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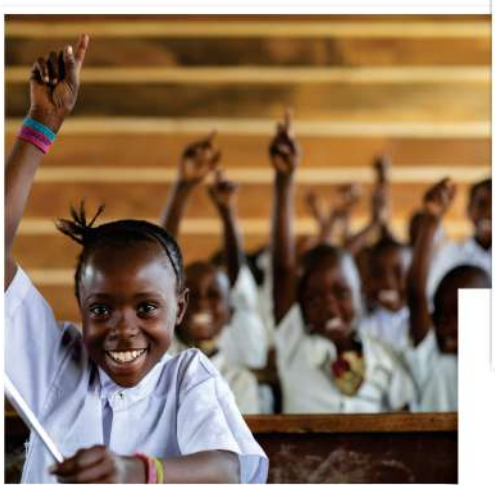
INNOVATIVE STRATEGIES FOR TEACHING VOCATIONAL, SCIENCE, TECHNOLOGY AND MATHEMATICS EDUCATION: CLASSROOM PRACTICES



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PREFACE

The electronic book (e-book) acknowledges that traditional methods in Vocational, Science, Technology and Mathematics Education: Classroom Practices may not be sufficient to equip students with the necessary skills for a rapidly evolving technological landscape.

Therefore, it advocates for the adoption of Innovative teaching approaches that promote a more dynamic and effective learning experience.

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FOREWORD

This book entitled "**Innovative Strategies for Teaching Vocational, Science, Technology and Mathematics Education: Classroom Practices",** is a book of readings on various innovative classroom pedagogies. It is a welcome literature for Education System and a very important resource book for teachers who are functioning in the disciplines of Vocational Education, Science, Mathematics and Technology education and training. It is a compendium of most of the **active learning strategies** aimed at producing graduates who have been prepared for adaptation to the conditions of the 21st century world of fluidity. The 21st century world accommodates soft skills which the individual can edit from time to time as the conditions of socio-cultural, economic and technological environments change constantly and uncontrollably. A century in which cross-border job openings are important means of employment, a century where attitude is more important than subject-based excellence, a century where collaboration, innovation and creativity are irreducible demands by employers of labour, a century where adaptive skills are critical for entrepreneurship, creation of jobs and wealth.

All categories of teachers at all levels of education would find this resource book interesting and professionally helpful for their teaching practice. Because conditions of the modern world are in perpetual flux, teachers have to re-skill in order to produce adaptive graduates and the era of lecture method is literally over. It is these modern innovative instructional strategies that would enable teachers to produce such graduates who would survive and then succeed in the 21st century global economy.

This book would also be very useful to researchers and innovators in the envisioned pedagogic paradigm shift of this era. I therefore, proudly recommend this book, a compendium on innovative pedagogies to all classes of teachers and researchers on pedagogies and curriculum reforms in the modern era.

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DEDICATION

This book is dedicated to educators in the world

CHAPTER 9

INNOVATIVE TEACHING STRATEGIES IN BASIC SCIENCE IN THE 21ST CENTURY CLASSROOM SETTINGS

Suleiman Dambai Mohammed
Perekeme Peresuodes

Abstract
This paper highlighted on most common innovative teaching strategies in Basic Science in the 21st Century classroom setting. It provided various definitions of innovative teaching strategies according to current authorities such as Piogroup, Kalthura; Characteristics of innovative teacher in the 21st Century according to Piogroup, Woulibrary; meaning of the innovative teacher by Netasite. Benefits of the innovative teaching strategies according to Epistemo such as enhanced engagement; improvement of learning outcomes, etc. Some challenges to the innovative teaching strategies according to Quora which include; Resistance to change by stakeholders in education; implementation challenges and cost by Research Gate. Itconcluded by some recommendations for improvement in implementation of the innovative teaching strategies such as teacher to get involved in training and retraining to get acquainted with the new methods and government's proactive actions in funding the institutions and ensuring equitable distribution of resource materials.
Keywords: Innovation Teaching Strategies

Introduction

Basic science is an offshoot of Integrated Science. In 2007, the Nigerian Educational Research and Development Council (NERDC) realized and restructured the revised curricular for basic science in Junior Secondary Schools in Nigeria known as 9-Year Basic Science and Technology Curriculum. The objectives are to help learners:

- Develop interest in science and technology.
- Acquire basic knowledge and skills in science and technology.
- Apply their scientific and technological knowledge and skills to meet societal needs.
- Take advantage of the numerous career opportunities offered by science and technology.
- And become prepared for further solutions in science and technology.

Hence to achieve the aforementioned objectives, the teaching and learning of basic science must be such as to bring learners into an active, productive contact with the stimuli of learning. In the past Piogroup (2023) opines that the teacher pictured himself as enduring a tedious class, the drone of teachers' voices echoing in their ears, struggling to keep their eyelids from dropping as they attempt to focus on the lesson which was not an ideal classroom. Therefore, in the present day, numerous educators are actively steering their classes away from such scenarios aiming to engage students more deeply in their learning process by exploring modern teaching methods. The educational landscape is evolving rapidly demanding that teachers stay abreast of and adapt to more contemporary strategies. Kaltura (2023) sees innovative teaching strategies as not something that always means introducing the latest and greatest technology into the classroom, but instead it is the process of proactively introducing new teaching strategies and methods into the classroom. That the purpose of Introducing these new teaching strategies and methods is to improve academic outcomes and address real-world problems to promote equitable learning. He posits that the innovation can help teachers become better at teaching in many ways. That, by applying innovative teaching methods to the classroom is a tacit understanding that our teaching methods can be improved. That it accepts the need to grow and develop, which is exactly what we ask of our students. She concludes that, it's a better way to lead than by example.

According to her, innovative teaching strategies start with a growth mindset. That we identify room for improvement. We invest our time in researching and thinking of better strategies to teach our students. In addition, that we create something new or adapt existing methods. That we take risks,

which we may fail and we try again. That we iterate and by doing so establish a culture of innovation and creativity in the classroom that inspires our students to do the same. To her, in this post, we talk of popular innovative teaching strategies that helps drive better students' outcomes. She states that, these strategies often focus on student engagement. That students who are actively engaged in their learning are less likely to be absent from the class and more likely to succeed academically. She therefore, suggests that it is important to take a student centric approach to our methods. That students sitting passively for 45 minutes in class lecture would hardly gain anything, but when students are actively participating in their class by asking questions collaborating on projects and problem-solving activities, he or she is likely to succeed academically.

Statement of the Problem

The 21st century has brought about significant changes in way students learn and interact with information, many traditional teaching methods remain ineffective in engaging and preparing students for success in an increasingly complex and rapidly changing world. As a result, there is a pressing need for innovative strategy that could enhance teaching and learning, foster critical thinking, creativity, problem-solving skills, and ultimately improve students' outcomes in the 21st Century. Education plays a vital role in the development of any nation, as it equips individuals with the necessary knowledge and skills to contribute to societal growth. Basic Science as one of the core science subjects in secondary Schools, form the foundation for various careers in medicine, agriculture, and environmental sciences etc. However, the academic performance of students in Basic Science has been a cause for concern particularly at the Junior Secondary School (JSS level). Reports from the Basic Education Certificate (BEC) consistently indicate low achievement in JSSCE and that traditional teaching methods, which are predominantly, teacher-centered may not adequately address the diverse learning needs of lecture-based instruction that dominates classroom practices which often fail to actively engage students in the learning process, leading to limited understanding and retention of biological concepts (Usman and Ibrahim, 2022).

Despite ongoing educational reforms aimed at enhancing the quality of teaching in Nigeria, there remains a significant disparity in students' academic performance, particularly in Basic Science (Ogunleye and Adeyemi, 2021). It is for this reason that, the paper is prepared to highlight, on some of the teaching strategies that are critical in achieving the goals and objectives of teaching and learning Basic Science in Nigeria.

Objectives of the Study

The purpose of innovative strategies for teaching in the 21st century is to enhance students learning, engagement, and outcomes by leveraging technology, fostering critical thinking and problem-solving skills, and promoting collaboration and creativity.

The primary objective of the study is to highlight on the current strategies that Basic Science teachers can utilize in teaching that will improve the academic performance of Basic Science students.

Specifically, the study will focus on how Basic Science teachers can improve their teaching strategies and achieve the best result in their students and career.

The role of teachers should be to guide and be facilitator of learning in the current dispensation.

Therefore, the study intends to explore the different available teaching strategies and come up with the strategies that can assist the Basic Science teachers to achieve this goal. Strategies that utilize hands-on activities, collaborative activities and peer-tutoring etc. could impact positively on the academic performance of Basic Science students.

Significance of the Study

The study will provide valuable insight into how these teaching strategies will improve the academic performance of students. By demonstrating their effectiveness, it could encourage

schools to adopt these instructional strategies to boost students understanding and retention of Basic Science concepts. The study will offer teachers and educational planners' evidence-based approaches to diversify teaching methods. These strategies can complement traditional teaching methods and can foster collaboration, communication and leadership skills among students.

Who Is an Innovative Teacher of the 21st Century?

Saf School Management Blog (SAFSMS, 2017) states that an innovative 21st century teacher is someone who can adapt to the needs of their students, use technology and creativity to engage students and encourage students to take an active role in their learning. That he or she possesses the following characteristics:

- Adaptable: They can adapt their teaching stylesto include different learning models, new technology and curriculum requirements.
- Creative: They can think outside the box, solve problems, and approach learning from different perspectives.They canintegrate creativity into lesson plans to encourage students to explore new ideas.
- Engaging: They can use technology, hands-on activities and other materials to help students learn in a meaningful way. They encourage students to take an active role in their learning.
- Problem-solving: They look at challenges from different angles, define problems, and use a variety of approaches to solve them.
- Critical-thinking: They are able to critically evaluate sources of information and teach students about media and digital literacy.

Netasite (2024) summarizes the characteristics of an innovative teacher to be a person who can share their stories and develop strong relationships on and offline with other innovative educators, administrators, parents and students; communicate learning goals and share their stories with parents, teachers, students and the community.

What Are Innovative Teaching Strategies?

Piogroup (2024) defines innovative teaching strategies as teaching method which extends beyond themere incorporation of cutting-edge teaching methods, or a constant pursuit of the latest educational trends, but methods that embody distinctive approaches to the teaching and learning process. That these modern methods of teaching prioritize students, emphasizing classroom engagement and interaction. It states that the innovative strategies encourage proactive participation and collaboration among students and teachers. That these demands increase effort from students and the approach is tailored to better meet their individual needs, fostering accelerated growth. Comparing with the conventional teaching practices, (it states that the conventional teaching practice primarily measured student success by the amount of knowledge transferred to students, innovative teaching methods delve into the nuanced understanding and retention of the materials. It is not just about what is taught, but how effectively students internalize and apply the knowledge imparted during lectures.

Piogroup therefore, concludes that innovative teaching in the 21st century is very essential because the educational landscape has undergone a transformation, transitioning from traditional classroom to visual and hybrid learning environments. However, it warns that the prevalence of staring at laptop screens introduces risks of students becoming easily distracted or disengaged, perhaps even succumbing to the allured of sweet dreams in the comfort of their beds while feigning concentration. Therefore, the teachers should as much as possible avoid tedious and monotonous lessons that can lead to students' disinterest. Leveraging digital programs has proven instrumental in captivating students' attention, providing them with access to classes and expanding the avenues through which their minds can be reached.

Key Characteristics of Innovative Teaching Strategies

Piogroup (2024) provides key characteristics of innovative teaching strategies as follows:

- Student-centric focus: That innovative teaching strategies prioritize the needs and encouragement of student fostering active participation in the learning process.

- Active learning: They encourage hands-on and participatory activities, moving away from passive learning to promote deeper understanding and retention.
- Flexibility and Adaptability: They adapt to the diverse learning styles and needs of students, offering flexibility contents delivery and new teaching methods.
- Technology integration: They utilize technology creatively to enhance effective learning experiences, incorporating digital tools and resources for effective and interactive instruction.
- Collaborative Learning: That they emphasize group work, collaboration, and peer learning to enhance social and communication skills among students.
- Problem-solving emphasis: They focus on developing critical thinking skills and challenging students to apply knowledge in real-world scenarios.
- Continuous assessment: They move beyond traditional exams and grades by implementing continuous assessment methods, providing ongoing feedbacks for Improvement.
- Creativity Encouragement: They cultivate a learning environment that stimulates creativity and innovation, allowing students to express themselves and explore new ideas.
- Individualized learning paths: They recognize and accommodate the diverse learning preferences and paces of individual students, promoting personalized learning experiences.
- Real-world Relevance: They connect classroom concepts to real world applications, demonstrating the practical relevance of what students are learning.
- Feedback-Oriented Approach: They prioritize constructive feedback to guide students' progress, facilitating a continuous cycle of improvement and reflection.
- Cultivation of soft skills: They integrate the development of soft skills such as communication, collaboration, and time management essential for success in various contexts.

Woulibrary (2024) says "Innovative Teaching" in the 21st century is characterized by focus on developing skills that are essential for navigating a rapidly changing world, such as:

- Growth Mindset: Students are encouraged to view challenges as opportunities for learning and improvement, which help them develop resilience and perseverance.
- Critical thinking: That students are taught to analyze information, questions assumptions and solve complex problems.
- Creativity and innovation: That students are encouraged to think creatively, take risks, and design novel solutions.
- Digital Literacy: That students develop digital literacy skills in open-ended, project-based learning environments.
- Problem-Solving: That students are challenged to apply their knowledge in real-world scenarios.
- Decision making: That students learn to navigate them. Decision making process by considering ethical factors.

Some Innovative Teaching Strategies for Basic Science in the 21st Century

Epistemo (2024) provides 10(ten) innovative teaching methods revolutionizing classroom today. It states that revolutionizing education is indeed necessary in the contemporary world characterized by rapid technological advancements, globalization and evolving societal needs. It says that traditional educational systems often fail to keep pace with these changes, leading to a growing demand for innovative approaches to the teaching and learning. Therefore, it records the following as its innovative teaching strategies:

1. Personalized Learning: That one of the most significant shifts in education is towards personalized learning. That this approach tailor's education to individual students' needs, interest and learning styles. Adaptive Learning technologies, data analytics, and artificial

intelligence can help educators deliver personalized content, assessments, and feedback to students, enhancing their learning outcomes.

2. ProjectBased Learning (PBL). That PBL engages students in real-world interdisciplinary projects that require critical thinking, problem-solving, and collaboration skills. That instead of rote memorization, students work on meaningful projects such as building prototypes, conducting scientific experiments or solving community problems, fostering deeper understanding and motivation.
3. Flipped Classroom: It states that in a flipped classroom model, students engage with instructional content, such as lectures or videos, independently outside of class, while class time is reserved for active learning activities, discussions, and problem solving. That this approach allows for more personalized support and interaction between teachers and students during face to face sessions.
4. Blended Learning: That this implies integrating conventional classroom teaching with online educational components. That by integrating digital resources, multimedia, and interactive platforms, educators can create a flexible and dynamic learning environment that accommodates diverse learning preferences and schedules.
5. Gamification: It explains gamification to involve applying game-design principles and mechanics to non-game contexts such as education. That by incorporating elements like points, budgets, levels, and leaderboards into educational activities, educators can increase student's engagement, motivation and retention of content.
6. Experimental Learning: Epistemo opines that experimental learning emphasizes hands-on, immersive experiences that allow to directly engage with concepts and skills in real-world contexts. Internship, simulations, field trips, and service-learning projects provide opportunities for students to apply theoretical knowledge to practical situations, enhancing their understanding and skills development.
7. Collaborative Learning: It states that collaboration fosters active engagement, communication, and teamwork among students. They are collaborative learning activities such as group projects, peer teaching, and cooperative problem-solving tasks, promotes social interaction, critical thinking, and empathy, preparing students for success in a collaborative work environment.
8. Multimedia and Interactive Content: That leveraging multimedia resources, such as videos, animations, simulation and interactive tutorials can enhance teaching effectiveness and student's comprehension. That visual and interactive contents appeal to different learning styles and helps clarify complex concepts through dynamic representations and demonstrations.
9. Global Education and Cultural Competence: In an increasingly interconnected world, global education and cultural competence are essential, according to Epistemo. That integrating diverse perspectives, multicultural literature, global issues across-cultural exchange into the curriculum fosters empathy, respect for diversity and a deeper understanding of global challenges and opportunities.
10. Critical Digital Literacy: With the proliferation of information and digital technologies. Epistemo believes that critical digital literacy skills are vital for navigating and evaluating online content critically. That educators must teach students how to assess their credibility, bias, and reliability of information sources, as well as how to responsibly create, share, and communicate using digital tools and platforms. It concludes that by embracing technology individualization, active learning, and global perspectives, educators can create inclusive, engaging, and effective learning experiences that prepares students for success in the 21st century. To achieve these objectives or goals, Epistemo recommends that it's crucial to recognize that implementing these changes requires ongoing professional development, institutional support and a commitment to continuous improvements because revolutionizing education is not a one-time event but a continuous journey towards excellence and equity in learning.

Benefits of the 10 Innovative Teaching Methods

According to Epistemo (2024) ten benefits can be derived from the ten innovative teaching methods as follows:

1. Enhanced Engagement: Epistemo suggests that innovative teaching methods like project-based learning, gamification and experimental learning make education attractive and relevant, boosting students' engagement.
2. Improved Learning Outcomes: He believes that personalized learning ensures each student receives tailored support, leading to better academic achievements and mastery of skills.
3. Critical Thinking Skills: That students develop critical thinking and problem-solving abilities through real-world problem analysis and collaboration with peers.
4. Preparation forthe Future Workforce: That beyond academic, students learn essential skills like communication, collaboration, adaptability, and digital literacy, crucial for success in the modern job market.
5. Lifelong Learning Habits: Epistemo agrees that revolutionized education fosters a culture of curiosity and self-directed learning, encouraging students to continuously seek knowledge and growth.
6. Promotion of Creativity and Innovation: He posits that the innovative teaching methods encourage experimentation and risk taking, nurturing students' ability to generate new ideas and solutions.
7. Global Awareness and Cultural Competence: He believes that global education initiatives and cross-cultural exchanges develop cultural awareness, empathy, and global citizenship among students.
8. Reduction of Achievement Gaps: That by addressing diverse learning needs and employing culturally responsive teaching practices, revolutionizing education promotes inclusivity and equity.
9. Social and Emotional Development: He believes that social-emotional learning programs and character education help students develop essential life skills such as empathy, resilience and self-awareness.
10. Empowerment: That a supportive and inclusive learning environment empowers students to take ownership of their education and become active participants in their learning journey.

Challenges to Innovation in Education

Quora (2024) agrees that change and innovation in education can bring about numerous benefits, but they also come with their fair share of disadvantages and challenges. He itemizes them as follows:

- Resistance to Change: That one of the most significant challenges is the resistance to change among educators, students, and other stakeholders. People may be comfortable with traditional teaching methods and resistance to adopting new technologies or teaching approaches.
- Implementation Challenges: Implementing new educational innovations can be complex and costly. That it may require significant training resources and time which can strain budgets and schedules.
- Inequality: Innovation in education can exacerbate inequalities if not implemented equitably. Students with access to the latest technology and resources may benefit more than those without, leading to a digital divide according to Quora.
- Learning Curve: New educational technologies and approaches often have a learning curve for both teachers and students. There he believes that this initial adjustment can be challenging and impact learning outcomes.
- Standardization Versus Individualization: He argues that innovations in education can sometimes clash with the need for standardized testing and curriculum. That balancing the

desire for personalized and student-centered learning with standardized assessments can be tricky.

Research Gate (2024) states that innovative teaching methods can have some disadvantages, including:

- Learner Readiness: That student needs to be able to ask questions and make decisions on their own.
- Parental Reluctance: That Parents, especially those on school committees, may be resistant to new teaching methods.
- Cost: It argues that using technology in the classroom can be expensive, requiring the purchase of devices and software as well as training for teachers.
- Distractions: It agrees that students may be distracted by social media, games and messaging while using classroom technology.
- Cyber Security: It states that classroom technology can increase the risks of cyber security.
- Physical Activity and Socialization: It also agrees that technology can decrease physical activity and socialization.

Conclusion

Innovative strategies for teaching in the 21st Century have the potential to transform education by providing students with the skills and competencies needed to succeed in an increasingly complex and rapidly changing world. By embracing innovative approaches, educators can create engaging, student-centered learning environments that foster deeper learning, creativity, and collaboration.

Suggestions for Improvement

Teaching Basic Science in The 21st Century classroom settings could be improved through;

1. Science educators leveraging technology in teaching which fosters engagement, develops critical thinking skills and prepares learners for the challenges of the modern world
2. By implementing these strategies, science educators can create a more engaging and effective learning environment for students, preparing them for the demands of the 21st century

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