Observed teaching techniques; Asked questions of teachers and students; asked teachers to complete questionnaire
Other M&E	None	None	
Exhibited Gender Sensitivity?	Interviewed teachers unaware of techniques to ensure gender sensitivity	All boys school	Good gender sensitivity; use groups of 5 with three girls in each group; was aware of gender issues in math & science
Other	Teachers manual and pupils workbook provided in the PMK package not available in the market	Sited need to have more M&E inspection; difficult to contact anyone about project; would like to see a model school where techniques are used according to best practice	

	Federal Government College, Enugu	Community Primary School, Enugu	Ibeku High School, Umuahia	Urban Primary School 1, Umuahia, Abia State
Students (total #)	1000+	500	897	342
STE Streams/ Subjects/ # Teachers	Biology (6) Chemistry (9) Physics (6) Math (15) Agric (7) IntroTech (8)	physics chemistry biology	Biology (3) Chemistry (3) Physics (1) Math (1) Agric (2)	Mathematics (1) Science (1)
STE Teachers (#)	51	6	10	
Trained Teachers (#)	None	2	2	2
Exhibited Knowledge of Action/ Experiential Pedagogy	Though not trained in the use of kits and ELT, teachers found manuals easy to use	Exhibited good knowledge of pedagogy. Teaching had improved. Memorable concepts better and quickly understood now because of kits	Exhibited knowledge of pedagogy, used equipment for demonstrations	Exhibited knowledge of pedagogy
Exhibited Knowledge of ELT Pedagogy	None	Exhibited fair knowledge	None	Good knowledge of ELT
Others Trained (Train the Trainers)	None	None	None	Trained 17 other teachers in the school
Other Schools-- Advocacy & Training (#)	None	None	None	Trained every teacher in two other neighborhood schools.
Kits in Use (Type)	Micro Science Kit	Primary Mathematics Kit	Micro Science Kit	Primary Science Kit
Frequency of Use	Evidence of regular use	Weekly	No evidence of regular use	Evidence of regular use. Keeps a log book of classes that borrow kits
Kit Status (Storage, Maintenance)	Kits kept in relevant laboratories	Kits stored in large lab	Kits kept in laboratories, in their original packets	Kits kept in head teacher's office
Other Materials Used	School has well equipped laboratories which are used by students for hands-on- experiments	None	None	None
Student Improvements	No records or students available for review	No records or students available for review	No records or students available for review	No evidence or records available but head teacher confirms improved performance of pupils
Federal Inspectorate Visits (#)	2 visits	2 visits	1 visit	1 visit
Federal Inspectorate Activities	Reviewed materials, observed teaching techniques, asked teachers to fill questionnaire	Reviewed materials (photos); Observed teaching techniques; Asked questions of teachers and students; asked teachers to complete questionnaire	Reviewed materials, asked teachers to fill questionnaire	Reviewed kit's content. Asked teacher questions, asked teacher to complete questionnaire
Other M&E	None		None	None
Exhibited Gender Sensitivity?	Good gender sensitivity; Performance of students independent of sex	Interviewed teachers unaware of techniques to ensure gender sensitivity	Not aware of techniques to ensure gender sensitivity	Ensure gender sensitivity in the use of materials.
Other	Complained about no training on ELT and on the use of kits, Of the view that kits should be relevant to curricula.		Need more training on ELT. Use of kits for lessons boosted class attendance in sciences	She visits other schools in the LGEA to handle practical science classes

	St Mary's Primary School Port-Harcourt	Community Secondary School, Rumuekini	Community Primary School, Ugwuokpa, Nenwe	Government Pilot Secondary School Daura Katsina
Students (total #)	946	743	380	
STE Streams/ Subjects/ # Teachers	Mathematics (1) Science (1)	Biology (2) Chemistry (1) Physics (1) Math (1)	Mathematics (1) Science (1)	physics chemistry biology science intotec
STE Teachers (#)		4		
Trained Teachers (#)	2	1	2	1
Exhibited Knowledge of Action/ Experiential Pedagogy	Exhibited knowledge of pedagogy. Pupils have become more creative and aware of the shapes of objects around. Participated in the science fare and had an award.	Limited knowledge of pedagogy; used primarily for demonstration-Good student interactivity	Exhibited thorough knowledge of pedagogy and use of the kits.	Exhibited good knowledge of pedagogy. Teaching ha improved. Memorable concepts better and quickly understood now because of kits
Exhibited Knowledge of ELT Pedagogy	Limited knowledge of ELT	Limited knowledge of ELT	Very good knowledge of ELT	Exhibited fair knowledge
Others Trained (Train the Trainers)	Trained 30 other teachers in the school	Trained 4 other teachers in the school	Trained 16 other teachers in the school	Organized training for school only. drawback is transfers
Other Schools--Advocacy & Training (#)	None	None	Trained 18 other teachers from neighborhood schools.	None
Kits in Use (Type)	Primary Mathematics Kit	Micro Science Kit	Primary Science Kit and Primary Mathematics kit	Science
Frequency of Use	Evidence of regular use	Evidence of regular use	Evidence of regular use, kept records	Weekly
Kit Status (Storage, Maintenance)	Kits kept in head teacher's office	Kits in the laboratories, some in shelves	Kits kept in head teacher's office	Kits stored in large lab are guarded since it's a zone lab
Other Materials Used	None	Improvised pressure cans	Improvised fish game, phone, weighing balance	Old equipment composed of pulleys in….plane simple pendulum
Student Improvements	Shapes of objects as building blocks for boats, buildings etc	School took third position in the Abuja Science fair	Evidence of Interest and excitement in science from pupils	Improvement in understanding of shapes obvious cubes etc. improvement in examination performance have done well in science quizzes come 2nd for the first time impressed crowds when they heated water without fire, using concave mirror. Class pass with ….. unlike before
Federal Inspectorate Visits (#)	2 visits	2 visits	2 visits	
Federal Inspectorate Activities	Reviewed kit's content. Asked teacher questions, asked teacher to complete questionnaire	Challenged the teacher to start use of kits, to train other teachers	Reviewed materials, observed teaching techniques, asked teachers to fill questionnaire, took photographs	
Other M&E	None	None	None	
Exhibited Gender Sensitivity?	Not aware of techniques to ensure gender sensitivity	Aware of techniques to ensure gender sensitivity	Aware of techniques to ensure gender sensitivity	There are no coeducation schools in the state of Katsina
Other	Science club, Mathematics club active in school	Community built a new laboratory to provide adequate storage for kits	Not given adequate notice for preparation for science fair. Science teacher initiated and organized training for other teachers in the LGEA	
	Pilot Primary School (Senior)	**Dutse Pilot Primary School Dutse**	**Government Junior Secondary**	**Model Science Primary School**

	Batagarawa	Jiquine	School Gamuwa Jigawa	Il Garki Village Abuja
Students (total #)	130	518	845	1454
STE Streams/ Subjects/ # Teachers	math science	Science math	Math Science Technology	math science
STE Teachers (#)				31
Trained Teachers (#)		3	2	2
Exhibited Knowledge of Action/ Experiential Pedagogy	Exhibited good knowledge of pedagogy. Teaching science in rural areas difficulty but now easier because of kits lesson plans easier to do	Exhibited excellent knowledge of pedagogy teaching has become easy because of the use of kits. Students grasp and understand concept quickly because of visual and physical interaction with the hearing process	Exhibited knowledge of pedagogy. Found teaching very interesting due to use of kits. Students understand concepts within a week unlike before when used to take long.	Exhibited knowledge of pedagogy. Kits very helpful in teaching pupils grasp concepts easily and quickly
Exhibited Knowledge of ELT Pedagogy	Teacher learnt no teaching methods e.g. snakes and ladders	Exhibited good knowledge	Exhibited good knowledge of ELT	Fair knowledge pupil centered. training techniques made pupils active in learning process
Others Trained (Train the Trainers)	None	Indoor course was organized for the teacher who did not attend course	School conducted one training for other teachers	School made arrangements for indoor training
Other Schools-- Advocacy & Training (#)	Many schools without teaching kits now want it. Inter schools debates. some schools want to borrow equipment	Minimal exchange of knowledge through Head Master's meetings	Local E.A encouraged schools to meet and exchange knowledge	The school has shared knowledge with other schools
Kits in Use (Type)	Math science	Primary science Junior secondary science	Math Science	primary math primary science
Frequency of Use	Weekly	Weekly	Twice a week	Daily
Kit Status (Storage, Maintenance)	Stored in locked room dusted often	School has no store room Equipment stored in H/Masters office, Equipment signed on for use	Kits are stored in the lab and store room lab attendant cleans and dusts equipment No problem with replacement yet	Kits stored in cupboards dusted and cleaned regularly
Other Materials Used	Cardboard paper for making geometric shapes. Mathematical sets. weighing balance	Wood work tools microscope tape recorder Saving machine	Before Kits school was making its own simple models like cubes, squares cuboids etc.	Teachers have created more kits through improvisation using wood and cardboard
Student Improvements	Students score better marks in assignments. Describe experimental process well;	Performance in examinations has improved Demotion rate has gone down 30% for classes 3 and 4 feed back from parents is very positive	Students have improved rules. In class of 15,20 passed unlike in the past when pass rate was 50% students now able to calculate heights of tall buildings using Pythagoras theorem	In primary 55% passed math this year compared to 35% previous years .pupils come first in Nigeria UNESCO math and science competitions
Federal Inspectorate Visits (#)	1 visit	None	1 visit by Insit (subec)	1 visit
Federal Inspectorate Activities	None		None	None
Other M&E	Sorbet team item from LGA	Subeb	UNESCO team	Nigerian UNESCO USAID
Exhibited Gender Sensitivity?	Classroom sitting segregated boys and girls mixed in lab sessions	mixed school in class Boys separated from girls Jigaur is rural and stepped in gender issues	Segregation is active in the school there are Boys and Girls classes during labs in Technology teacher forces Boys & Girls to mix and the Head master has agreed	Not traceable all children encouraged to work together science is team work
Other		Merthe School Board members on a UNICEF project inspection tour at the School		13 teachers attended school interviews

	Model Science Primary School II Garki Village Abuja	Junior Secondary School Gwarimpa Abuja	Olusegun Obasenjo Model Primary School Jos Plateau	Federal Government College Jos Plateau
Students (total #)	1454	324		378 (Science only)
STE Streams/ Subjects/ # Teachers	math science	math science	math science	Chemistry Physics Biology
STE Teachers (#)	31	3		
Trained Teachers (#)	2	2	4	3
Exhibited Knowledge of Action/ Experiential Pedagogy	Exhibited knowledge of pedagogy. Kits very helpful in teaching pupils grasp concepts easily and quickly	Exhibited good knowledge of pedagogy. Theory has been practiced, teaching enriched students grasp content easily teachers find it easy to teach	Good Knowledge of pedagogy	Teachers interviewed exhibited good knowledge of experiential pedagogy
Exhibited Knowledge of ELT Pedagogy	Fair knowledge pupil centered. training techniques made pupils active in learning process	Exhibited fair knowledge on ELT	Exhibited good knowledge of ELT pedagogy have changed lesson plan to suit child centered learning	No teacher went for ELT
Others Trained (Train the Trainers)	School made arrangements for indoor training	Trained other teachers in the school	Translated knowledge of other teachers through indoor workshop	Yes in-house by those who went for training
Other Schools-- Advocacy & Training (#)	The school has shared knowledge with other schools	Principals from other schools come to check kits	None	None
Kits in Use (Type)	primary math primary science	micro science primary science primary math	Primary science	Secondary science
Frequency of Use	Daily	Daily	Once every 2 weeks	Once a month
Kit Status (Storage, Maintenance)	Kits stored in cupboards dusted and cleaned regularly	Kits stored in principals office. kits kept clean but need no maintenance as at now	Kit stored in lab and used in lab	Stored safely in lab
Other Materials Used	Teachers have created more kits through improvisation using wood and cardboard	Schools have improvised other teaching heads, charts, shapes, figures, use of old alongside with new	Water solvent	Attempted to use FMG supplied equipment but is obsolete
Student Improvements	In primary 55% passed math this year compared to 35% previous years .pupils come first in Nigeria UNESCO math and science competitions	Continuous assessment tests performance has improved. 90%passing examinations school came in 3rd position in science exhibition. They have never qualified in the past	Students grasp concepts faster. Better marks in home works and tests	Learning has become easier for the students 93% of students who took math scored credit to distinction. Increase in enrolment in senior sec. in science streams
Federal Inspectorate Visits (#)	1 visit	1 visit	1 visit	1 visit
Federal Inspectorate Activities	None	None		1 UNESCO visit
Other M&E	Nigerian Enesco USAID	PTA very interested in school programs		
Exhibited Gender Sensitivity?	Not traceable all children encouraged to work together science is team work	Boys and Girls mixed in class sitting arrangements		
Other	13 teachers attended school interviews			

	GSSS Dass Bauchi	Muazu primary school, Gombe	Government Science Secondary School, Gombe
Students (total #)	200 (Science only)	3000	3000
STE Streams/ Subjects/ # Teachers	Chemistry; Physics; Biology		Physics; Chemistry; biology
STE Teachers (#)			
Trained Teachers (#)	3	2	3
Exhibited Knowledge of Action/ Experiential Pedagogy	The one teacher interviewed showed an Excellent knowledge of pedagogy	Exhibited fair knowledge of pedagogy. Teaching Cause work has become quick, including Teaching procedures. Lesson Plans have also become easy to make due to the Use of teaching kits	Experiential knowledge of pedagogy.
Exhibited Knowledge of ELT Pedagogy	Good knowledge of ELT Exhibited by interviews	Limited knowledge of ELT pedagogy. Did not attend course but has picked up some into from Colleagues	Fair knowledge
Others Trained (Train the Trainers)	Trained teachers trained those who did not go for training school has made policy to train all newly joining teachers	None	The trained teachers Others trained before two teachers transferred
Other Schools-- Advocacy & Training (#)	None but many schools come to inspect the kits and some want to borrow	None	None
Kits in Use (Type)	Micro science	Math, Science	Micro science, Math
Frequency of Use	Once a month	Regularly in labs and demonstration	Regularly during lab sessions, the School is a pure science school
Kit Status (Storage, Maintenance)	Kits well stored in the departmental stores of the chemistry & physics departments	Stored in locked laboratory, No breakages yet	Properly stored in inner store rooms in the laboratories
Other Materials Used	Boyles and chortes law, dissector pipette skeleton measuring cylinders and litmus paper	Thermometers; Triple stand lubricated cord board shapes	Old equipment neglected before e.g. dissector
Student Improvements	School has recorded improvements in% passing GCSE	Students passing tests with good marks. Creativity Of students has improved	Students' performance in sciences in sciences has improved. There has been an increase in those passing biology chemistry and physics
Federal Inspectorate Visits (#)	2 visits	1 Visit	2 visits
Federal Inspectorate Activities	None	None	
Other M&E		Visit from MAN ETF	Skill 'G' Director of science
Exhibited Gender Sensitivity?		Mixed school. However in class boys and girls sit separately; Science teacher mixes the groups during laboratory activities	
Other	Training Team		

Annex VIII: Evaluation Matrix

Source	Stakeholder	Analysis/Evidence	Achievements	Challenges
Relevance *The extent to which the stated objectives of the project are consistent with the identified STE needs of Nigeria, namely:*				
o How and when were the STE needs established (base lines)?				
Document Due Diligence (UNESCO) Document Due Diligence (Nigeria) Comparative Evidence Relevant Best Practices	**FME** (Restructured) **UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation) **Institutional** (NCC, ETF, State Ministries, Regional Governors, Federal Science Equipment Centre, Academia)	There is no evidence that sufficient baselines or needs assessments were conducted by any of the key stakeholders. This was confirmed by the FME. However, UNESCO has established key studies and project that science and technology are critical to a country's economic and overall development. The Task Force on Science, Technology & Innovation of the Millennium Development Project highlights the importance of knowledge and development in these areas to a country's capacity to respond to economic productivity, agriculture, education, gender, health, water, sanitation, environment, and participation in the global economy. NEPAD also states that scientific advances and technological innovation are the main drivers for economic growth and development. While it is intuitive that the investment in STE is critical for broader government policies and initiatives, the Government should now ensure that appropriate needs-based analysis is conducted and that this analysis supports the linkages between the initiative and broader policies. In its most basic form, this analysis may begin with an estimate of the number of trained scientists, across disciplines, fields and professions that will be required to support the nation's economic and developmental goals, amongst other necessary needs-based analysis. *This section will be expanded in subsequent drafts.* With this analysis in place, it can then demonstrate that by ensuring that 50% of all schools in each state participate in the scaling-up of the project (as stated in the scaling-up plans) that the initiative will be supporting the overall training and education of a sufficient number of students to achieve these goals. Of course, this analysis will need to consider attrition/retention rates, the projected number of students who will participate in the initiative and how many of these may likely go on into careers in the selected disciplines and professions, and other similar analysis. Nigeria-UNESCO should also investigate the benefits of focusing on science and technology as a means of supporting study in other fields. Comparative and best practice evidence should demonstrate that the focus on STE has additional benefits to how students perform in other subjects. In other words, can the government not only demonstrate a clear need of particular number of qualified persons in science and technology fields and disciplines but also that an emphasis on science and technology (and action-based experiential learning techniques) may provided a foundation for all fields of study?		Nigeria-UNESCO will need to create baselines and conduct sufficient needs analysis to insure that the initiative is clearly deliver results that may not be achieved through other means. The perennial question is, could the same resources be committed elsewhere to achieve the same or better results? Although there is no evidence of substantive baseline and/or needs-based analysis, the initiative is in-line with broader governmental policies. In addition, while the initiative now needs solid needs analysis, one should not dismiss the intuitive and informed good sense to make investments in STE.
o Was the approach adopted consistent with an overall operational national policy and/or strategic framework and STE curricula?				
Document Due Diligence (UNESCO)	**Presidency/ Gov't Policy** **FME**	While the approach is consistent with national policies, especially those related to 20/20 and other government emphasis on STE, there is not a coherent strategic framework for how the initiative is tangibly and practically linked with these broader strategies. Based on interviews with key stakeholders, including the Federal Ministry and ETF, they recognize the need to have a more practically based strategic framework for the initiative's		SEE ABOVE.

Source	Stakeholder	Analysis/Evidence	Achievements	Challenges
Document Due Diligence (Nigeria) Interviews (Stakeholders)	**UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation) **UNESCO** (Policy/Advisory) **Partners** (JICA, World Bank, UNICEF) **Institutional** (NCC, ETF, State Ministries)	scaling-up. By their admission, this will include the formation of a standing committee and better linkages between the Federal and State ministries, international agencies (including those beyond UNESCO, e.g. JICA, World Bank, etc.), and other key local and national stakeholders. However, there is little evidence of a clear strategy for how to develop and implement the standing committee and an overall management scheme for ensuring that the initiative maintains quality assurance (especially with regards to the training of teachers and state and federal inspectorates) and that impact is effectively measured going forward. The Federal Ministry has said that they will implement a standardized test for all teachers involved in the programme in January 2009. This should be supported with additional measures to not only ensure appropriate quality assurance but also that there are clear and practical links between the initiative and broader government strategies and policies.		
o Was the design of the project the most appropriate in the Nigerian context for improving the quality of Science and Mathematics education in Nigerian schools?				
Document Due Diligence (UNESCO) Document Due Diligence (Nigeria) Interviews (Stakeholders)	**Presidency/ Gov't Policy** **FME** (Restructured) **UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation) **UNESCO** (Policy/Advisory)	In the absence of base line studies as to particular needs and without a clear and practical framework that links the initiative to broader government policies and initiatives, it is not clear that this was the most appropriate initiative. While additional comparative and other evidence will be evaluated, the project design was appropriate for improving the quality of STE—it is simply not clear if it was the *most* appropriate. In particular, the action based/experiential pedagogy was effective, as based on the evidence collected during school visits. A majority of the teachers were able to site key ways they have included the pedagogy in lesson plans and there is a discernable improvement in student performance, as based on increased membership in science clubs (Jets Club), the formation of other science and mathematics clubs, increased enrollment in science and mathematics streams at the secondary and tertiary levels, and general evidence of increased retention and comprehension levels among students in key subjects as measured by periodic quizzes and other instruments conducted by the teachers.		SEE ABOVE.
To what extent were the activities undertaken by UNESCO consistent its mandate, functions, and capacities?				
Document Due Diligence (UNESCO) Document Due Diligence (Nigeria) Interviews	**Presidency/ Gov't Policy** **FME** (Restructured) **UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy &	As based on project documentation from UNESCO and the Government, as well as interviews with key stakeholders, UNESCO positioned itself as best suited to provide counsel on science and education (two of UNESCO's sectors) and used this comparative advantage to focus on the substantive issues of the project (as compared with the actual supply of kits). This does seem consistent with UNESCO's mandate, functions and capacities. UNESCO may wish to emphasize its comparative advantage in this area. It has the resources (intellectual, in particular) to provide clear guidance on how the training is designed and how to link the initiative to broader governmental policies and initiatives. This is particularly important as other partners are brought in for the scaling-up, e.g. JICA		

Source	Stakeholder	Analysis/Evidence	Achievements	Challenges
(Stakeholders) Interviews (Other) Comparative (UN)	evaluation) **UNESCO** (Policy/Advisory) **Institutional** (ETF)	and World Bank. UNESCO should assert and document its particular comparative advantage in the substantive issues related to education and science. In addition, the FME stated during interviews that UNESCO has performed well in its role of coordinating the initiative overall. This implementation facet of the project falls somewhat beyond UNESCO's mandate and yet, given the success to date and its accumulated knowledge in the initiative, it should maintain this position. Some stakeholders, in particular ETF, stated that they expected UNESCO to play more of a role in resource mobilization. While UNESCO may play a critical role in advocacy and in bringing various partners together, actual resource mobilization may fall beyond UNESCO's mandate, functions and capacities. As based on international agreements, like the Paris Declaration, and to ensure appropriate commitment and ownership, it must be the Nigerian Government that acts as the primary player in resource mobilization at all levels.		
Were the activities undertaken in a gender sensitive way?				
Document Due Diligence (UNESCO) Document Due Diligence (Nigeria) Document Due Diligence (School/Teacher Records) Interviews (Teachers)	**FME** **UNESCO** **Students** **Trained Teachers** **Other Teachers**	The Effective Learning Technique, a proprietary pedagogy developed in coordination with the initial training consultant and with teachers and other stakeholders, does hold gender sensitivity as a primary pillar of the pedagogy. However, evidence drawn from school visits indicates that the training here could be improved. Of the eight schools visited by this evaluator, only one teacher was able to site effective teaching techniques to ensure that boys and girls participated equally in the lessons. (Two of these schools were also all boy and all girls schools where this was not appropriate. As per the training of teachers, documentary and physical evidence drawn from the schools does indicate that appropriate efforts were made to train men and women. In the Northern schools as a rule, it was observed that in coed schools, boys and girls are segregated in classroom sitting, i.e. boys and girls sit in separate areas of the classroom. One teacher however submitted that when it comes to laboratory sessions he mixes boys and girls in group work. The Head teacher of the school has given a go ahead for this arrangement, It is important to note the kits are gender neutral.		Schools especially in the North to understand the technique of Effective Learning and its five pillars fully. Sample size; this may be supported by evidence from the other evaluators.
Efficiency & Effectiveness *Quality of organisational management, programme implementation systems and associated resource allocation:*				
To what extent was the implementation of the project consistent with the project agreements, covering such details as:				
Nigeria (Federal Ministry, other Government)				
Source	**Stakeholder**	**Analysis/Evidence**	**Achievements**	**Challenges**
		Based on an initial review of project documents combined with the on-site school visits, the project implementation does seem to be consistent with project agreements and other reports. In fact, there is evidence that the initiative was able to go beyond these sated agreements and train additional teacher as demand grew and to deliver key components of the initiative within or under prescribed timelines.		
Document Due Diligence	**FME** (Restructured)	The initial project document produced by the FME The project demonstrates a high level political committee to the improvement of science	Project was successfully	More co-ordination and collaboration is necessary in

Source	Stakeholder	Analysis/Evidence	Achievements	Challenges
(Nigeria)	**UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation)	and mathematics education in Nigerian schools. The training of teachers and orientation courses for mathematics and science for both heads band classroom teachers was commendable	implemented albeit initial start-up momentum	the up scaling. It is not late to even at this stage to use UNESCO's comparative. UNESCO will need a much larger coordination office in the scaling-up
UNESCO				
Document Due Diligence (UNESCO)	**FME** (Restructured) **UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation)	There appears to have been undue haste and accelerated speed in implementation thereby not allowing UNESCO time and space to prescribe or maintain norms and standards that would raise the quality of delivery of science education in Nigerian schools. The coordination acting between the UNESCO office and the FME have however been undertaken well		Strength in curriculum review, teaching and learning materials and institutional capacity building
Resource Mobilization				
Document Due Diligence (UNESCO) Document Due Diligence (Nigeria) Best Practice Standards	**FME** (Restructured) **UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation)	As based on the training of teachers and the delivery of kits, appropriate resources were mobilized for this pilot phase. According to project documentation, the Federal Ministry has already committed US$387 million for Phase 1 of the scaling-up (31% of the total budget requirements). This amount will be matched by State Ministries and other federal Actors. While the same project documents says that the World Bank's US$180 million funding of Step B Initiative may fill part of the remaining gap, this has not been assured and still leaves a significant gap in funding for the scaling-up of the project. As noted, UNESCO may review its role in resource mobilization to ensure that it is the Nigerian government that is at the forefront of this effort.		Resource mobilization will be a major challenge in the scaling-up phase
Were the adopted project management structures and the implementation procedures and processes commensurate with the scope and size of the project?				
Document due diligence (UNESCO) Document due diligence (Nigeria) Interviews (Teachers) Interviews (Stakeholders)	**FME** (Restructured) **UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & **Trained Teachers**	Based on the sample of schools visited, implementation was relatively successful. Of eight schools visited, only one school had received kits but had not trained any of its teachers. In all the other schools 1 – 3 teachers had been trained and appropriate kits received in good order. It is important to note that even though this is referred to as a pilot project, it is a mega project because of its geographical spread. The processes put in place thus far have worked well. Communication needs to be improved.		

Source	Stakeholder	Analysis/Evidence	Achievements	Challenges
Steering Committee				
Document due diligence (UNESCO)	FME UNESCO SUBEB	Organization of the first steering committee meeting took place in November 2005, a month after the official inauguration of the project. This shows commitment to start up processes. The steering committee should however meet more often.		
Implementation Committee				
		Its setup was critical to the success of the project. The incessant change of MOE and SUBEB political office holders is creating communicating gaps in the implementation of the project. The SUBEB officials interviewed at Dutse Pilot Primary school had little knowledge of the Nigeria- UNESCO initiative in science and technology as they had only taken up office.		
Project Coordination				
Document due diligent Nigeria	FME UNESCO FSG	In project coordination there was duplication of effort by EFT. The FME should coordinate the activities of its parastals efficiently to save costs and conserve resources		
How well did the structures, procedures and processes function at Federal & State levels?				
Document due process	FME UNESCO	Apart from the high turn-over of staff due to political change and career progression, the structures, procedures and processes established within the framework of the project were adequate. There was need however to release financial and operational functions to the committees at state and local government levels. The federal steering committee should deal with policy matters only and leave implementation to the state committees. Too much bureaucracy will not auger well for the up scaling phase. In as far as monitoring is concerned, there are three functional committees: these, the State Steering Committee chaired by the Governor, the implementation committee composed of various stake holders and the monitoring committee also composed of various stake holders including school inspectors. There are also zonal committees to articulate overall policy. There are operational difficulties to get these committees to meet. In most states visited, the state committees had not met since the governor chairs this committee and is presumably tightened up with other state and federal Government matters. The school based implementation committees should be empowered with executive and financial functions. These are chaired by the head master/principal and PTA is the member.		Funds are a problem at state level
What were the quality assurance mechanisms put in place to cover details such as:				
KITS:				
Suitability of the kits				
Document Due Diligence (UNESCO) Document Due Diligence (Nigeria) Document Due	**FME** (Restructured) **UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation) **UNESCO** (Policy/Advisory)	In general, teacher, principles, students and other interviewed said that the kits included equipment that was appropriate to standardized curriculum and other subjects. There were only a few instances where teachers said that the material was not appropriate to the intended student grade levels. As per whether the kits provided the right equipment for the relevant teachers and students, no evidence has yet been found to demonstrate the kits' suitability. As noted there was no baseline survey conducted to establish specific needs at participating and other schools. Several of the schools visited had ample equipment already and so the kits simply augmented existing equipment. However, nearly all teachers interviewed did say that they found the manuals that accompanied the kits useful in providing clear step-by-step procedures for demonstrating various subjects and concepts. Some teachers also went beyond these prescriptions and used the questions in the manuals as periodic quizzes to	Kits recognized as a demonstration tool Kits recognized as a demonstration tool.	Need to supply many more kits to school. Need to supply more of the consumables that come with kits so that after the teacher demonstrates, pupils are given the hands on experience i.e. performing the experiments themselves. Kits are qualitative but not quantitative. They are good

Source	Stakeholder	Analysis/Evidence	Achievements	Challenges
Diligence (School/Teacher Records) Interviews (Teachers) Interviews (Students)	**Students** **Trained Teachers**	gauge student comprehension and retention. In other schools (especially those that had not had the effective combination of teacher training and regular and substantive inspectorate visits) the kits were not used regularly and when used they were used primarily for demonstration rather than practical, hands-on action-based learning with the students. Thus, the kits in and of themselves are not sufficiently relevant to the initiative's objectives. The kits fall short of satisfying WAEC and NECO requirements. They are excellent as a demonstration tool. There is little hands-on with students as replenishment of consumables is high. some schools felt that the kit ought to be tightened intimately to the curriculum One State Deputy Director of Science submitted that the kits are excellent as a demonstration tool. There is need however to develop and equip the conversional science laboratory especially for senior secondary.		for demonstration but not for actual measurements. They need to be calibrated. Calibration is possible with re-design Sample size small.
Kit storage, Maintenance & Repair				
Document Due Diligence (School/Teacher Records) Interviews (Teachers) Interviews (Students) Interviews (Other)	**Students** **Trained Teachers** **Other Teachers**	Based on site visits to the schools, the kits were generally stored in relevant laboratories and classrooms where they were generally accessible by teachers and students. Most teachers and/or principles maintained record of what was checked out and by whom (although few listed the time and purpose). In some cases the kits were not easily accessible, kept in the principle's office or in other facilities that prohibited easy access. This may be strengthened both in the provided teacher training and in inspectorate visits. In both cases, teachers may be advised as to how best to store and maintain the kits so that they are easily accessible while maintaining appropriate maintenance and security. The kits in themselves were relatively durable enough—very little breakage was witnessed during the visits and most of the equipment was stored well to prevent undue breakage. In the case of the science and mathematics kits that included storage packs, these packs helped to ensure that the materials were appropriately kept and maintained. However, these storage packs also limited accessibly somewhat.		Inadequate number of kits lack enough trained qualified science teachers in most schools Sample size small.
Kit replenishment and consumables				
Interviews (Teachers) Interviews (Students)	**Students** **Trained Teachers** **Other Teachers**	No evidence was found that the kits were regularly replenished as part of the initiative. This is a particular drawback in the case of chemistry that relies on hard to attain materials to conduct lessons. However, many of the interviewed teachers demonstrated effective ways to improvise in getting more materials. In some cases, they used local contractors to make additional shapes and materials. In many cases, they used found objects and other materials to supplement the kits' materials. This was a key facet of the training—improvising and using found materials to conduct lesson. As noted, this "improvisation" in using additional materials beyond those supplied in the kits is a key part of the training and an effective pedagogy—by using found materials teachers are able to emphasize that science and technology is a regular part of how we interact with the world. This is part of the basic action based/experiential pedagogy that enables students to have higher levels of comprehension and retention and so it should not be underemphasized. (Best practice evidence is forthcoming.) However, the initiative must be clear in emphasizing this learning strategy—that using found and improvised materials enables students to recognize the "real" and practical aspects of concepts and theories. Federal and State ministries need to ward against schools perceiving that the stress of "improvisation" is a way to negate the appropriate provision of materials.		- For every experiment, there is only one packet of consumable, so the experiment can only be performed by the teacher. - As seen from the above there is need to maintain conversional laboratories. - State governments have know capacity to maintain the kits - Schools are able to maintain simple every day life consumables e.g. salt, sugar, candles etc - Schools need budgets to purchase chemicals e.g. iodine etc Constraint: Small sample size.

Source	Stakeholder	Analysis/Evidence	Achievements	Challenges
Teacher Training:				
Design				
Document Due Diligence (UNESCO, Nigeria, School/Teacher Records); Interviews (Teachers, Stakeholders, Other); Best Practice Standards	**FME** (Restructured) **UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation) **Trainers** (NCCE, Skill G)	Based on a review of project documentation as well as in interviews with key teachers, the design of the teacher training was effective. It drew on leading methodologies (action-based, experiential) that have substantive research and best practice to indicate the benefit of these techniques for student comprehension and retention, as well as engendering a great interest in science and technology related subjects. In relation to actual curriculum of the training, this also seems to have been effective. As noted, nearly all interviewed teachers were able to demonstrate a firm grasp of the action based experiential teaching techniques and they had integrated this methodology into their lesson plans and other activities. The other effective design feature involved the use of expert consult in the field of action based experiential training techniques who conducted training workshops for NCCE's national trainers. NCCE's trainers were not only able to incorporate the key action based/experiential techniques into their repertoire but were also able to build on it by creating the ELT. In this way, the design not only proved to be effective for imparting critical teaching techniques but also adaptive enough to adapt for the precise needs of Nigerian teachers.		
Delivery				
Same as above	FME; UNESCO Trainers; Teachers Associations; Other Suppliers; Institutions	The initiative deployed an international educator to provide initial training to NCCE who then fanned out across the country to provide direct training to the teachers. It was in this iteration that the NCCE, and later Skill G, the primary supplier of Micro Science Kits for secondary schools, developed the ELT as an adaptation to established international pedagogies.		
Pedagogy				
Same as above	FME; UNESCO Trainers; Teachers Associations; Other Suppliers; Institutions	As noted, action based/experiential pedagogies are proven methods for teaching abstract and other concepts for all age groups. The pedagogy has especially demonstrated a substantive increase in learner comprehension and retention rates. Given this, the pedagogy was particularly effective for STE. It should be noted that while there are some clear benefits to the Effective Learning Technique, a proprietary adaptation of action based/experiential learning techniques, it does move the initiative's pedagogy away from international best practices and leading research. While there is some value in developing a pedagogy that is tailor made to the needs, like ELT, it also hinders trained teachers capacities to further develop their skills through other learning institutions. It may also have a cost implication. By having a proprietary pedagogy, the initiative will need to spend funds training people in something that they may already know but through international best practices—the initiative will be training people in a less common form of the same thing.		There should be a more concerted effort to conduct evaluation interviews with the trainers (NCCE), Associations (STAN/MAN) and key State and local stakeholders to understand the full relevance of ELT. However, this is not a prohibitive constraint given the existing evidence and best practice standards for education.

Source	Stakeholder	Analysis/Evidence	Achievements	Challenges
		Given the implications of additional teacher training and potential cost increases, the initiative should carefully consider the value of the ELT pedagogy.		
Materials (Availability & Suitability)				
		Based on school visits, the materials were suitable to the teaching needs and pedagogy. As noted, in some schools the materials supplemented existing materials while there was also evidence of significant improvisation with other materials.		
How facilitating were the procedures and processes in the UNESCO Abuja office in the implementation of the project (value-added)?				
Document due diligence (UNESCO)	**UNESCO (implies education)**		Procurements for project inputs were sourced timely	UNESCO's contribution to raise funds for scaling-up set up a natural project management team for the scale up with strong support from FME, FMST and all stakeholders.
How many teachers were trained in the use of the kits and ELT through the project and how many more were trained at school and state levels at their own initiative or cost?				
Document Due Diligence (UNESCO)	**UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation)	According to project documentation, the following numbers of teachers were trained: o 1480 primary Science and Mathematics Teachers o 1740 Secondary Science Teachers No evidence was discovered that would cast doubt on these numbers. In fact, these numbers may be conservative given the evidence that many trained teachers trained other teachers in their schools. Project documentation alone states that another +3000 primary and secondary teachers were trained. While this number may be slightly exaggerated, the additional teachers trained in train-the-trainer schemes are most likely significant.	The trained teachers are equipped to train their colleagues, especially on the use of kits and ELT. Successful teachers in training their colleagues to be used as resource teachers in scaling-up of the project	Teacher transfer and mobility i.e. teachers being transferred before they have a chance to train others The teachers trained per school were small in number.
How many schools and colleges received kits and how many schools and colleges procured additional kits at their own initiative or cost?				
Document Due Diligence (UNESCO)	**UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation)	According to project documentation, the following numbers of kits were delivered: o 961 secondary science kits o 740 primary science kits o 740 primary mathematics kits It should be noted that while all the secondary schools visited had received at least one of the secondary science kits, the provision of primary science and mathematics kits was sporadic. Some had received either one of either or both. In one instance, the math kit delivered to the department of education at the university of the Jos was still lying in the university stores under the bursors office with no idea of the beneficiary. FCT, Sokoto, Benne and Kogi states bought more science and mathematics kits for their schools Katsiha, Adamawa, Akwa-I bow and Kwara states had made proposals in their 2007 budgets to purchase more kits for their schools. Kogi state trained more teachers than any other state.		
To what extent did the M&E undertaken help to steer the project?				
"The Report of Monitoring &	**UNESCO MFE**	According to project documentation and as confirmed through school visits, many States had implemented initiatives to ensure that the initiative was successful.	The various M&E teams	Synchronize M&E exercises to periods

Source	Stakeholder	Analysis/Evidence	Achievements	Challenges
Evaluation Exercise for Nigeria-UNESCO Special Agreement on Improvement of STE in Selected Secondary Schools across the Federation"	**Schools**	More importantly discussions held between the various M&E teams and the executives and committees in the schools identified and gave valuable guidance regarding the following: - procurement of more kits and training of more teachers in their schools - deployment of more science and mathematics based teachers to primary schools - building of science/mathematics room or laboratories for every primary school - involvement of PTA, professional (STAN/MAN) and private sectors in the improvement of the teaching in the schools - improvement s in the activities of state steering and implementation committees in order to accept the ownership of Nigeria -UNESCO project These intervention helped to steer the project in the right direction	succeeded in initiating interest on the need of inaugurating school based project committees until they were visited by the M&E team	teaching and learning processes are taking place in schools.
What role did the school inspectors play in the implementation of the project?				
Document Due Diligence (UNESCO, Nigeria, School/Teacher Records); Interviews (Teachers, Stakeholders, Other); Best Practice Standards	**FME** (Restructured) **UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation) **Trained teachers and other teachers**	Most of the surveyed schools had had 1 – 3 inspector visits in the last two years. There was a noted inconsistency in inspectorate activities and the number of their visits to schools. They were charged with not only assessing the status of the kits and having relevant teachers complete the assessment questionnaire, but also with observing teachers during relevant lessons, interviewing students, and providing immediate feedback on what the teachers could do to improve and/or adapt their teaching skills to ensure the maximum benefit from action based/experiential techniques and the Effective Learning Technique. Of the eight schools visited, only one school had received this type of participatory and performance based evaluation. In addition, the number of visits was erratic, from one to three visits for any school. Evidence suggests that the maximum benefit of the initiative is achieved when there is sufficient training of the teachers combined with regular and effective inspectorate visits. Inspectorate activities should be strengthened to not only ensure that these facets are covered by inspectors but that they also promote and facilitate train-the-trainer efforts, advocacy amongst other schools, and counsel on how best to engage and work with state and federal ministries.		Would be helpful to interview a sample of State and Federal inspectors to support evidence collected during on-site school visits.
Considering the project's results, could the same results have been achieved at lower costs using suitable alternative strategies and/or design and/or other programme delivery mechanisms, including cost effectiveness?				
Document Due Diligence (UNESCO) Document Due Diligence (Nigeria) Document Due Diligence (School/Teacher Records) Interviews (Teachers) Interviews	**FME** (Restructured) **UNESCO** (Implementation--Advisory, technical, resource mobilization, advocacy & evaluation) **Students** **Trained Teachers** **Other Teachers**	The training, administrative and auxiliary costs are in-line with reasonable comparatives. However, the unit cost of the kits for primary and secondary schools exceeds reasonable comparatives. **Training Costs** Based on project documentation, the basic unit cost for a 4-day workshop for both teachers and inspectors ranged from US$400 – US$800 per participant.[30] This is below available comparative and benchmark data. A Masters of Business Administration (MBA) programme at INSEAD, a standard comparative for learning and development costs, costs US$748 per day, including tuition and accommodation. In another comparative, the American Society for Training & Development includes analysis on average annual expenditures for learning and development. Their 2005 "State of the Industry" report determined a range of US$955 to US$1,1554 average annual expenditure per employee.[31] However, this figure is misleading not only because of its North American sample but also because of the increased use of e-Learning in US organisations, a comparatively cheaper way to delivery training programmes.	The overall design, training and administrative costs are within best cost comparatives. In fact, the initiative actively sought and found further cost reductions as based on the initial project plan.	Even with the unit price reductions, the stated costs of the kits remain uncompetitive. This could have negative ramifications on the initiative, its stakeholders, and its benefactors. Every effort should be made to negotiate more competitive prices. While it is laudatory to move wholly toward Nigerian suppliers, the cost issue may necessitate a regional or international

<table>
<tr><th>Source</th><th>Stakeholder</th><th>Analysis/Evidence</th><th>Achievements</th><th>Challenges</th></tr>
<tr>
<td>(Students)

Interviews (Stakeholders)

Interviews (Other)

Comparative (UN)

Comparative (Regional)

Best Practice Standards</td>
<td>Partners
(JICA, World Bank, UNICEF)

Institutional
(NCC, ETF, State Ministries, Regional Governors, Federal Science Equipment Centre, Academia)</td>
<td>Thus, at US$400 for a four-day workshop, or US$100 per learning day, these costs are reasonable.

Unit Cost for Kits
An initial review indicates that the cost of the kits was not competitive. Comparative evidence will surely reveal that similar materials could be procured at significantly lower costs. The unit cost for the kits was as follows:

<table>
<tr><th></th><th>Naira</th><th>USD</th></tr>
<tr><td>Primary Science & Mathematics Kits</td><td>500,000</td><td>4,244</td></tr>
<tr><td>Secondary Micro-Science Kits</td><td>2,000,000</td><td>16,978</td></tr>
</table>

This cost exceeds reasonable comparatives. For instance, a similar approach was undertaken with Ministry of Education in Pakistan, also in collaboration with UNESCO. This project also focused on the training of teachers in action-based experiential learning techniques for science and technology and included the provision of kits with relevant materials for students and training manuals for teachers. The kits cost PKRs. 3000 each with a supply of supplementary readers (100 titles with five copies each) at PKRs 4000, for a total cost of PKRs. 7000, or approximately US$115.17.[32]

It should also be noted that UNICEF regularly procures and provides similar science and mathematics kits for Member States. As part of a large Procurement Services project on behalf of the Ministry of Education in Rwanda, UNICEF supplied thirty secondary schools with Micro-scale science kits plus teacher's and student's manuals, microscopes and supporting didactic materials in French and English, such as overhead transparencies, video cassettes and posters. While the precise costs for these are not immediately available, a price range was provided of between US$200 and US$500.[33]
In a rather crude summary but one that also puts this issue in perspective, a review of on-line suppliers of primary and secondary educational science kits revealed that a range of kits could be had for between US$12.95 for a Solar Science Kit to US$275 for an Electronics Project Lab.
This evaluation clearly recognises the inadequacy of some of these comparatives but they do highlight the relative cost disparity. Given both UNESCO and UNICEF's activity in this area, they should be able to have additional comparative evidence worth considering.
UNESCO recognized this costing issue and worked with the Government and other stakeholders to substantially reduce the kits' costs. These revised costs are as follows:

<table>
<tr><th></th><th>Naira</th><th>USD</th></tr>
<tr><td>Primary Science & Mathematics Kits</td><td>100,000</td><td>849</td></tr>
<tr><td>Secondary Micro-Science Kits</td><td>450,000</td><td>3,820</td></tr>
</table>

However, even at these new rates, the pricing does not seem to be competitive. According to interviews with UNESCO's project coordinator and others, efforts have been made to address this issue. UNESCO must also be diligent in ensuring that there are fair and competitive procurement processes going forward. If not, there may be evidence of unfair pricing or other fraudulent procurement practices to which UNESCO and others may be charged as complicit.

Other Cost Considerations
The initiative has emphasized train-the-trainer activities for the teachers, whereby the</td>
<td>It should also be noted that the FME with UNESCO were able to implement all project component to or ahead of schedule, often with an increased number of trained teacher and inspectors. This project execution is not only a substantive project management achievement; it also has clear and positive indirect cost benefits.</td>
<td>bidding for future procurement.</td>
</tr>
</table>

Source	Stakeholder	Analysis/Evidence	Achievements	Challenges
		trained teachers will return to their schools and train others, as well as for the Federal and State inspectors. While this is generally perceived as a cost effective strategy, it must be buttressed with effective M&E systems to ensure that teachers, inspectors and others are trained to sufficient levels. Inevitably, train-the-trainer schemes result in some dilution to the training curriculum and so robust M&E systems and structures need to be in place to ward against this dilution. Therefore, analysis should be conducted to ensure that the train-the-trainer scheme, as supported by effective M&E, is actually more cost effective than direct training. In many cases, it is actually more cost effective and effective overall to train participants directly rather than shift the costs to elaborate M&E structures and systems. If this proves to be the case, the FME may also seek to implement teacher certification as based on their participation in direct training activities and thereby be able to have less elaborate follow-up M&E systems, e.g. they could simply administer periodic examinations and other performance based evaluations rather than discovering, through the M&E systems, that the train-the-trainer scheme caused substantive dilution in the quality of the training. Either way, train the trainer schemes should be encouraged—it is an effective means of generating momentum for the initiative, in advocacy amongst key stakeholders, and in creating sufficient ownership on behalf of schools.		

Annex VIII: UNESCO-Abuja: Management Response Table

Findings and/or conclusions	Recommendations	Actions taken/to be taken by the Director-General, and/or if recommendation is not accepted, give reasons for rejection
Relevance		
1: Achievements: The Nigerian Government places high priority on STE, as is demonstrated by several supporting policy statements, plus the funding of the pilot phase of the project. Various stakeholders, such as the FME, state education officials, school principals, and science and mathematics teachers are supportive of the project.	**Recommendation #1** Given the stated commitment of the Nigerian Government to scaling-up, the FME, should ensure that appropriate needs-based analysis is conducted for an appropriate design and planning of the project. This analysis may begin with an estimate of the number of trained scientists, required to support the nation's economic and developmental goals and design and appropriate strategy to address the needs. Appropriate use should be made of expertise within UNESCO and Nigeria.	There are ongoing questions of overpricing of the kits (some 800%). Once these are cleared with no possibility of a repeat, UNESCO may then support a systematic design and planning for a possible next phase, drawing from the knowledge base of existing science education and other projects in Nigeria, and expertise from Nigeria UNESCO Headquarters, IBE and/or the Regional Offices. Further, in response to recommendations 1, 2, and 3 of the UNESCO Abuja Office Audit Report of November 2007, the Director UNESCO Abuja will ensure that in the next phase of the STE Project: 1. The Project document is reviewed by the Sector/Units concerned at headquarters to provide quality assurance; 2. There is competitive bidding from vendors for the supply of goods and services (as per laid down procedures); and 3. UNESCO's obligations in Agreements are entered into after carefully assessing UNESCO's capacity to carry out the said obligations. A needs-based analysis would be useful in identifying areas for intervention to improve the teaching and learning of science, technology and mathematics in Nigeria's schools in partnership with institutions of higher education and research.
2: Challenges: The consultants found that the *Strategy Note on Scaling Up The Science, Technology and Mathematics Project, 2007 – 2015*, Federal Ministry of Education, lacks the very same needs-based analysis that this Evaluation recommends. There were no evidence that the Strategy Note was prepared in consultation with experts in science, mathematics and technology education in Nigeria, and UNESCO's Headquarters. It requires more than just kits to make sustainable improvements in STE; the STE curriculum and the teaching and learning approaches must be suitable. Better leveraging of expertise and information across UNESCO (e.g. UNESCO-supported TVET project) was needed.	**Recommendation # 2** Nigeria-UNESCO should also investigate the benefits of focusing on science and technology as a means of supporting studies in other fields. Comparative and best practice evidence should demonstrate that the focus on STE has additional benefits to how students perform in other subjects. In other words, can the government not only demonstrate a clear need of particular number of qualified persons in science and technology fields and disciplines but also that an emphasis on science and technology (and Action Based Learning/ELT techniques) may provide a foundation for all fields of study. **Recommendation 11** UNESCO may wish to emphasize its comparative advantage in science and education, two of UNESCO's sectors. It has the resources (intellectual, in particular) to provide clear guidance on how the project links with broader governmental policies and initiatives. While the evidence collected in this evaluation is relatively inclusive in this regard, UNESCO may wish to investigate how best its resources in these sectors may be leveraged to facilitate the initiative's objectives. For instance, were the	The strategy for the next phase of the STE project would be prepared by UNESCO in collaboration with the Federal Ministry of Education (FME) through consultations with national and international experts in the education of science, technology & mathematics. This would need to take into account the limited capacity of UNESCO's Abuja office to coordinate and backstop a larger project. Quality Assurance in science education will be addressed in the broader context of monitoring learning achievements in Nigeria. The project design of the STE project will also draw upon UNESCO's project (2001-04) in "Support of Revitalizing Technical Vocational Education in Nigeria Phase I" (552NIG1011) which is now in its second phase. The TVET project has made cost-effective and sustainable interventions in UNESCO's areas of comparative advantage, viz. institutional building, capacity development; modernization of curricula, ICT-based learning and the provision of technical reference books.

	best people, resources and other information dully used, including those from UNESCO HQ and other field offices? For instance, this Evaluation compared the kit costs to a similar UNESCO project in Pakistan where, as the analysis indicates, the overall costs of the kits were competitive. It would seem prudent that the UNESCO offices in Nigeria work with those in Pakistan to compare best practices, strategies, and other information and guidance. **Recommendation 12** UNESCO should undertake work that is consistent with its mandate in education and science, e.g. teacher training, curriculum development both for teacher training, and for STE in schools and colleges, etc. In particular, the Project will require that one institution acts as primary coordinator between the growing field of international agencies and others that may be involved going forward. As noted in this Evaluation and in related documentation, this is a primary role that UNESCO has served to date and may thus be continued similarly. See also Recommendation #1 above	
Results, Efficiency, Effectiveness		
3: Achievements: The project contributed to some improvements in the teaching (and learning) of science and mathematics in 25 of the 26 schools and colleges visited by the evaluation team, including: The kits are now used for demonstrating science experiments in cases where science teaching was previously only by explanations given by the teachers.	**Recommendation #7** The component of the micro science kits that requires consumables should come with at least one full school year's supply of the average requirement. This is based on the storage capacities available at most schools visited, with the assumption that this is representative, combined with the inconsistency in actual lesson plans. For instance, some schools may use all of their consumables in October – March while others will use more toward the school term's end. It seems imprudent to attempt to adjust delivery to this complicated logistics when a supply for one school year would suffice. Furthermore, to provide more than one year's supply may raise the risk that these consumables are contaminated, stolen, or otherwise lost. See recommendations given in #1 above.	Te improvements in the teaching and learning of science and mathematics by adoption of a hands-on, practical and experiential approach using demonstrations will be sustained through modifications in the curriculum for teacher training in these subjects and inclusion of Effective Learning Techniques (ELT) in the pedagogy for schools. Institutional training under the auspices of NCCE will be supplemented by opportunities for open and distance learning provided by NOUN and NTI. Further studies would be required to assess the nature and type of kits that are appropriate for different levels of education in the Nigerian context. The feasibility of re-vitalizing science laboratories will be considered as envisaged in the original project document. Alternate cost-effective approaches will be explored, where possible through south-south collaboration for sharing best practice.
4: Achievements: 740 primary and 961 secondary schools received kits. There is growing interest in science and mathematics, seen through increased membership of school science clubs, the winning of schools science competitions and increased enrolment in science streams in secondary schools.	**Recommendation #14** Advocacy activities and sensitization should be intensified at all levels in particular at local government and community levels. This should be conducted primarily by the FME and include a focus on non-participating schools and teachers thus encouraging train-the trainer schemes across regions rather than in selected schools. See recommendations given in #1 above.	While the supply of kits may have generated enthusiasm in some schools, this approach does not appear to be affordable, sustainable or replicable in view of the high cost of kits, design problems, uneven quality and difficulties related to storage, supply of consumables and regular use in the classroom. In the next phase a well thought-out advocacy and communication strategy would be devised for popularizing the teaching and learning of science, technology and mathematics among teachers and pupils with particular attention to girls and rural areas. This would build on the positive experiences of the pilot phase and best practice from other developing countries, particularly in Africa.

5: Achievements: Some 3220 mathematics and science teachers were trained. All the trained teachers interviewed were satisfied with the instructions for the use of the kits. Several had gone on to train other teachers in their schools, while some have developed substitute kit items from local materials.	**Recommendation # 5** UNESCO should undertake work that is consistent with its mandate in education and science, e.g. teacher training, curriculum development both for teacher training, and for STE in schools and colleges.	The gains of teacher training in the pilot phase would need to be consolidated by embedding such training in the curriculum for training school teachers throughout Nigeria and in institutionalizing the approach in Colleges of Education through the auspices of NCCE and NTI. The initiatives adopted by some teachers in developing kits from locally available material may be recognized, recorded systematically and disseminated across the educational system in the country. School teachers, who have demonstrated a special aptitude for S&T, may be given an opportunity to act as trainers in future.
6: Achievements: The teachers in 20 out of the 26 schools visited successfully demonstrated their grasps of Active Learning Techniques (ALT), and have actually integrated parts of the methodology into their lessons.	**Recommendation #9** Kits should be aligned with WAEC and NECO curricula. See also recommendations given in #1 above.	The use of Active Learning Techniques (ALT) for teaching science & mathematics will be promoted and expanded in the next phase.
7: Achievements: The Steering Committee, Chaired by the Federal Minister of Education was effective. It carried out its duties diligently given that the Project was implemented on-time and to budget.	**Recommendation #4** A National Project Management Team should be established for scaling up with strong support from the Federal Ministry of Education, FMST and other stakeholders. The National Project Management Team should be charged with implementation and general operations and report to a newly formed Standing Committee that should be comprised of members from Federal and State ministries, international agencies, and other key local and national stakeholders. Depending on the actual scale of the scaling-up, the composition of this Standing Committee may be altered to include only those institutions, agencies, organizations and/or persons who are either directly involved with the initiative or who may provide useful guidance and counsel. Regardless of the actual scale of the next phase in this initiative, this Evaluation does recommend the additions of a National Project Management Team. The National Project Management Team should be comprised of persons with relevant project management experience and skills and be able to establish effective quality assurance and performance indicators for all facets of the Project's implementation and continued sustainability. Ideally, this National Project Management Team will use a Results Based Management approach and tools to guide their work. See recommendations given in #1 above.	The roles and functions of the Steering Committee vis a vis UNESCO's structures and hierarchy will need to be properly defined and delineated.

Results, Efficiency, Effectiveness Continued		
8: Challenges: The qualities of several kit items were inappropriate; for instance: mathematical shapes supplied in wood, instead of durable plastics and primary science kits contained glassware instead of plastic.	**Recommendation #8** The primary science kits should come with plastic--not glass--ware while the primary mathematics should be made of fortified plastics for durability and safety and in colors attractive to pupils. See recommendations given in #1 above.	Issues relating to an equipment-centered and kits-oriented approach to improving Science & mathematics education calls for a serious review in the light of the findings of the audit and evaluation that the kits are grossly over-priced and are not designed for sustained use in the classroom. The design and durability of kits would be reviewed in the next phase.
9: Challenges: In 10 of the 15 states visited, the State Committees, who were charged with, among other tasks, making sure that a sufficient number of teachers were trained, as well as periodic inspections by State Inspectors had not met in at least a year. The committees had unclear roles and responsibilities.	**Recommendation #3** There must be a clear strategy and management scheme for ensuring that the Project maintains quality assurance (especially with regards to the training of teachers and State and Federal inspectorates) and that impact is effectively measured going forward. This will require exceptional project and performance management skills. This should be initiated by the FME in consultation with all stakeholders and then vetted and managed by professionals who have the skills and experience to manage projects of this scale. These professionals may be part of the National project Management Team, described in the following recommendation. See also Recommendation #4	This illustrates the risks of adopting a management by committee approach that by passes the established structures of governance at the federal and state levels and results in diffusion of responsibility and dilution of accountability. A thorough analysis of the efficacy of the project structures in the pilot phase would be undertaken prior to the next phase in order to ensure institutional ownership, efficiency and sustainability of project management structures. The proposals made in the report regarding establishment of a National Project Management Team and a new Standing Committee would be reviewed in this context
SUSTAINABILITY		
10: Achievements: Potential local suppliers of the kits are putting in place infrastructure necessary for the local production of kits.	See recommendations given in #1 above.	This issue is not directly relevant for the future of the project.
11: Challenges: The consultants found that UNESCO did not deliver with respect to the mobilization of funds for the envisaged scaling up of the project (as stated in the agreement), and as expected by the Nigerians.	**Recommendation #6** Given that this Evaluation demonstrates the need of effective State and Federal inspector visits to participating schools, there should be a standardized process, manual, and affiliated records for what the inspectors do during their school visits. These will need to go beyond the simple records currently used and include the more qualitative activities wherein inspectors work with teacher to improve their skills and approaches. **Recommendation #13** UNESCO should refrain from acting as a sponsor or other agent for resource mobilization. This falls beyond UNESCO's mandate and should more aptly be placed with the Nigerian Government.	While UNESCO is not a funding agency it has an important role in acting as a catalyst for mobilizing resources for science education in developing countries. Nevertheless it is unrealistic to expect it to mobilize resources of the order of approximately USD 125 million for the next phase of the STE Project in Nigeria.
12: Challenges: The primary kits were very much over-priced. Costs for kits in two similar situations were: (i) US $ 4244 in Nigeria vs. US $115 in Pakistan and (ii) US $ 4244 in Nigeria vs. US $ 200 – 500 in Rwanda. It was not clear to the consultants whether competitive bidding was done for the supply of the kits. The inflated costs made the project none cost effective, and also non-sustainable.	**Recommendation #10** The current costs of the science and mathematics kits remain uncompetitive. This remains so even after the re-negotiated prices for the kits. The Nigerian Government must make every effort to ensure that these costs are reduced. See also Recommendations #4, #7, and #8.	The relevance, efficiency, sustainability and cost-effectiveness of an equipment-oriented approach to improving science & mathematics education ,which poses operational and reputation risks to UNESCO, is open to question and would be re-examined. In any case a competitive and transparent bidding process must be in place for the procurement of the equipment that would be required (See also the response given in #1 above)