International Journal of Education, Learning and Development, 14 (3),1-8, 2026
Print ISSN: 2054-6297(Print)
Online ISSN: 2054-6300 (Online)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development-UK

Building and Sustaining the Skills for Teaching and Learning of Basic Scence and Technology at The Basic Education Level: A Tool for Scientific Reforms and Advancement

Sunmaila Oyetunji Raimi
Department of Integrated Science, Faculty of Science Education, Emmanuel Alayande University of Education, Oyo.

Malik Oyewale Raimi
Department of Integrated Science, Faculty of Science Education, Emmanuel Alayande University of Education, Oyo.

doi: https://doi.org/10.37745/ijeld.2013/vol14n318 Published May 17, 2026

Citation: Raimi S.O., and Raimi M.O. (2026) Building and Sustaining the Skills for Teaching and Learning of Basic Scence and Technology at The Basic Education Level: A Tool for Scientific Reforms and Advancement, *International Journal of Education, Learning and Development*, 14 (3),1-8

Abstract: *This paper examined the role of building and sustaining the skills for teaching and learning of integrated Science at the Basic Education level. It keenly examined the skills required for effective teaching of Basic Science and Technology at the Upper Basic Education level and highlighted the requirements for integrating 21st Century Science Skills to teaching and learning of the contents and concepts in integrated Science as well as approaches needed for better learning outcomes. It looked into the major steps and criteria to sustain the skills for effective teaching and learning of Basic Science and Technology The paper posited that the use of practical applications, Hands-On inquiry techniques, blending theoretical understanding with active based learning to replace rote learning for effectiveness can positively transform science teaching and learning. Besides, it identified the import of the use of field trip / excursion and the use of models and prototypes, for learners to visualize the complex processes in a simplified way for life-long learning that can aid entrepreneurial knowledge needed at this era of technology. It recommended that building, developing and sustaining the skills for teaching and learning of Basic Science and Technology is capable of removing the barrier in understanding complex topics in science by using technology tools for regular practices for improvement and advancement in science.*
Keywords: building and sustaining science skills, teaching and learning, basic science and technology, basic education level, scientific reform / advancement.

INTRODUCTION

Teaching and Learning are two interrelated concepts and processes. The duo occurs in stages with the intention and purpose of creating an impact on the parties involved after a desired interaction. Teaching deals with knowledge, skills and attitude modification through interaction, engagement on activity(ies) and mentoring /facilitating where the professional or specialists' guides, helps or leads in the provision of

positive knowledge and skills for effective functioning. The Educator /the teacher, the facilitator or the mentor who is believed or expected to be more knowledgeable or skillful in the specific field of endeavor performs these functions professionally. Teaching and learning is a process because it occur in stages. Sambo and Utin (2015) stated that Effective teaching and learning of basic science and technology requires the teacher to possess academic proficiency, pedagogical knowledge and ability to work with the day to day technology used at the modern schools. These process require skills which can be measured and can easily impact the teachers' productivity and effectiveness in the discharge of teaching–learning activities. Besides, effective teaching require teachers to possess certain qualities, such as empathy for students, adequate knowledge of subject matter, preparedness, openness to change, provision of feedback to students and creativity on the part of the teacher. It is expected of the teacher to plan their lessons effectively with aiding materials, such as videos, class activities and assessment tools created by expert teachers in their fields or disciplines. Science being a field of study that uses observation, through watching, listening, feeling, recording, and experimenting to discover what is in the universe and explain the natural phenomena in the world through meaningful exploration of environment. For meaningful predictive activities, the experiments for empirical evidence must show clearly the methods, process of data collection and testing as well as activity so designed that must be capable of making the teaching and learning effective. This is directly dictated or influenced by following the guidelines or rules set in specific theory of learning of science contents. This will enable the recipients of the training accomplish the desired skills and knowledge of the present day science and technology. Hence, building the skills of Basic Science and Technology teachers is a requirement for Science reforms and advancement.

Abdullahi (1982) examined some of the applications of the psychological theories to teaching and learning of science. He emphasize meaningful exploration to acquire a life-long knowledge to withstand the test of time. Amongst the theories that suitably fits in here include- David P. Ausubel (1960) in Abdullahi (1982) who distinguished between rote learning and meaningful learning posited that clear understanding can be attained through hands-on activities that engages learners better in exploring the knowledge by themselves. This makes the learners owners of their discovered knowledge and skills as dictated by constructivist learning theory. He buttressed it further that teachers should ensure that the new concept to teach the students must be related to the previous lesson for proper interaction between the student's appropriate elements in the knowledge that already exists and the new one to be learned, that is, there must be a link of a new content with the previous one, either already existing or newly created. Jerone S. Bruner's (1960) in his work, the theory of learning, keenly examined the role of skills in science teaching as one that utilizes the mental processes (that is acquisition of knowledge through discovery learning) by associating the new knowledge and its elements to the existing one, when related or restructuring the existing one where differences are discovered to accommodate the new knowledge. This view supports the import of links creation between the concepts and contents being delivered to the learners. Robert Gagne's (1965) theory of learning explains the tasks analysis of learning hierarchy of intellectual operations, done in a way that can lead to positive transfer of learning in various activities or skills lower in the hierarchical ladder to those higher tasks in the concepts or topics being taught to

learners. These activities buttressed the need for the rearrangement of the content of instruction sequentially in a way to aid easy understanding of the concepts by the students.

Above all, teaching of basic science and technology requires special skills that will empower the teachers of the discipline to make sure that certain ingredients are added to the professional efforts in the field to make the teaching and learning of science effective, such include- incorporation of local materials from our immediate environment into the teaching and learning activities, give enough practice to the trainees in the identification of and the use of local resources or materials, use improvised items made from local materials and encourage all trainees on the needs to adequately engage the stakeholders in the construction and use of improvised materials during science and technology lessons. Teaching of these contents and concepts must address the student's needs and requires professionalized skills for success to be attained at these technological age.

Requirements for Teaching Basic Science and Technology in the 21st Century

There are many ways, techniques, approaches and strategies for teaching and learning of concepts in science but the effective way advocated for 21st century education is active learning which connects the learner with the real-word as well as the integration of technology to teaching and learning of science. Makinde (2020a) said that effective and quality education can only be achieved through adequate teaching and learning. He buttressed it further that using innovative technology in imparting and acquiring knowledge in educational environment can help the teachers to give the expected outcome. Akinsola (2014) also submitted that if information and communication technology (ICT) is fully adopted into teaching and learning in Nigeria schools, it would have a positive influence on teaching, learning and research. The belief is that it will lead to acceleration of knowledge acquisition, and enrich the knowledge by deepening the acquisition of skills for effective teaching and learning of contents. As a follow-up to the above submissions and to be a successful science teacher in the 21st century, the skills and strategies to be employed for effective teaching of science rest heavily on the following; Inquiry- based learning, project-based learning, Collaborative -based learning which are all designed to foster critical thinking, problem-solving, effective communication/scientific literacy and creativity which are major skills for the 21st century science teaching. The strategies germane to effective and successful teaching of basic science and technology in 21st century include but not limited to- use of active and inquiry based strategies, Technology integration, Development of 21st century skills and Effective teaching practices.

The use of active learning and inquiry based strategies emphasized that the students should be empowered and encouraged to explore the situation, raise questions on it, investigate the issue and construct their own understanding of scientific concepts from the exploration. This process enables the learners develop their knowledge positively and comprehensively and at the same time empowers the learners to learn at their own rate. The hands-on activities and experiments provides students direct engagement with scientific phenomena that makes the abstract concepts more concrete and memorable and pave way to life-long learning experience. Another active based learning considered effective for teaching science is project based learning. Its potency lies heavily on its ability that enhances hand-on tasks, where students work on

practical exercises or investigation to acquire the permanent knowledge. Here, students' works on real-world problems through extended investigations, collaborations and communication skills. This involves linking lessons to everyday life activities and students experience by providing real objects for proper engagement with the real-world objects and making meaningful connections. Collaborative learning in which students work together to solve problems, to share ideas and learn from each other and one another during discussion and interaction is promoted. Adoption of flipped classroom is another active learning strategy that is student-centred. It enables the students to learn foundational concepts and contents outside the classes through the use of videos, readings and using the class time for interactive activities, discussions on their experiences and discoveries for problem solving which makes the recipient become the real owner of his/her acquired skills and knowledge. The interactive nature of the approach is a good means of keeping the record of content knowledge with ease. Another approach of skill building in teaching and learning of basic science and technology is by integrating technology through demonstration of abstract scientific concepts for real life experiences and providing access to simulations and virtual laboratories. The interactive tools provided in the educational apps and software can enhance effective and meaningful learning through personalized feedback by self-assessment. This give the student opportunity to learn different methods of interpreting data from various sources, both from real life activities and experiments as well as online data bases.

Development of 21st century skills is another method of building a life-long skills for effective teaching of science in this technological age for real advancement. These skills include – critical thinking, creativity and innovation, communication and team work or collaboration. In critical thinking, students are empowered and encouraged with the skills to identify problems by exploring, suggesting and developing solutions and at the same time evaluate the potency of the effectiveness of steps taking,(Raimi, 2023) . This enables the students to learn how to articulate their ideas both in writing and speech hence developing their skills of communication. The process of skill building make the students creative and innovative as well as preparing students to think outside the box, explore and discover new ideas and develop their own solutions to any observed challenges or scientific enterprise. Building of team spirit and collaborative thinking into the lesson delivery prepares students to work effectively with others to achieve common goals for the benefits of all and attainment of reformed education.

Adoption of effective teaching practices for Basic Science and Technology aids students' ownership of skills and knowledge. Incorporation of differentiation, formative evaluation and creation of supportive learning environment fosters conducive learning /classroom culture where students feels very comfortable to take risks during learning, asking questions for sake of clarity of thoughts that will allow them effectively, adequately and professionally correct their mistakes. This is possible in a tension free or non-threat prone environment. Formative evaluation will assist the teacher to adjust his/her teaching strategies while considering the feedback received from students' achievement as the activity progresses. Necessary adjustment is made based on the performance of the curriculum been implemented. Differentiated learning assist teachers to adjust his/ her instruction package to meet the needs of the diverse groups of students,

he is to take note of students interest, students learning styles and their ability as a welcome guide to sustain students' interest in the teaching and learning activities.

The success of students in Basic Science and Technology in the 21st century depends mostly on the ability of the teacher / educators to effectively incorporate these strategies into the lesson, this will allow for proper engagement and provision of effective learning experiences that can make students' succeed in the 21st century and beyond. The 21st century teacher need to integrate technology into teaching practices, such as differentiation, formative evaluation and creation of conducive environment. Integration of 21st century skills of creativity and innovation, critical thinking, communication both orally and writing and collaboration / teamwork is a necessity as a tree can never make a bush. Adoption of innovative teaching strategies such as project based learning and flipped classrooms which are hands-on activities is capable of fostering the growth of mindset and life-long learning of concepts and can reveal the professionalism of the teacher.

The method required for successful classroom teaching in the 21st century depends on the nature of the contents to be taught, environment to do the teaching and availability of resources as well as age and ability of the learners. This dictates how to go about it to a large extent for the effectiveness of teaching of the concepts in science and technology contents. It demands the teachers of the discipline to be dynamic in their choice of methods during teaching and learning process. The methods of interest include : Active learning strategy, Blended learning technique, Cooperative learning strategy, Differentiated instruction technique, Social emotional approach, Gamification, Use of simulation and host of others that are considered suitable for the contents to be presented to the students. Integrating and incorporating these approaches and strategies to Problem-based learning (PBL) will basically bring out the best skills and competences required for 21st century science knowledge. It will raise the competences in innovation and creativity, critical thinking, effective collaboration and communication and Character building which are tagged and described as the basic tool called 5C's of 21st- century teacher. All will assist the teacher to improve the teaching of science by

- building on the ideas that the pupils bring to the class/lessons, that is, by considering the knowledge already acquired by the learner (entry behavior or previous knowledge
- helps students direct their own learning
- guides students in the construction of knowledge and skills
- support students to retain the acquired knowledge
- Use practical work as part of the learning sequence
- develop scientific vocabulary
- use structured feedback to acquaint both the learner and the teacher during remediation.

Integrating all the above in the 5E's model by focusing on allowing students to understand a concept overtime through series of established steps, such as providing students avenue to interact with the natural situation (by proper engagement), providing the learners desired opportunity to explore their environment (exploration), give the students time to come up with their views with clear opportunity to exsplain,

elaborate and evaluate through clear analysis of the situation on any phenomena. This approach will expose the learners to better ways of acquiring and applying the knowledge and skills so attained to different fields of human activities.

Fundamental skills for Teaching Basic Science and Technology

The fundamental skills for science teaching at the Basic Education level must be explicit and specific in order to pave way for clear understanding of the concepts and contents. It require the teacher of the subject to have specialized skills, such as communication both in writing and speech, patience and adaptability which is considered very essential to make teaching and learning of contents effective, other skills that can make the teaching functional include imagination, teamwork, questioning, risk taking , leadership, sense of humour, interpersonal relationships, permissive attitude, authoritarian attitude, behavior modification approach, social system approach etc. This recognize the elements of individual differences and environmental factors or influence

Basic science recognizes the potency of observation as a basic tool for science teaching. Meaningful science activities begins with observation which engages the use of our five sense organs that enable us to learn about the world around us and our immediate environment. The ability of both the teacher and the students to make good observation is very essential to the development of the other science process skills which include classifying, quantifying, communicating, measuring, concluding, inferring, predicting as a good means of arriving at reasonable decision on any issue or task being considered. These skills are basic rudiments to any successful scientific enterprise or activities. Acquisition and possession of these skills by science teachers is a basic ingredient that determines the success of science enterprise. The Scientists start proffering solution to problems from a well-defined task through very clear objectives with high expectations from the students based on the target set for the task at hand. He works on the way to make the content challenging, set the modalities for its delivery, how best to explain it step by step for easy understanding of the work. These must be accompanied by modelling of works excellently done in other related fields through effective collaboration. Students should be given desired opportunity to produce meaningful and authentic work under the guidance, practice and desired supervision that will help them clarify and consolidate their explorative knowledge. Makinde, Ahmed and Olanrewaju (2022) stated that most of the teaching done in most schools emphasize content and revolve around textbooks through lecture methods and presentations with tutorials and learning activities designed to consolidate the content as teaching supplement. This was observed to have leaving some salient knowledge un-catered for which the adoption of process skills will address. The gap that the lecture method and textbooks might have created on self–reliance education process that nations of the world are aspiring to effectively attain would perfectly be addressed.

Sustaining the Skills for Teaching and Learning of Basic Science and Technology

Teaching and Learning of Basic Science and Technology at the upper basic education level in Nigeria and any nation require a desired commitment from all stakeholders in education ranging from the government,

religious bodies, voluntary organizations, international agencies, teachers, community members and the learners. On the part of the government, planning, designing, implementing the curriculum document must attend to the needs and aspirations of the society and the students through provision of adequate resources in terms of both human and materials. The agencies and the teachers are to work on suitable methods for effective teaching of the subject for efficiency. Teachers should be innovative and positively adhere to guidelines set for the success of the package. The requirements for effective teaching and learning of Basic Science and Technology to triumph include: provision of adequate laboratory, training of teachers, availability of well-equipped laboratories, provision of instructional materials, allocation and release of sufficient fund to science programme, incorporation of real-world examples through the use of Culturo-Techno-Contextual Approach (CTCA) to teaching of concepts (Dung, 2024). This requires positively attending to teacher quality, provision of adequate resources and the use of innovative strategies that can aid creativity and innovation, Collaboration and Communication that ensure access to integration of technology to concepts learning.

The inevitable steps to attain the above include the use of specialized strategies to teach Basic Science and Technology, motivating the teachers to get the best from them for proper functioning and dedication, sponsor the teachers for additional knowledge on newly proposed or discovered skills and strategies, making the environment very conducive to learning of both theory and practical work. The laboratory should be adequately stocked with desired chemicals, laboratory equipment and providing textbooks for additional knowledge on the subject. Adoption of variety of methods that can aid effective concept and contents learning like explore, investigate and discovery strategies, use of practical activities, experiments and projects to engage students in learning activities, use different tools which would make the work more interactive through technology integration, hands-on-activities as well as inquiry-based activities and engage in periodic or formative assessment/evaluation of the processes. Adoption of station rotation, flipped classroom, collaborative online learning, personalized learning etc as affirmed by Raimi (2025) can equally build and sustain life-long learning of Basic Science and Technology.

Recommendations for sustaining the Skills for teaching and learning of Basic Science and Technology.

Maintaining the skills for effective teaching and learning of Basic Science and Technology at the Basic Education level involves the following:

- Adopting a blend of theoretical understanding with practical applications as well as creation of curious mindset which is more and far beyond rote learning and engender active, inquiry based learning in teaching activities.
- Engaging on the proper development of observing, questioning, hypothesizing through experimentation for accurate measurement and clear data analysis.
- Developing appropriate Communication skills- For clear explanation on methods, results, report writing, data presentation and diagrammatic illustration of facts from the outcome of our experiments.

- Developing critical thinking and argumentative skills for effective experimental activities and data analysis
- Engaging learners in Hands-on and practical experiences through participation in laboratory work experiments for clear understanding of the steps and processes required or involved
- Building of Models and Prototypes by using the created physical and digital models to explain complex processes to ease the task that may first look difficult to learners.
- Use of Excursion / Field trips: This requires going on visit to Science Museums, botanical gardens or local laboratories for first-hand information on any phenomena being considered.
- Promoting permanent learning efforts by fostering mindset of inquiry and understanding of why and how of the world around us and relating it to daily life activities to reduce or minimize rote learning practices
- Utilizing effective studying and learning techniques by breaking down complex topics, do regular practices and use diverse resources, documenting the activities and reflecting on it for improvement.

REFERENCES

Abdullahi, A. (1982). Science Teaching in Nigeria. Atoto Press Limited, Ilorin.

Akinsola, B.(2014,March 31). Use of ICT facilities will enhance learning in schools, Says don Naija247news.Naija247news. https://naija247.com/244/03/31/use-ict-facilities-will-enhance-learning-schools-says-don/.

Ausubel, D. P. (1960). The use of Advance organizer in the learning and retention of meaningful verbal material. Journal of educational Psychology.51.

Bruner, J.S. (19 62). The act of discovery in knowing Cambridge Mass. The Belknap Press of Haroard University Press.

Dung, M.G.(2024). Competences of basic science and technology teachers in Junior Secondary Schools for effective service delivery in Bassa local government area, Directorate of education. Plateaux state, Nigeria. Journal of Educational research. 14(1). https://doi.org/10.15580/gjer.2024.111101624131

Gagne, R.M. (1965).The condition of learning. New York: Holt, Rinehart and Winston.

Makinde,S. O.,Ahmed, A. T. and Olanrewaju, A. O.(2022). State of ICT facilities used for Teaching and learning in Secondary Schools in Ilorin Metropolis, Kwara state, Nigeria. Journal of Science, Technology, Mathematics and Education (JOSTMED). 18 (1)

Makinde, S. O. (2020a). Influence of Social/Mass media on childhood Social pedagogy and achievement. Indonesia Journal of Early Childhood Education Studies. 9(1)

Raimi, S. O. (2023). Shaping the Future Trends and Insights for Developing World through Science Education Reforms and Development. Communication in Physical Sciences. 10(3).

Raimi, S. M. (2025). SLOPP-Blended Pedagogy: A panacea for achieving effective science education for national development. Maiden Faculty lecture of faculty of science education, Emmanuel Alayande University of Education, Oyo.