

INNOVATION IN THE TEACHING AND LEARNING OF BASIC SCIENCE AND TECHNOLOGY: A KEY FOR ATTAINING THE SUSTAINABLE DEVELOPMENT GOALS IN SCIENCE

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Abstract

This paper discussed the role of adopting or utilizing innovative strategies and techniques on teaching and learning of concepts in Basic Science and Technology and its contribution to the attainment of sustainable development goals in Science. It highlighted some of the suitable innovative methods that can influence effective transition from how science was taught and learned in the traditional era to this era of technology driven knowledge acquisition. It stress the potency of innovative strategies in achieving science development goals as entrenched in national policy on science and science education. The authors looked into the impact of these innovative strategies on the attainment of science development goals and how it influences the teaching and learning of basic science and technology. The paper rounded up its submission through identification of some of the challenges facing effective adoption of innovative strategies to teaching efficiency and suggested the ways to overcome the listed challenges which is believed when positively adopted can influence the attainment of sustainable development goals in science.

Keywords: innovation, innovative strategies, teaching and learning, basic science and technology, sustainable development goals.

Introduction

Basic Science and Technology is an aggregate of subjects integrated or joined for holistic knowledge about the world we live. Teaching of the subject over the years had been along the conventional ways and this strategy is yet to give the targeted expectation. In order to attain the sustainable development goals of science,

adoption of innovative teaching strategies become imperative. Innovation in the teaching and learning of basic science and technology is a shift in the teaching strategies from passive Teacher- centered approach or technique to active learner-centered, hands-on and technology driven approaches that attends to the needs of the learner. Innovation in teaching of basic science and

technology for efficiency include adoption of Project- Based learning (PBL), the use of Simulations, adoption of Inquiry-Based learning (IBL), Use of Games, adoption of Artificial intelligence to enhance students curiosity, facts and contents retention as well as knowledge application. This approach will assist the teacher or lecturer in the process of transition from the traditional approach to facilitating the lesson, guiding students learning through the use of technology driven inquiry based tools/gadgets. Kamba and Wasagu (2019) describes innovation as the act of making change by introducing a new thing, new ideas and new techniques to operation. This implies doing things differently as against the way it was used to be done in the past. Also, the results of researches on innovative strategies recommendations had not been fully implemented in the classroom practices and activities. Among these researches include the submission of Kayode et al (2024) that the instructional tactics like think-pair- share, online virtual laboratory, peer tutoring which alleviate anxiety and stress usually face by students' when dealing with difficult concepts and boost class attendance are only employed occasionally in biology classrooms. Inability to use these innovative strategies in science classes will affect students' self-motivation and learners' improvement in Psychomotor, affective and cognitive domains. None use of these innovative strategies will negatively influence advancement and normal science skills reforms needed at this era of technology. Development of learners interest and knowledge to fully utilize these innovative tactics and strategies will assist towards possessing direct ownership of knowledge are not properly entrenched with conventional methods, hence adoption of innovative methods become worthwhile. Many teachers are aware of these strategies but rarely used, not even talk of been fully utilized in the

teaching–learning practices as observed and reported by Yussuf and Adedeji (2010), Nwagbo and Chukelu (2011), Ukala (2018). The inability of teachers to use it may be attributed to some conditions which may not be unconnected with their knowledge of technology application and need for continual training. This submissions clearly revealed that the way the curriculum of basic science and technology is been presented to the learners require adoption of innovative approaches that can arose the learners' interest and build their willingness to learn and practice anytime and anywhere they found themselves. Educationists all over the world have realize it that without introducing change and innovations our educational systems cannot provide solution to solve the challenges pose by the technology of the modern society. Olagunju, Adesoji et al (2003) asserted that innovations produce greater motivations in both teachers and learners, thus encouraging the attainment of improved learning outcomes. This situation generally urge the teachers to think of more suitable approaches to the teaching and learning of science. Bisanmi-Awoderu (2012) quoting Adetayo (2011) categorically stated that the success of any educational system or programme depends to a large extent, on the quality and quantity of qualified and committed teachers. This was further buttressed that it is the teacher who formulates, manipulates, designs, assembles, controls, supervises, selects, explores, facilitates, assesses the teaching-learning materials and evaluates all other factors in the teaching – learning process. This further buttressed the value of building and sustaining the skills of teachers of basic science and technology towards their efficiency and attainment of science sustainable goals for science advancement. This corroborate the views of Wasagu (2019) that the complexity of today's world requires all people to be engaged with new set of the core knowledge and skills, to

solve difficult problems, gather and evaluate evidence and make sense of information they receive from varied print and increasingly digital media. Hence, learning and doing STEM helps and develops those skills and prepare students' for a workforce where success results, not just from what one knows but what one is able to do with the knowledge and skills he/she acquired. Thus, acquisition of those skills alone is not enough but need to be sustained to meet the needs of ever changing technology driven-era. The goal of Strategy for American Innovation (SAI) is to ensure academic readiness for College and career in STEM fields which could not be achieved without increasing students' abilities to apply knowledge and skills to analyse, reason and communicate effectively (Conley, 2007) as cited by Danjuma, Musbahu and Mohammed (2019). This corroborates the quest for effective use of innovative strategies on the attainment of reformed science skills and knowledge for the technology dictates of the present day. Information and Communication (ICT) literacy as one of the innovative strategies is more than acquisition of technical skills but inclusive the use of digital technology tools or networks to operate in the knowledge society. This will enable the learners apply the knowledge and skills gained in a discipline to specific fields and guide them link up with relevant areas and cope with complex problems and situations in a variety of ways. The innovative strategies required should promote the reconstruction of ideas about a particular content based on balance creation between the content and the experiences which the teachers and the learners bring to the class. In the science teaching and learning, innovation is the act of bringing new methods or ideas or simply introducing changes in a given situation; such changes or modifications may include curricula change, teaching strategies or altering the existing process and programmes. This changes call for re-

arrangement of strategies and resources for promoting acceptable teacher-content-learners interactions believed suitable for the current technology quest. This approach take note of personalized learning that look into what, when and how each learner is taught to attain the desired objective of instruction. This can be attained through adequate consideration of the contents starting from the structure of curriculum elements, to follow a pattern that will empower the Nigerian students' to organize the information acquired properly and report it accurately as the observation is made. This is within the purview of what Akpan (2010) proposed to be incorporated into the curriculum document of integrated science course to guide learners to

- be actively involved in the learning process
- develop the motivation and ability to work and think in an independent fashion
- recall information and experiences
- devise scheme for solving problems
- use and classify given information
- apply previous knowledge to new situation
- interpret information by showing evidence of judgement and assessment
- communicate selectively and effectively
- relate experiences in each subject area to other areas and to live in the society.

Innovation in science education require the teacher to be more committed and show readiness to peer collaboration and utilizing their experience to develop more productive strategies to meet the needs of the technological era of the present, especially now that technological use of tools and machine in the learning process play a vital role in knowledge acquisition and application. This view is not at diverse with the submissions of Okonkwo et al (2025) who submitted that hands- on activities, interactive lessons, team teaching, inquiry based learning,

peer tutoring play a vital role in attaining a reformed science programme and making the learning of basic science and technology learning at our schools effective. Also, Elmesery (2025) asserts that traditional methods often fail to properly engaged the students and ignite their passion for scientific exploration. This situation demand and call for new approach referred to as innovative teaching strategies in science education that can help the students to perform experiments online from their computers anytime and anywhere without much pressure because the approach cater for individual differences and necessary modification is attainable with ease.

Notable Innovative Methods and Strategies for Effective Teaching of Basic Science and Technology

Innovation in the teaching and learning of basic science and technology focuses on shifting from passive teacher centered classes to active learner centered instruction, Raimi (2025). The integration of technology into teaching and learning of basic science and technology is believed capable of enhancing students' willingness/eagerness to learn and at the same time boost the retention and application of knowledge. The suggested strategies here include- Interactive and Creative Strategies, Technology- enhanced learning, Student Centered learning strategies and Active learning and hands-on strategies.

Interactive and Creative strategies – This is a process of providing learners with detailed explanation of science facts and laws in the form of story-telling to make abstract content memorable and relatable. Also involve creating science stations by setting up multiple activity centers in the classroom for learner's observation, experimentation, description and so on for students to ruminate on and come up with their views using different learning styles. This

practice keyed into the Constructivists theory of learning that makes the learner have direct control of its acquired skills and knowledge. Another suitable interactive strategy that can make science learning a fun to learners is the use of Multimedia approach which combines texts, video, animation, audio to explain difficult concepts and contents. Besides, science journals can be used through creation of notebooks with sketches, charts and make learners effectively reflects on their daily observations on various activities of interest.

Technology- enhanced Learning- This involves the creation of virtual and remote laboratories in a resource deprived schools and platforms. Simulations are used by students in experiments on subjects like Physics, Chemistry and Biology. This include the use of Augmented reality (AR) and Virtual reality (VR) which allow students to explore any object of interest in such a way that abstract concepts are simplified using 3D illustration. Adoption of game mechanics points, leaderboards quiz for competitive reviews as well as the use of educational mobile apps and use of video science apps for interactive learning are of interest here.

Student-Centered Teaching Strategies – Such as Role Play method, Flipped Classroom Model, Jigsaw Method and Peer-to-peer Teaching strategies by engaging students physically and intellectually on the contents for clear understanding and study new content at home through video lectures or articles and using the class time for hands-on activities and collaborative problem solving. It can equally be done through grouping of students to become experts on the specific aspect and regroup all to show the skills so acquired from the process. Students thereafter explains the scientific concepts to each other which reinforces their understanding and promote teamwork.

Active Learning and hands-on strategies: This provides students opportunity to work over a range and elongated time length to investigate, report and respond to the authentic, engaging complex task. The teacher use questions to arouse the learners' interest and curiosity that will enable them to investigate or find out through experiments to draw meaningful conclusion from their observation and discoveries. It also involves making or building objects to represent abstract phenomenon through craft materials to visualize complex structures such as cells in human body, chain reaction, electron movement and many others. Creation of low cost apparatus/ mini-labs to make science accessible to learners using the readily available household items like balloons, straws, plastic bottles to produce balloon powered cars or strings telephones.

Impact of Innovative Strategies on Teaching of Basic Science and Technology

It is not a gainsay that innovation is the mother of invention, the use of technology in teaching of concepts in basic science and technology makes what look difficult and boring becoming interesting to learners. The use of innovative strategies enhances learners' engagement, students' performance, advancement in skill acquisition and meaningful participation between and among those involved in the activity. Teaching activities in the present era of Science and Technology requires a lot of practices, techniques, approaches, strategies for the success to be positively attained. Hence, a need to lubricate the teachers' talent to enhance his/her quality in service delivery becomes inevitable. Akanbi (2019) submitted that initiative to activate your talent, sustaining perseverance, develop positive character, belief in your talents to team work amongst other things and continual practice during and after the training can bring out the best and lubricate your talent to accomplish your

desire. This implies that the use of innovative strategies can lubricate the teachers' potential and guide them towards ensuring that the teachers are properly involved in planning and designing of teaching activities to better their service delivery. The hallmark and background of good teaching is the quality learning outcomes among the learners. The students' understanding of the process of science teaching are fundamental propositions that guides the teacher on nature/uniqueness of the learners, differences in individual development pattern and the active nature of students learning. This and many other factors greatly influence the selection of instructional materials, instructional activities and learning outcomes as well as methods and techniques of assessment. This corroborates the submission of Erinoshio (2008) that effective teaching of science requires sound pedagogical skills, knowledge of the subject matter and Classroom practices to support the learning process among all categories of students. This further strengthen the need for adopting innovative strategies in the teaching and learning of basic science and technology in the era of technology knowledge driven. Thus,

Activities involving student roles always leads to higher and clear retention of facts with better conceptual understanding which makes the knowledge so acquired permanently influencing their life practices and engagements.

Innovative methods increase student's engagement and interaction and makes lessons a fun and enjoyable to learners and at the same time changes the attitude of the learners to science and turn science from boring enterprise to a curious adventure by increasing their eagerness to learn. The 21st Century skills development in teaching and learning of science can positively influence effective science advancement. This can be attained by liaising with learned societies through effective communication, critical thinking, creativity and digital literacy through creation of

links with widely separated environment/communities for effective interaction and knowledge sharing. Adoption of technology media at different levels such as zoom, twitter, Use of mobile devices, Instagram, face-book, whatsApp and other forms of online interaction and learning devices can make the teaching and learning of science more effective. The location of the institution and/ or available resources pose no barrier to effective teaching and learning of science as the learners will be able to adequately participate in the activity or process using low-cost laboratory resources and technique and at the same time provide easy access to learning process to both the teachers and the learners.

Challenges to the Teaching and Learning of Basic Science and Technology

Basic Science and Technology is the pillar of scientific advancement, its teaching greatly influence the extent of technological transformation any society can attain. Adoption and infusion of innovative strategies to the classroom activities can bring drastic change to the level of advances in the subject. The teaching of the subject is confronted by several factors ranging from lack of / non-availability of projected policy plan for functional teacher development, interrupted power supply, lack of proper coordination between the indigenous and foreign organization, the supervision and monitoring of the processes and activities, inadequate funding for meaningful implementation, attitudinal disposition to changes on the part of both the teachers and learners among others.

No projected functioning policy formulation on staff training and development for teachers teaching the subject, this alone can affect the success of science and technology advancement of the nation. Another serious challenge is the

supply of electricity which in no small measure hinders the use of innovative tools, where teachers may be willing and ready to make use of technology gadgets the electricity to power the gadgets and equipment are always unavailable. Supervision and monitoring of the process for effective remediation are inadequate and less functioning for desired science development request of the present era.

Suggestions

The dynamism of knowledge and advent of technology demand a continual review of the way teaching and learning of the science subjects is being conducted at our schools. Adoption and positive use of innovative strategies is believed capable of influencing the acquisition of knowledge, skills and modify the attitudes of both the teachers and the learners. The effective use of these strategies in teaching and learning of concepts in basic science and technology is capable of improving the advancement of science and technology status of the nation. Thus, the following suggestions are recommended for teaching and learning of basic science and technology at the Basic Education level:

The planning and design of the curriculum must incorporate and emphasize the importance of continual staff development programme and should specify its mode of operation in a way to benefit the target group, may be two or three times a year or at the beginning of every academic session. This must be made compulsory and sponsored by the government.

Funds must be adequately provided for the sponsorship of various types of staff development programmes like Seminars, workshops, conferences, exhibitions to update the knowledge of those who are implementing the curriculum.

Besides, on the issue of challenges on electricity, Solar installation could be adopted for

use in place of supply of electricity from Power holding (PHCN) and can cater for the needs of both the teacher and the students' from Urban and rural areas.

Effective monitoring and supervision must be done with sincerity to guide the implementer of the curriculum in realizing the objectives of the subject and for necessary adjustment to meet the request of the technological age.

References

- Adetayo, J. O. (2011). Knowledge of Subject matter as a measure of Teachers' Competence. *Studies in Curriculum* , 5. 88-103
- Akanbi, G. O. (2019). Some Trending Parts into Quality Assurance in Teacher Education: A discuss for Teachers' in Nigeria. *African Journal of Historical Sciences in Education. Ibadan. 15* (2). 28-46
- Bilesanmi-Awoderu, J. B. (2012). Science Education in Nigeria: *Drowning but waving*. 61st Inaugural Lecture of Olabisi Onabanjo University, Ago-Iwoye; 11 December, 2012.
- Conley, D. T. (2007). Redefining College readiness. OR: Educational Policy Improvement Centre.
- Danjuma, B., Musbahu, A. and Mohammed, I. N. (2019). Perspective on innovation in Science, Technology, Engineering and Mathematics (STEM) Education Research in Nigeria. 2019 60th Annual Conference Proceedings of STAN. *Innovation in STEM Education*. The STAN Place limited. 46-56
- Erinosho, S. Y. (2008). Teaching Science in Secondary Schools. *A Methodology Handbook*. African Cultural Institute (The research/ publishing division of African Culture International), Ketu, Lagos. Nigeria.
- Elmesery, M. (2023). The Most Innovative Teaching Methods in Science. From Bore-down to Brilliance, Innovative Teaching Methods/ Transforming Science Education
- Kamba, A. H. and Wasagu, M. A. (2019). Innovation in Science Education: Problems/Challenges in Physics Education. Innovation in STEM Education. . 60th Annual Conference Proceedings of STAN 2019, Ifamuyiwa, A. S. (ed.). The STAN place Limited. 486-489
- Kayode, O. O., Gbigbadua, and Mustagha, B. O. (2024). Utilization of innovative teaching strategies by Biology Teachers in Senior Secondary Schools in South West Nigeria. www.kije.com.ng. *KWASU International Journal of Education*. 7(2)
- Nwagbo, C. and Chukelu, U. (2011). Effects of Biology Practical Activities on students' Process Skills Acquisition. *Journal of Science Teachers Association of Nigeria*. 46(10)
- Okonkwo, O. J., Mbachi, R. A. and Ahurnezenma, A. A. (2025). Innovative Methods in teaching Basic Science and its impacts on the academic performance of Primary School Pupils in Awka South Local Government Area of Anambra State. <https://unijerps.org> *UNIZIK Journal of Educational Research and Policy Studies*. 19(2)
- Olagunju, A. M. Adesoji, F. A., Iroegbu, T. O. and Ige, T. A. (2003). Innovations in Science Teaching for New millennium. *Education this Millennium, Innovations in theory and practice*. In Ayodele-Bamaisaiye, O.: Nwazuke, I. A. and

- Okediran, A. (eds.). Macmillian Nigeria. 219-232.
- Raimi, S. O. (2025). Enhancing the Teaching and Learning of Basic Science and Technology at the JSS Level through the Use of Teacher Professional Development Programme. <https://journalscps.com> *Communication in Physical Sciences*. 12 (8).
- Wasagu, M. A. (2019). Innovation in STEM Education the missing link in Nigeria. The Keynote Address delivered at the 2019 Annual Conference of Science Teachers Association of Nigeria (STAN). *Innovations in Science Education*. The STAN Place Limited. 4-26
- Ukala, G. (2018). Utilisation of Innovative Teaching Strategies for Biology Teaching in Senior Secondary Schools. *AJSTME*, 4(1). 30-37
- Yussuf, M. D. and Adedeji, O. A. (2010). Effect of Cognitive Assisted Instruction on Secondary School Students' Performance in Biology. *The Turkish Online Journal of Educational Technology*. 9 (1), 62-69