# Global Development in Science, Technology and Mathematics Education: An Appraisal of Science Teaching in Katsina State, North West-Nigeria

Dr. Suleiman Sa'adu Matazu[1*]     Elizabeth Julius[2]

1.Department of Science and Vocational Education, Usmanu Danfodiyo University Sokoto Nigeria.
PMB 2346 sokoto, Sokoto State, Nigeria

2.Department of Science Education, Kebbi State University of Science and Technology, Aliero Nigeria.
PMB 1144, Aliero, Kebbi State. Nigeria.

**Abstract**

Science education is considered as an indispensable variable in the civilization and development of any nation. Nation that pays serious attention to the improvement of its Science, Technology and Mathematic Education (STME) will soon be classified as a developed country on the ground that all other developmental aspects will surely be positively affected by STME. The purpose of this study is therefore to assess the happenings/activities of STME particularly in secondary schools of Katsina State, North West Nigeria with the view of comparing them with the global development in STME. The study is guided by four (4) research questions and survey design was used. The sample of the study was made up of six (6) science secondary schools – students and science teachers. Equally important, Focus Group Discussions (FGDs), Personal Observations (POs) and Questionnaire were used as instruments for data collection. It was discovered that contrary to the best global practices on teaching and learning science, conducive STME teaching and learning is lacking and science teachers are not up to date with global practices in STME. Also STME curriculum is hardly covered. It is recommended amongst others that intensive staff development and conducive environment must be provided for Nigerian STME to meet up with the global development.

**Keywords**: STM Education, Global development, Science Teaching and learning

## 1. Introduction

Science, Technology and Mathematics (STM) education is at the forefront of any nation's future global development and power (Nadelson, Seifert, Moll, & Coats, 2012). The term STM Education is used to describe teaching and learning in the fields of science, technology and mathematics (Gonzales & Kuenzi, 2012). It has a sole aim of helping the learners to acquire appropriate skills, abilities and competencies in science, technology and mathematics that would enable them contribute meaningfully to their lives and to the development of the society at large. Unfortunately, there is a glaring gap between the above aim and what is produced today by STM Education. The National Policy on Education (2004) stated the necessity of introducing Information and Communication Technology (ICT) into the school system to enhance innovation and changes in order to facilitate in closing the existing gap between the aim of STM Education and what is obtainable in reality (Chen, 2011; Seters, Ossevoort, Tramper, & Goedhart, 2012; Srisawasdi, Srikasee, & Panjaburee, 2012 ; Sangra & Sanmamed, 2016).

It is obvious that the emergence of global best practices in STM Education has transformed teaching and learning to a more viable and effective method and would likely set the standard for the future. It is important therefore to note that global developments in respects to Science, Technology and Mathematics Education STME required countries to have well trained and well-motivated STM teachers, adequate supply of relevant equipment and facilities for effective teaching and learning of STM including ICT facilities, learner friendly teaching and learning environment, encouragement for positive attitude to STM Education by all and finally development of scientific culture among other things (Panjaburee & Srisawasdi, 2014).

In Nigeria, the sciences are taught in school subjects as Biology, Chemistry, and Physics. The National Policy on Education in the National curriculum for Senior Secondary Schools volume 3 identified the objectives of teaching science to include: (i) knowledge of science academic discipline; (ii) to acquire the skills of scientific method; (iii) having clear explanations for societal issues through increasing interest in science literacy and societal goals; (iv) for personal needs; and (v) for career awareness.

These objectives could only be achieved by the science teacher through giving the right types of instructions to the students (Ngozi, 2014). No matter how well-developed and comprehensive a curriculum is, its success depends on the quality of the teachers implementing it (Ughamadu 2005; Patrick 2009). The Federal Republic of Nigeria (2004) while stressing the importance of teacher quality' in curriculum implementation noted that no nation's educational system can rise above the quality of her teachers. Furthermore, it is generally believe that schools are not doing enough of quality practical work (Effiong Anyang & Anenagbe 2013).

Studies conducted by researchers shows that the integration of STME into school system is fundamental for

preparing the students for the larger world, for instance John et al., (2016) conducted a study investigating the extent to which integrative STME program had an impact on high school students in southeast region USA and the result reveals the students have higher level of engagement and high mean score. In another related study by Christensen et al., (2014) on students participation of science, technology and mathematics education (STME) content and career, using 364 high school students the result shows that disposition of STME to students make them more STME professional and away from or less similar to traditional high school students.

Similarly, Patrick (2009) observed that most of the science teachers in Nigerian classrooms failed to put into practice teaching skills acquired, that could bring about effective teaching and learning of science, technology and mathematics. The deficiencies in science teaching range from; non-coverage of contents in schemes of work, non-giving and marking of assignments, non-supervision of instruction, non-organization of practical lessons, non-organization of extra lessons to cover lost grounds, non-assessment of learning outcomes regularly, non-application of improvisation knowledge in instruction to non-taking out of students to field experiences. Again all these, the researcher tend to suggest that teachers are to be blamed for the lack of proper exposure of the science students-which result in poor learning outcomes among the science students. From these observations therefore, it is clear that most of the underdeveloped and developing nations are far from meeting up with the global standard of disseminating STM knowledge.

It is against this background that this study investigated the teaching of science in Katsina State North-west Nigeria with the view of comparing it with global development in STM Education.

## 2. Brief overview of Katsina State, Nigeria
Nigeria has 36 states, one of which is Katsina State. It is located in the north-west geo-political region of Nigeria. Katsina State has 34 Local Government Areas and the state was formed from Kaduna State on the 27th September, 1987. The people of the state are mostly Muslims with substantial number of Christians and few traditional religion worshippers. The indigenous languages are Hausa and Fulfulde with a land area of 24,192km2. In addition to Islamic education scholars that are popular in the state, the people of the state have since accepted western education that is why the state is not among the educationally backward states.

## 3. Statement of the Problem
This study investigated some of the problems affecting effective teaching and learning of sciences among students of secondary schools in Katsina State Noth-west Nigeria. The teaching and learning of science, Technology and Mathematics Education have standard that is globally accepted which should be followed by STME personnel if effective learning is desired. Available literature on best practices with regards to science teaching require well trained and well-motivated STM teachers, adequate supply of relevant equipment and facilities for effective teaching and learning of STM including ICT facilities, learner friendly teaching and learning environment, encouragement for positive attitude to STM Education by all as well as development of scientific culture among other things. These standards appears to be lacking in some areas of the country thus the need to critically looked in this area with the views for improving standard to meet up with global development.

## 4. Research Questions
The following research questions were raised and answered at the cause of this study.
1.      What is the nature of interactions in STM classrooms in Katsina State?
2.      What instructional techniques do teachers use for teaching sciences in schools of Katsina State?
3.      To what extent is coverage of curriculum contents in science in Katsina State schools?
4.      To what extent is science practical lessons organized in Katsina State schools?

## 5. Research Methodology
### 5.1 Method
The design for this study is survey research design and the population includes all science secondary school students in Katsina State, north- west Nigeria. These students are within the age range of 15-18 years. There are fifteen (15) science secondary schools in the state. Eight (8) of them are boys schools while the remaining five (7) are girls schools.

### 5.2 Respondents/ Sampling method
The respondents in the study were secondary schools students in Katsina state. The sample for this study was drawn from the entire population of the study. Stratified random sampling technique was used to select six (6) schools for the study. To select the sample in each school, proportionate sampling technique was used. A sample of three hundred students (300) were selected from the proportionately selected schools. This is in line with researchers table for determining sample size. The table stated that for a population of 1,300, a sample of 297 is appropriate.

**Table 1: Sample Schools and Enrolment of Science Students**

| S/No | Name of school | SSII students' population | Sample |
|------|----------------|---------------------------|--------|
| 1 | Govt. Science Sec. School Dutsinma | 223 | 51 |
| 2 | Govt. Girls Science Sec. School Mani | 207 | 47 |
| 3 | Govt. Girls Science Sec. Sch. Daudawa | 210 | 48 |
| 4 | Govt. Science Sec. School Faskari | 229 | 52 |
| 5 | Govt. Science. Sec. School Bindawa | 218 | 49 |
| 6 | Govt. Girls Science Sec. Sch. Sandamu | 235 | 53 |
| | Total | 1,322 | 300 |

**Source: Katsina State Ministry of Education 2014**

## 5.3 Instrument

Three instruments were used to gather relevant data for the study.
Questionnaire, Focus Group Discussion and Personal Observation
The questionnaire was a self-designed questionnaire by the researchers developed to address the questions raised in the course of the study.  The questionnaire was answered by the students and some teachers from the sampled schools, the questionnaire was validated by experts (Professors, Senior Lecturers and Chief Lecturers) in Science Education and Educational Psychology in Usmanu Danfodiyo University, Sokoto-Nigeria and reliability index of 0.86 was obtained for the questionnaire using Cronbach's alpha.

Focus groups were also formed in order to get additional information from the respondents with regard the questions that were raised in the study, and the researchers also made some observations on what was going on in the schools with regards to teaching methods, frequency of science practical,  nature of interaction and the level of coverage of curriculum

## 5.4 Data Collection

The researchers collected the data themselves, six days was spent for the administration of questionnaire, collection of classroom interaction data by observation with the classroom interaction category and interviewing of some selected science teachers in each of the schools. All the questionnaires were collected from the respondents as soon as they finished with their responses. Their responses were scored, summarized and presented in figures.

## 6. Result

The result of the study address the research questions one after the other thus,
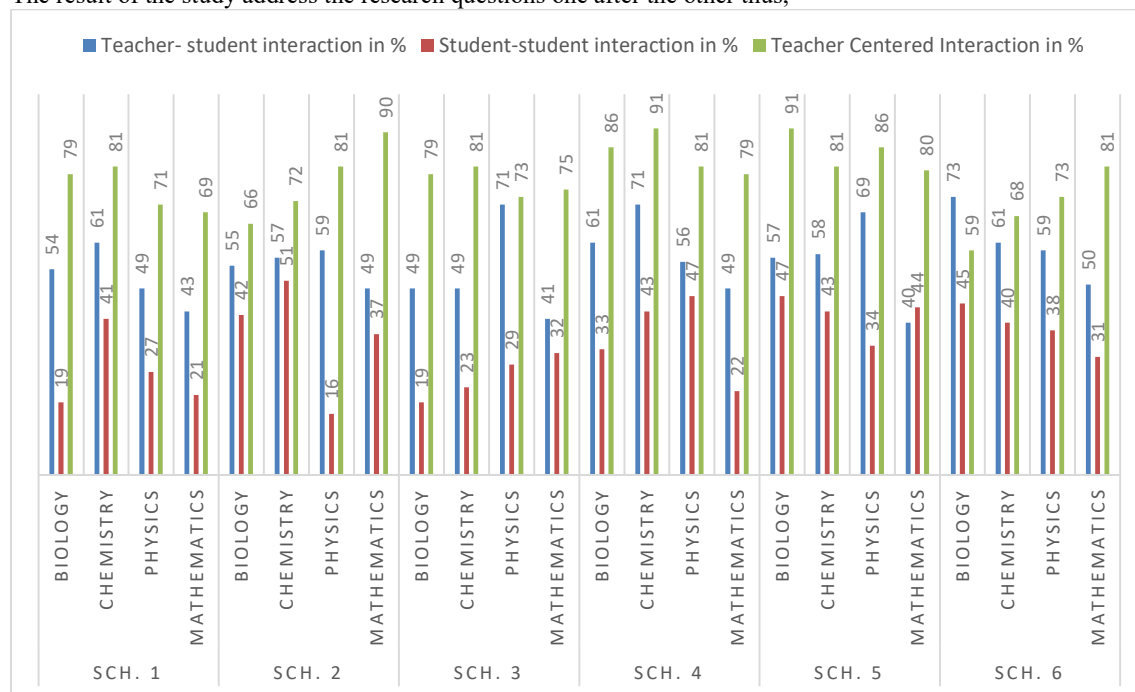


Figure 1: Nature of Instruction in STME Classroom
From the above result in figure 1, it revealed that the nature of interactions that takes place in science

secondary school classrooms of Katsina State is teacher centered. This is evident in the high percentage recorded in the teacher-centered interaction column, as against the student-student and student-teacher column.
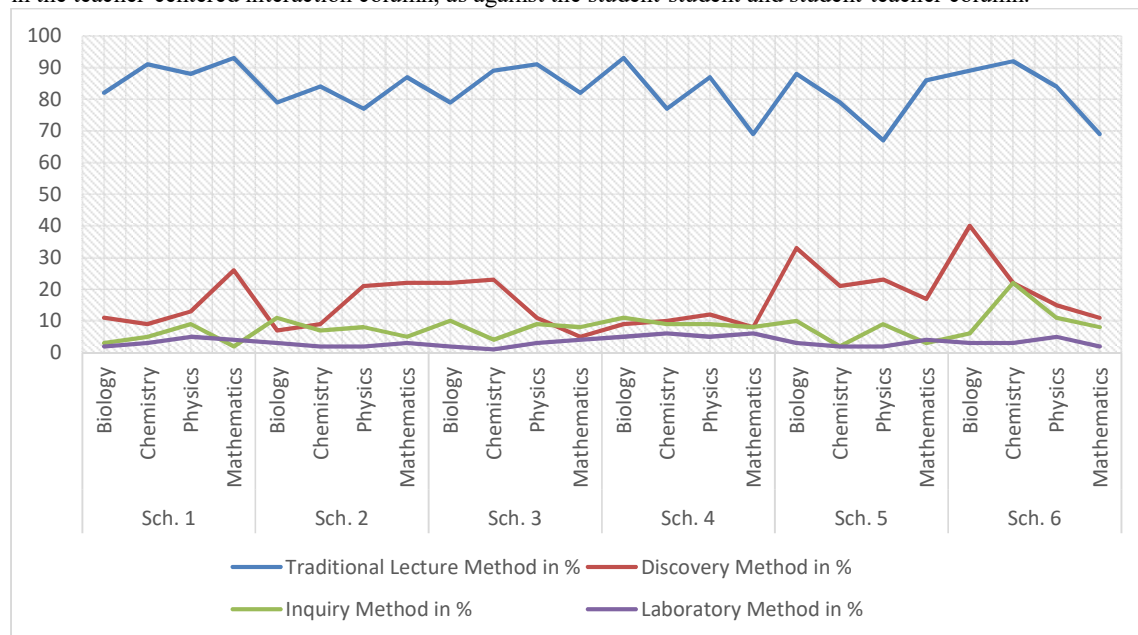


Figure 2: Instructional Technique Employed by Science Teachers in Schools

Figure 2 above gives the analysis of the kind of instructional techniques employed by science teachers in Katsina State secondary schools. It shows that the teachers form all the schools are 70-90% using the traditional lecture method of teaching.

Table 2: Level of Coverage of Science Curriculum

| Schools | Science Subject | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sch. 1 | Biology | √ | | | | | | | | | |
| | Chemistry | | √ | | | | | | | | |
| | Physics | | | √ | | | | | | | |
| | Mathematics | | | | | | | | | | |
| Sch. 2 | Biology | | | | | | √ | | | | |
| | Chemistry | | | | | | √ | | | | |
| | Physics | | | | | | | √ | | | |
| | Mathematics | | | | | | | √ | | | |
| Sch. 3 | Biology | | | √ | | | | | | | |
| | Chemistry | | | | √ | | | | | | |
| | Physics | | | | | √ | | | | | |
| | Mathematics | | | | | √ | | | | | |
| Sch. 4 | Biology | | | √ | | | | | | | |
| | Chemistry | | | | √ | | | | | | |
| | Physics | | | | | √ | | | | | |
| | Mathematics | | | | | √ | | | | | |
| Sch. 5 | Biology | | | √ | | | | | | | |
| | Chemistry | | | √ | | | | | | | |
| | Physics | | | | √ | | | | | | |
| | Mathematics | | | | | √ | | | | | |
| Sch. 6 | Biology | | | | | | √ | | | | |
| | Chemistry | | | | | | √ | | | | |
| | Physics | | | | | | | √ | | | |
| | Mathematics | | | | | √ | | | | | |

Table 2 in the result revealed level of coverage of science curriculum in secondary schools of Katsina State. The result showed that most of the curriculum contents of biology, chemistry, physics and mathematics are hardly covered as analysis indicated that only 10-60% of the contents are covered.

Table 3: Extent of Science Practical Lesson Organized by Science Teachers

| Schools | Science Subject | Never | Twice a Week | Weekly | Monthly | Termly | During WAEC/ NECO |
|---|---|---|---|---|---|---|---|
| Sch. 1 | Biology | | √ | | | | |
| | Chemistry | | √ | | | | |
| | Physics | | | √ | | | |
| | Mathematics | √ | | | | | |
| Sch. 2 | Biology | | | | √ | | |
| | Chemistry | | | | √ | | |
| | Physics | | | | √ | | |
| | Mathematics | √ | | | | | |
| Sch. 3 | Biology | | | | | √ | |
| | Chemistry | | | | | √ | |
| | Physics | | | | | | |
| | Mathematics | √ | | | | | |
| Sch. 4 | Biology | | | | | | √ |
| | Chemistry | | | | | | √ |
| | Physics | | | | | | √ |
| | Mathematics | | | | | | √ |
| Sch. 5 | Biology | | | | | | √ |
| | Chemistry | | | | | | √ |
| | Physics | | | | | | √ |
| | Mathematics | √ | | | | | |
| Sch. 6 | Biology | | | | | | √ |
| | Chemistry | | √ | | | | |
| | Physics | | | | √ | | |
| | Mathematics | | | | √ | | |

Table 3 gave the extent of science practical lessons organized by science teachers in Katsina State. The result here reveled practical are only conducted either monthly, termly, or during external examinations like West African Examination Council WAEC or National Examination Council NECO. This situation is alarming as it will only produce half-baked graduates who are not anything good for the future STME of the country and this negate the effectiveness of global practice on STME.

## 7. Discussion and Conclusion

The result revealed the nature of interactions that takes place in science secondary school classrooms of Katsina State. It shows that teachers dominates the classroom interactions. This is evident in the high percentage recorded under the column teacher-centered interactions which ranges between 60-90% as against teacher-student interactions that had the percentages of 30-70%. This is in sharp contrast with the global standard that encourages teacher-student and student-teacher interactions in a typical science class. This finding is in line with the finding of Matazu 2014 who found out that contrary to standard of science teaching of teacher-student interactions, science teachers often denied students to interact with them. Figure 2 above revealed the kind of instructional techniques employed by science teachers in Katsina State secondary schools. It indicates that most teachers still employ traditional lecture method. Wasagu, (2001) pointed out that science is practical oriented and that requires anyone wanting to excel in science related discipline must take practical aspects of sciences very serious. This assertion is in line with the best global practice in science that encourages practical/ laboratory activities while doing science. Figure 3 in the result revealed level of coverage of science curriculum in secondary schools of Katsina State. Result showed most of the curriculum contents of biology, chemistry, physics and mathematics are hardly covered as analysis indicated that only 10-60% of the contents are covered. This implies that, students may not be able to perform as expected in a country like Nigeria that operates centralized system of education. This trend is not in line with the best global practice in science, technology and mathematics education which emphasized adequate coverage of curriculum content for efficiency in STME. Figure 4 gave the extent of science practical lessons organized by science teachers in Katsina State. As pointed out by Wasagu, (2001) that science is practical oriented discipline thus anyone wanting to excel in science related discipline must take practical aspects of sciences very serious. But the result here reveled practical are only conducted either monthly, termly, or during external examinations like West African Examination Council WAEC or National Examination Council NECO. This situation is alarming as it will only produce half-baked graduates who are not anything good for the future STME of the country and this negate the effectiveness of global practice on STME.  It is therefore, concluded that much is needed to be done in the area of science technology and mathematics in Katsina state in order to meet up with the global standard in STME.

## 8. Recommendations
Based on these findings, the following recommendations are put forward for improvement.
1. Government should ensure adequate training and retraining of science teachers in Katsina State to enable them acquire up to date scientific knowledge. This will boost their moral and enable them have an improved interactions and compete globally.
2. Again training and retraining of science teachers through workshops, seminars, and conferences will acquaint them with latest instructional strategies in line with global standard. So government and Non-Governmental Organizations should look into this aspect
3. Conducive environment must be provided by government for Nigerian STME to meet up with the global development. Well-equipped laboratories, other teaching and learning facilities such as chemicals and reagents, ICT facilities should be made available.

## 9. Implications of the Study
This study revealed a sharp contrast between global development on STME and reality STME in in Katsina State North-west Nigeria. It revealed the application of ineffective teaching methods in science classrooms, uncondusive science teaching and learning environment which negate effectiveness of STME in Nigeria. It is on this ground that this study implies that educational planners and managers should be conscious in planning of education particularly STME which is believe to be the back-borne for national development to make sure that delivery of STME has meet up with the global happenings most especially in a country like Nigeria with a great desire to become scientifically and technologically relevant world-wide

## References
Chen, L. H. (2011). Enhancement of student learning performance using personalized diagnostic and remedial learning system. *Computers & Education*. 56, 289–299.
Christensen, R. et al. (2014). Students Perception of Science, Technology Engineering and Mathematics (STEM) content and career. *Journal of Computers in Human Behavior*. 173-186.
Effiong V. et al. (2013) Repositioning Tertiary Education for National socio Economic Transformation focus on South- South zone of Nigeria. *Niger-Delta Journal of education*. 1, 196-206.
Federal Republic of Nigeria (2004). *National Policy on Education* (4th ed.) Lagos: NERDC Press
Gonzales, H., & Kuenzi, J. (2012). Science, technology, engineering, and mathematics (STEM) education: A primer (Report R42642). Retrieved from the Congressional Research Service Reports website: http://www.phibetaiota.net/2013/07/congression-research-service-catalog/
Iloeje, M. U. (2002). The Challenges, Innovations in Technology Pose to Libraries and Librarians. *39th National Conference and AGM of NLA. NLA Publication 13*.
John, M. et al. (2016). A formative evaluation of southeast high school integrative science technology engineering and mathematics (STEM) academy. *Journal of technology in society*. 45(1). 34-39.
Krejcie, R. & Morgan, D. W. (1970). "Determining Sample Size for Research Activities. *Educational and Psychological Measurements 30*.
Matazu, S.S. (2014). Relationship between Self- Concept, School Location and Academic Performance among Science Secondary School Students in Katsina State, Nigeria. *Unpublished Ph.D Thesis*. Usmanu Danfodiyo University, Sokoto, Nigeria.
Nadelson, L. S. et al. (2012). I-STEM summer institute: An integrated approach to teacher professional development in STEM. *Journal of STEM Education: Innovations & Research*. 13(2), 69-83.
Ngozi, I. H. (2014). Evaluation of the implementation of national curriculum for secondary school Biology in Anambar State. *PhD Thesis*, University of Nsukka, Enugu State, Nigeria.
Patrick, A. O. (2009). Evaluation of Science Teaching in Secondary Schools in Delta State to Teaching of the Sciences. *International Journal of Education Science*. 1(2): 119-129
Shaikh, K. (2000). UNESCO International Science, Technology and Environmental Education: Newsletter, xxv, 3-4
Seters, J. R. et al. (2012). The influence of student characteristics on the use of adaptive e-learning material. *Computers & Education.* 58, 942-952.
Srisawasdi, N., Srikasee, S., & Panjaburee, P. (2012). Development of a Constructivist Web-based Learning System with Student Personalized Conceptual Profile. Proceedings of the 20th International Conference on Computers in Education. Singapore: Asia-Pacific Society for Computers in Education. 44-50
Ughamadu K.A (2005). Curriculum: *Concept, Development and Implementation.* Onisha: Emba Printing and Publishing Company Ltd.
Wasagu, M.A. (2001). The Place of Formal Education in Special Reference to Popularizing Science with Teacher Education. *Journal of Science Teachers Association of Nigeria.* 40 (1) 6-14.