

STEM Teaching for National Unity, Security, and Development in Nigeria

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Abstract

This Paper is a short discourse on STEM teaching for national unity, adequate security, and national development. It delineates the procedure for developing a good society following the cyclical and continuous process of integrating STEM into the instructional process. It highlights the societal needs of the nation in an era-related pattern as a guide to providing an appropriate education for the citizens. STEM and twenty-first-century education; digital education and entrepreneurial education were discussed. The paper attempts to provide the required inputs of STEM in national development. The issues raised in this presentation are considered the basics for successful STEM teaching for the development of Nigeria if the government has the political willpower to deal with presentation bottlenecks.

Keywords: STEM teaching, National security, National development, Tool

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1. Introduction

The essence of education globally is to assist individuals to maximize their potential for optimum self-development and the development of society. Therefore, education is a prerequisite for an individual to attain self-reliance and the greatest instrument for any meaningful and sustainable national development. The role of education in the 21st century is not just only inculcating knowledge in students but also the skills they need to survive and bring about changes in society. It involves science and technology-driven education designed to prepare and equip humans for an acceptable, profitable, and worthwhile life that brings national unity, adequate security, and national development. Within the context of Education, there has been a call for the integration of Science, Technology, Engineering, and Mathematics (STEM) for global development. STEM is a problem solver, logical thinker, technologically literate, and able to relate culture to learning which aids national development. Over the years, STEM education has been given attention in the National policy on education but its teaching and recruitment of manpower for it have not been fully in practice which is the focus of this presentation. This presentation focuses on STEM teaching for national unity, security, and development.

1.1 STEM and Twenty-First Century Education

Education plays a critical role in developing essential market skills, especially in this 21st century. Education prepares the individual to add value to society in skill or trade. This kind of education involves modern instructions that involve science, technology, engineering, and mathematics (STEM) and it embraces skills in various fields of study. STEM as an integrated approach to teaching science, technology, engineering, and mathematics promotes the learning of 21st-century skills and provides developing countries with the tools they need to improve people's lives and bring unity into society. 21st-century skills are generally referred to as all the skills and competencies that the school administrators and its advocate believe Schools need to teach their students to help them thrive and succeed in today's world.

STEM tends to achieve the provision of trained manpower in the applied sciences, technology, and business and give training and impart the necessary skills to individuals for economic self-reliance. Therefore, STEM teaching could only become the foundation stone of a society like Nigeria, only if it succeeds in imparting necessary life skills to individuals as it becomes necessary to adequately equip students with STEM teaching to meet the needs of the ever-increasing Nigerian youth population who require adequate skills for gainful employment. STEM teaching goes beyond the preparation of learners for jobs and economic attainment, it is also meant to equip the next generation with knowledgeable, critical, and ethical skillsets and mindsets (Chesky and Wolfmeyer, 2015). STEM teaching in the 21st century provides a unique platform for teachers to engage their students in meaningful, issue-based experiences where a student needs to solve a particular problem. STEM teaching plays a crucial role in achieving the Sustainable Development Goals, improving the lives of people in every nation, and ensuring inclusive and equitable education for all as it is enhanced and developed in every nation.

2. STEM Teaching, Digital Education and National Development

The 21st-century is the contemporary century of the Anno Domini era or Common Era, following the Gregorian Calendar. It began in January 1, 2001, and will end on December 31, 2100. It is the first century of the 3rd Millennium which is also synonymous with the Digital Information and Technology generation. Technological advancements in all spheres of life today cannot be overemphasized as a veritable tool for the growth and development of every nation. The importance of Science, Technology, Engineering, and Mathematics (STEM) in any society that would remain within the center of the fourth industrial revolution is very crucial. Africa stands at the margin of the global digital technology revolution (also referred to as the fourth industrial revolution) due to many factors such as STEM skills shortage among professionals as well as low student attainment in STEM subjects, (African Union, 2014; Tikly *et al.*, 2018).

STEM teaching has influenced most nations like the United State of America, China, Singapore, Korea etc in digital technology as it aids the growth and development of the nation. This is due to the application and integration of technology. Industrialists and other employers of graduates are concerned about the quality of graduates churned out from Nigeria universities in Science and Technology related disciplines due to the slow rate in the adoption of STEM in our Education system

Digital education is characterized by advanced digital computing technologies that permit the free flow of knowledge and information. It is a new internet technology that is supporting web platforms and plays a significant role in education. The components of digital education have been identified as supporting infrastructure (i.e. hardware, software, telecommunications, networks, etc.) E-learning, and E-assessment. Every digital education is powered by skills embedded in STEM developmental culture.

STEM teaching fosters the 21st-Century skills which are the competencies that learners need to contribute their quota to the national development. According to UNESCO, (2016), the skills are sub-divided into three. (Note 1)

The skills have been categorized so as to help in STEM teaching to aid national development. The required learning skills can be developed via literacy skills and lead to life skills that can help in promoting the unity, development, and security of a nation. Cognitive intelligence (learning skills) emphasizes reasoning analysis and communication competencies. They also bring about a mixture of intra-personal and intra-personal competencies and are in the domain of emotional mastery and control that enable learners to function as team players.

2.1 The Twenty-first Century Skills

The employers' ranking of skills required for employment is presented in Note2.

Digital technologies can be used to acquire the set skills. Digital technologies are acknowledged as powerful tools in the development of education that is meaningful in the 21st century (Peeraer & Van Petegem, 2011). The digital technologies that can aid digital education for national development are characterized as Technologies for teaching, Technologies for learning, and Technologies for assessment.

2.1.3 STEM Teaching and National Security

National security includes the security from terrorism, drug abuse, drug trafficking kidnapping for ransom, herdsman menace, attack on oil infrastructure economic security, energy security, environmental security, food security, and cyber-security. Mostly all of these are as a result of a lack of complete and quality education, unengaged youth, unemployment/underemployment, poverty, and lack of good National policy to mention just but a few. Studies have shown that there is a correlation between age and crime and crimes are most prevalent during mid to late adolescence which signifies the youthful age. The most committed crime has to do with drug abuse followed by theft and murder (National Baseline Youth Survey, 2012). Only recently the National Drug Law Enforcement Agency (NDLEA) released a heart rendering and alarming reports of its activities in recent times. It might interest us in this gathering to note that Drug abuse has so become pervasive to that extent that about 70,000 youths were arrested with hard drugs ranging from Meth to Tramadol, Squeezes, Indian hemp, and many more. This has a serious implication for any society that is desirous of a good peaceful coexistence of its citizen and the need for urgent attention. With a good STEM education policy, out-of-school youth will be minimised, students will be engaged with all the 21st-century skills thereby making them to be innovative and entrepreneurship driven. For example, the United State of America laid emphasis on science education after Russia launched Satellite Sputnik in 1957 after World War II. The then American President saw the need for Scientists and Engineers. And this led to the STEM acronym being evolved in 2001 by the Scientific Administrators at the National Science Foundation (NSF). Since then, there are a lot of initiatives in the USA to have a sound STEM education like the 'Educate to innovate', 'the Change the Equation', 'the 100k in 10. etc.

2.1.4 Classroom Practices for Successful STEM Teaching

The main actor in the effective STEM teaching in any country is the Teacher whose only business is effective and productive teaching and learning process. To do this successfully, He/She needs the following classroom practice:

Believe in your students. For your sake and the sake of your students, set high expectations for your students, challenge them to succeed, and believe that they will. Most students will perform at the level you expect, so trust

them to make informed choices about their engineering challenges, come up with creative solutions, complete complex tasks, and work together smoothly to do so.

Transfer control of the learning process to the students. Develop new roles and rules that stress student responsibility.

Foster curiosity. Learn the art of asking open-ended questions with plenty of possible answers. Pose problems rather than answers and send students on a search for solutions. Use discrepant events to intrigue students and draw them into the problem.

Provide hands-on, experiential learning. Don't be the old-fashioned sage on the stage if you want to stimulate 21st-century learning. Learning through reflection and doing is compelling. When your students have their imagination piqued, give them opportunities to investigate multiple possible solutions to a problem or solve a mystery. Provide materials that teams of students can explore and manipulate.

Increase collaboration among students. Get comfortable with teamwork. Actively teach teamwork skills and work with students to heighten awareness of their team behaviors and ways of interacting in the class.

Be a Reflective practitioner. Make a conscious effort to think about your lesson both during and after the class to examine the way your teaching went through to see if there is a need for modification and adjustment. As you do this, encourage your students to do so too.

Accept failure – both yours and the students – as a necessary part of learning and growing. That is, accept the failure that accompanies taking a risk and experimenting, knowing that they might not get it right. Everyone in the classroom should feel safe in taking risks.

Be an inspiring leader and role model for your students. Be positive and enthusiastic about what students are learning and how they are learning it. Be passionate in your teaching and your love of your subject area.

Accept some drawbacks. STEM education will improve student engagement, critical thinking skills, and workforce skills. But it may also play havoc with the lesson plan you wrote and make it more difficult to cover content benchmarks in a stepwise process. In the STEM classroom, you'll need to be flexible and ready to make some quick shifts in your thinking. You may also need to be willing to deviate from your lesson plan, depending on the direction the students' investigations and decisions take them.

Evolve and grow as a learner. One of the most important things you can do, as a STEM teacher, is to pay attention to the art of teaching. Develop your skills in facilitating (as opposed to dictating) so that students focus on learning how to think like Engineers, Scientists, and Mathematicians. Embrace digital tools and technology in the classroom with help from your students.

Learn in the community. Work with your colleagues to study effective ways of teaching STEM lessons. Interact well and freely with your colleagues both senior and junior as nobody is an island of knowledge. Exchange ideas and knowledge with them.

2.2 STEM Teaching Methods/Strategies

While educators employ many strategies to teach STEM, there are methods/ strategies that are used in disseminating the required knowledge and skills. Some of the methods are discussed as follows

Project-based learning

Project-based learning is considered one of the most effective instructional methods for STEM teaching. Through project-based learning, students engage in meaningful, long-term projects to develop and demonstrate essential skills. Not only does project-based learning require students to apply skills, but it also provides teachers with opportunities to directly assess student progress in established standards.

Integrating STEM education through project-based activities has the potential of increasing the quality of learning and enhancing motivation. Freeman, Alston, and Winborne (2008) investigated undergraduate students' attitudes, motivation, and learning in STEM because of participating in linked (or integrated) courses at two historically Black colleges and universities in 2006 and 2007.

Problem Based Learning

Problem-Based Learning is a student-centered approach in which students learn about a subject by working in groups to solve an open-ended problem. It has the ability to teach students the importance of opportunities and possibilities. In STEM education. Students could work independently or in a group to conceptualize, design, and launch their innovative products in front of classmates and community leaders.

Gamification

The technological age of games has created a culture of students accustomed to continuous external stimuli and active engagement within the environment. This technological era capture students' interest in STEM. Gamification creates adequate preparation for students for STEM careers. Experiential learning, hands-on activities, integrating STEM teaching, and creating learning communities are possible ways to spark students' interest in STEM and STEM careers.

The linked courses helped them better understand the course material.

Collaborative Learning

Exploring STEM career options through collaborative learning also has the potential to spark students' interest in STEM teaching. Students will meet to work as a team to complete a task. This can be in the form of Reciprocal Teaching, Peer Tutoring, or Cooperative teaching

3. Trends in Implementing Good STEM Education

Nations are continuing their efforts to advance STEM teaching. Although many simultaneous actions are needed to grow participation and outcomes in STEM teaching. There are six key steps that stakeholders in education should be taken to achieve STEM teaching (Thomasian, 2011). The six steps are:

- Adopt rigorous math and science standards and improved assessments;
- Place and retain more qualified teachers in the classroom;
- Provide more rigorous preparation for STEM students;
- Use informal learning to expand math and science beyond the classroom;
- Enhance the quality and supply of STEM teachers; and
- Establish goals for postsecondary institutions to meet STEM job needs.

To realize the goals of a STEM agenda, states will need to adopt improved math and science standards and the assessments that test student knowledge and problem-solving ability. Such standards should define the knowledge and skills students should have along with their educational progression.

3.1 Tools for STEM Teaching to Foster National Unity, Security, and Development

For STEM teaching to bring about national unity in a developing country, there are tools that can enhance the teaching. The tools are listed according to Coder-Z online learning environment as follows:

Campus Ties: Campus Ties offers micro-courses and built-in tests devised by trusted professionals. Micro-certificates are also given to learners who have completed a course.

CLEAN: This website offers a collection of more than 600 free resources created and verified by esteemed scientists and teachers.

Energy.gov: Featured on this US government-based website are free energy literacy videos that educators can pull out and show their students. For more videos, you can also check out their [Youtube channel](#).

Exxon Mobil: Exxon Mobil offers a variety of programs and information particularly related to maths and sciences, as well as real-world applications. It also includes useful tools for STEM teachers.

MIT Blossoms: MIT Blossoms offers math and science videos for high school learners.

NASA Digital Learning Network: They aren't only discovering new planets and galaxies. NASA's free-for-all digital learning network offers premium lessons about space technology and other STEM-related careers. They feature only the most capable experts and guest speakers for their lessons.

National Science Board: The National Science Board is a government-backed website that offers standardized action plans and regularly updated STEM educational opportunities.

National Science Digital Library: The National Science Digital Library is an extensive collection of educational materials for educators and learners of all levels, including STEM. These materials are curated by teaching experts that serve as digital librarians.

PhET: This free interactive website is filled with fun and enjoyable simulations that pertain to the four core subjects of STEM education. It has delivered over 360 million simulations since it started in the year 2002.

Planetarium: This website lets you explore the heavenly bodies in your browser. You can also add this as an extension for Google Chrome users.

Save on Energy: Save on Energy is a fun and free way to make your students learn about the science of electricity. It features animated infographics that demonstrate the principles and movements of electricity.

Science Fair Projects: This website is a treasure chest of ideas for science experiments and projects.

Space School: Space School is a Canadian educational initiative that aims to provide premium online training for students in the following key areas—STEM, Coding, Space Technology, Robotics, and Problem Solving.

Teacher Challenge: This website contains a list of more than 20 STEM educational tools that teachers may find helpful and interesting.

Tinkercad: A website that offers free 3D models for printing and teaching.

3.2 Benefits of STEM Teaching towards National Unity, Security and Development

1. Encourages Experimentation

Nearly all technological advancements were realized through risk-taking and experimentation. People thought that some of these ideas would never work, but through risk-taking and experimentation, the same ideas became the best like sliced bread. This kind of attitude is possible with the incorporation of STEM education, which encourages students to try something out and see the outcomes.

2. Encourages Teamwork

Teamwork is power, and two good heads are better than one. STEM education enables students of different abilities to work together; through discussions and experiments to find solutions to real-life problems.

3. Encourages Knowledge Application

The traditional system of learning focuses on learning through textbooks and continuous assessments. On the contrary, the STEM education system equips students with the ability to apply what they learn in real-life. Besides, the ability to apply what is learned in class may bode well for students when they finally get employed.

4. Encourages Tech Use

Technology is one of the major drivers of nation economy. For example, in the Singapore economy, Prime Minister, Lee Hsien said that the country welcomed the idea of a STEM system of learning very early and that accounted for accelerated growth in their economy. STEM system of learning educates students about the power of innovation and technology. That said, students who pass through the STEM system of learning can embrace the new innovations instead of being uncertain about them.

4. Conclusion and Recommendations

This paper has streamlined STEM teaching for national unity, security, and development of Nigeria as it cannot be underestimated when it comes to a national issue. For knowledge-based development, Nigeria needs well-educated STEM teachers who can raise a generation of students with the capacity to innovate. There must be an investment in the professional development of In-service teachers as well as reorganisation of the Teacher Education program at all tertiary institutions (public and private). There should be a highly structured, flexible, and practicable curriculum that allows teachers to teach STEM subjects effectively. There should also be an increase in the number and quality of STEM teachers to help students develop 21st-century skills. STEM places emphasis on learning outcomes using digital technology in the 21st century to achieve 21st-century skills for lifelong learning. STEM teaching via the use of digital technology is now a necessity for the development of every nation and to tackle insecurity in the country. Digital technology such as Artificial intelligence, virtual reality (VR), and augmented reality (AR) Adequate digital technology tools should be made available for STEM teaching in schools. The above listed are not only lacking in our schools and society, there is no any attention to bring them to the fore. The state of our primary Schools is deplorably nauseating to the extent that one can conveniently and convincingly say that nothing, absolutely nothing good can come out of them when it comes to realizing the goals of STEM education. In this modern day of 21st century, pupils in Nigeria still learn under trees because of dilapidated structures or lack of classrooms. Attendant to this is lack of or absence of desks and tables in most all our schools.

This inclement environment has seriously eroded the grains of learning in whatever forms from the foundation of our education sector. And when the foundation is weak or dysfunctional, the superstructure cannot stand. Over the years, an assemblage of this nature has not been interrogating vigorously the state of our education and why we are still where we are. It is a known fact that our Science as a subject still remains at the level and stage of pipette and burette in Chemistry, spirogyra, and amoeba in Biology, prism and pendulum in Physics, and Pythagoras theorem in Mathematics, when the world has since moved beyond that to the extent that the pupils in elementary schools in such nations as Japan, China North, and South Korea are already assembling phones that have become the objects of affluence here when their counterparts of the same age here have no bearing on what to do for themselves and with their lives.

The pervading insecurity situation in the Country is depressing as well as alarming, this can and will not give any conducive room for a thought process that will enable the STEM program to thrive in our society in those climes where STEM education has impacted the society both the teacher and the students are well secured and protected from the disruptive tendencies in the society. But can we say that in this country? I live you to your belief.

Government (both federal and state), NGOs, and international organizations should rise to support STEM teachers around training and retraining programs in teaching methods/strategies that will instill STEM teaching to foster national unity, security, and development. Teachers also needs to be well motivated.

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Notes

Note 1.

Table 1: Twenty-first-century skills

Learning Skills (4Cs)	Literacy Skills (IMT)	Life Skills (FLIPS)
Critical thinking	Information literacy	Flexibility
Creative thinking	Media literacy	Leadership
Collaborating	Technology literacy	Initiative
Communicating		Productivity Social skills

Note 2.

Table 2: Employers' ranking of skills required for employment

Skills	Mean	Rank
Communication (verbal & written)	4.69	1
Honesty/Integrity	4.59	2
Teamwork skills	4.54	3
Interpersonal skills	4.50	4
Strong work ethics	4.46	5
Motivation and initiative	4.42	6
Flexibility/adaptability	4.41	7
Analytical skills	4.36	8
Computer skills	4.21	9
Organisational skills	4.05	10
Detail-oriented	4.00	11
Leadership skills	3.97	12
Self-confidence	3.95	13
Friendly/outgoing personality	3.85	14
Well-mannered / polite	3.82	15
Tactfulness	3.75	16
GPA (3.0 or better)	3.68	17
Creativity	3.59	18
Sense of humor	3.25	19
Entrepreneurial skills/risk-taker	3.23	20

Source: Job-interview-site.com (Employability Skills Checklist) <http://www.jobinterviewsite.com>

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