SCIENCE EDUCATORS AND DIGITAL LITERACY IN THE 21ST CENTURY

Editor in Chief
Prof. Josephine N. Okoli

ASSOCIATION OF SCIENCE EDUCATORS ANAMBRA (ASEA)

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INNOVATIONS, DIGITAL TRANSFORMATION AND SUSTAINABLE SCIENCE EDUCATION IN THE 21ST CENTURY

2nd Annual CONFERENCE PROCEEDINGS 2026

Editor in Chief
Prof. Josephine N. Okoli

ASSOCIATION OF SCIENCE EDUCATORS ANAMBRA (ASEA)

THEME:

INNOVATIONS, DIGITAL TRANSFORMATION AND SUSTAINABLE SCIENCE EDUCATION IN THE 21ST CENTURY.

2ND ANNUAL CONFERENCE PROCEEDINGS HELD ON 9th APRIL, 2026 AT ARCHBISHOP ALEXANDER IBEZIM COLLEGE OF EDUCATION NIBO-NISE, ANAMBRA STATE, NIGERIA.

Editor

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CHAIRMAN'S ADDRESS VENERABLE NNAMDI B. EMENDU PhD. PRESENTED DURING THE SECOND CONFERENCE OF THE ASSOCIATION OF SCIENCE EDUCATORS, ANAMBRA (ASEA) HELD AT ARCHBISHOP ALEXANDER CHIBUZO IBEZIM COLLEGE OF EDUCATION, NIBO-NISE, ANAMBRA STATE ON 9TH APRIL 2026

THEME: Innovation, Digital Transformation, and Sustainable Science Education in the 21stCentury

Distinguished Professors, Esteemed Researchers, Academic Leaders, Policy Partners, Ladies and Gentlemen,

Introduction

It is my distinct honour and privilege to welcome you to the Second Conference of the Association of Science Educators. I extend warm greetings to our keynote speakers, paper presenters, research scholars, institutional representatives, and valued partners whose presence underscores the importance of this gathering.

Our theme — "Innovation, Digital Transformation, and Sustainable Science Education in the 21st Century" — speaks directly to the evolving mandate of higher education institutions and research communities in shaping scientific literacy, discovery, and societal progress.

The Imperative for Academic Innovation

Higher institutions have historically been the custodians of knowledge creation and dissemination. However, in the contemporary era marked by rapid technological advancement and global interconnectivity, the academy must transcend traditional pedagogical models. Innovation in schools is essential because it prepares students for the future, enhances learning experience, encourages creativity and curiosity, improve teaching methods, promoting problem solving skills, increases students engagement, supports inclusive education and keeps education relevant.

Innovation in science education within academia must be:

1. **Research-driven** – informed by evidence-based pedagogical studies and discipline-based education research.
2. **Interdisciplinary** – integrating science with technology, engineering, social sciences, and humanities to address complex global challenges.
3. **Problem-oriented –** focusing on real-world applications, design thinking, and translational research.

Generally, our curricula must reflect not only foundational theories but also emerging scientific frontiers. We must continuously revise course content to incorporate developments in data science, artificial intelligence, climate science, biotechnology, and other rapidly evolving fields.

Furthermore, innovation in academia demands that we reconsider assessment models. Are our evaluation frameworks measuring deep conceptual understanding, research competence, and critical thinking — or merely factual recall? The 21st century requires scholars who can analyze, synthesize, and innovate.

Digital Transformation in Higher Education

Digital transformation is important for schools bcause it improves how students learn, and how institutions operate. According to Hurb (2020), digital tools improve schools efficacy and enable better decision making through data. It enhances teaching and learning. Study by QECD (2019). shows that technology supports better learning outcome when combined with effective teaching practice. Likewise digital transformation helps to expand access to education. The world bank

(2020). highlight that digital learning helps researcher understands population and ensures during.

Sustainable Science Education: Institutional Responsibility

Sustainability within science education must be understood in both environmental and systemic terms. As academic institutions, we bear responsibility for cultivating graduates who are equipped to confront global challenges such as climate change, biodiversity loss, food security, renewable energy transitions, and public health crises. Science education must therefore embed sustainability principles across curricula rather than isolating them within specialized courses.

Moreover, sustainable science education requires:

1. Strengthened research infrastructure.
2. Long-term funding commitments for scientific inquiry.
3. Mentorship pipelines for early-career researchers.
4. Gender and diversity inclusion in STEM disciplines.
5. Institutional policies that promote environmentally responsible campus practices.

Sustainability also means ensuring that our educational systems remain adaptable, resilient, and responsive to societal needs. Higher institutions must remain spaces where rigorous inquiry, ethical reflection, and innovation coexist harmoniously.

The Role of Academic Leadership in Innovation, Digital Transformation, and Sustainable Science Education

As researchers, and academic leaders, our influence extends beyond lecture halls and laboratories. We must Champion inquiry-based learning and undergraduate research opportunities. We need to foster industry-academia partnerships to enhance experiential learning. We need to advocate for policy reforms that strengthen STEM education nationally and globally. Also, we need to mentor the next generation of scientists with integrity and intellectual humility.

Our scholarly work must bridge theory and practice. Publications, policy briefs, and community outreach must reflect the societal relevance of our research endeavors.

Academic leadership must also prioritize education development programs that enable educators to integrate digital tools, innovative pedagogies, and sustainability frameworks effectively.

Conference Expectations and Scholarly Engagement

This conference provides a vital platform for intellectual exchange. Over the coming sessions, we will engage with research findings, pedagogical innovations, technological applications, and policy perspectives that shape the future of science education.

I encourage participants to:

Share empirical evidence and best practices.

Engage in constructive critique and interdisciplinary dialogue.

Form collaborative research networks that extend beyond this conference.

Let this gathering generate not only discussions, but actionable frameworks and research agendas that inform institutional strategies.

Conclusion

In closing, innovation, digital transformation, and sustainability are not isolated ambitions. They are interconnected imperatives that define the mission of modern academia.

If we are to remain relevant as institutions of higher learning, we must embrace transformation while preserving the core values of scholarship: rigor, integrity, curiosity, and service to humanity. Let us commit to advancing science education that is intellectually robust, technologically empowered, and socially responsible.

I thank you all for your dedication to this cause and wish us a conference marked by insightful deliberations, meaningful collaborations, and lasting impact.
Thank you.

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A WELCOME ADDRESS PRESENTED TO THE ASSOCIATION OF SCIENCE EDUCATORS ANAMBRA STATE AT ITS SECOND CONFERENCE ON THE THEME: INNOVATIONS, DIGITAL TRANSFORMATION AND SUSTAINABLE SCIENCE EDUCATION IN THE 21ST CENTURY.

REVD CANON DR H. O. N. BOSAH

AG. PROVOST, ARCHBISHOP ALEXANDER IBEZIM COLLEGE OF EDUCATION NIBO-NISE

On behalf of the Proprietor of this citadel of learning, His Grace, The Most Revd Alexander Chibuzo Ibezim, Arcbishop Ecclesiastical Province of the Niger and Bishop, Diocese of Awka, the College Governing Council, College Management and the entire College Community, I cordially welcome the Association of Science Educators, Anambra State and its cream of attracted conferees to Archbishop Alexander Ibezim College of Education, Nibo-Nise: A Centre Par Excellence in Teacher Education.

Conscious of the fact that that we are here for an intentional academic conference - a gathering where scholars and experts have deliberately gathered to foster meaningful discussions, collaborations, and knowledge sharing around a specified theme, quite different from mere traditional conference; engagement, interaction, and outcomes are set to be prioritized over mere presentation of papers. We are therefore here for a curated dialogue, rather than mere series of lecture presentations.

Lead discussions on innovations, digital transformation and sustainable science education in the 21st century shall consequently be interrogated as a theme, across academic seniority levels, diverse experiences, and intellectual interests among the conferees. Focus on how learning, networking, exploring and how digital transformation will impact research areas will be anticipated. Sharing experiences, application discussions, inter disciplinary interactions and collaborative explorations will not be left out .

Research papers will therefore be anticipated from diverse areas of interests, such as data-driven research; digital tools & methods with modeling, computational techniques; collaboration & data sharing enhanced through digital platforms; open science initiatives and impacts on disciplines, simulation and predictive modeling.

Finally, sharing insights, and shaping future development directions would apparently constitute a path finder to the Conference colluding remarks. Panel discussants will constitute the much needed brainstorming in this conference.

We earnestly pray that the conference turns out a huge success, with a scholarly proceeding and publication that will positively project the association in the community of sound academics. This second conference shall not be the last but an improvement on previous ones with sustainable qualitative development in the future.

Revd Canon Dr H. O. N. Bosah

Ag. Provost, Archbishop Alexander Ibezim College of Education Nibo-Nise.

MERITORIOUS AWARD
CITATION OF DR. SULEIMAN DAMBAI MOHAMMED

Dr. Suleiman Dambai Muhammed was born to the family of Mallam Mohammed Ozaki Toto in Toto Local Government Area of Nasarawa State on 2nd June 1961. He attended Government Teachers' College Wukari from 1975-1980. He proceeded to the prestigious Ahmadu Bello University Zaria, first to Institute of Education from 1985-1989 and then Faculty of Education from 1990-1995 where he obtained his NCE and B.Sc Ed. (integrated Science)

After his First Degree, Dr. Suleiman proceeded to University of Jos Plateau State, where he obtained M.Sc (Ed) Biology in 2003. He later enrolled and obtained his Ph.D in Science Education in University of Abuja (Nigeria) in 2016.

Dr. Suleiman started his work Career as a Lecturer III in Nasarawa State College of Education Akwanga from 1998-2002. He later transferred his services to FCT College of Education, Zuba-Abuja as Lecturer II in 2002 and rose through the ranks to the Chief Lecturer in 2017. In 2020 he transferred his services to Federal University of Lafia Nasarawa State as Senior Lecturer. In 2023; he was promoted to the rank of Associate Professor by the University.

During his career, he had served as Head of Department, Member Junior Staff, Appointment Promotion and Disciplinary Committee, Etc in both Colleges (College of Education Akwanga and Zuba).

In recognition of his astute leadership qualities and administrative acumen, he was appointed as Acting Head of Department, Science Education in 2022 by the Vice Chancellor, Professor Shehu AbdulRahman, The position he is still holding till date. He is a Member of the Senate of the University of Lafia.

Dr. Suleiman has some honors and distinctions to his name. Some of them are; The Best Lecturer, the Best Teaching Practice Coordinator and the Best Head of Department of FCT College of Education Zuba 2007, 2009 and 2012 respectively.

Dr. Suleiman has over forty (40) publications in reputable Journals both nationally and internationally, numerous papers presented at National and International Conferences, contributions to chapter in Textbooks and a number of Textbooks

He is a member of the following organizations: International Research and Development Institute (Research and Development Network) from 2012 to date; Academic Staff Union of Universities (ASUU); Teachers' Registration Council of Nigeria (TRCN) etc.

Amongst countries he has visited are Singapore, Saudi Arabia, and Dubai. He is married with Children.

He is now an Associate Professor with the Federal University of Lafia, Nasarawa State.

FOREWORD

It is with great pleasure that I present this conference proceedings, which brings together a rich collection of scholarly works centred on digital literacy and its transformative role in contemporary education. The articles featured in this volume, collectively reflect the growing recognition that digital competence is no longer optional but essential for effective teaching, learning, and sustainable development in the 21st century.

A dominant theme across the contributions is the critical role of digital literacy in enhancing students' academic achievement, particularly in core subject areas such as Mathematics, Chemistry, Biology, and Basic Science. Several studies in this volume establish digital literacy competence as a strong predictor of learners' performance, while also demonstrating how innovative instructional strategies such as science video instruction and virtual learning environments can significantly improve learning outcomes.

The proceedings also highlight the importance of equipping educators with the necessary digital skills. Papers examining teachers' digital competence, awareness, and utilization of educational technologies reveal both progress and gaps, underscoring the urgent need for continuous professional development. Contributions focusing on tools such as Google Classroom and Google Scholar further illustrate how accessible technologies can enrich teaching practices and expand learning opportunities when effectively deployed.

Another notable strand of research in this collection explores personalized and technology-driven learning approaches. Studies on online platforms, personalized learning environments, and digital assessment practices demonstrate how technology can support learner-centred education and foster improved engagement and achievement. These insights are particularly relevant in advancing flexible and inclusive education systems.

Beyond classroom practice, the proceedings also address broader systemic and societal dimensions. Papers examining the sustainability of academic programmes within current economic realities, as well as the role of digital education in promoting national development, provide valuable perspectives for policymakers and educational leaders. Additionally, interdisciplinary contributions such as those linking digital literacy with physical and health education and environmental monitoring systems underscore the expanding scope of digital competence across diverse fields.

Collectively, the papers in this volume make a significant contribution to knowledge by providing empirical evidence, practical insights, and innovative approaches to integrating digital literacy into education. They not only deepen our understanding of current challenges but also offer actionable pathways for improving teaching and learning in Nigeria and beyond.

It is my hope that this compilation will serve as a valuable resource for researchers, educators, policymakers, and all stakeholders committed to advancing education through technology. May it inspire further inquiry, collaboration, and innovation in the pursuit of quality and sustainable education.

Telima Adolphus, *FHEA.*
Professor of Science Education,
Rivers State University.

PREFACE

This years' conference on innovations, digital transformation and sustainable science education in the 21st century is meant to educate and re-educate science educators effectively. It exposed educators towards evolving scientific and technological world. Science educators must embrace digital tools and resources to enhance their teaching methods, re-structure learners' mindset, foster students' scientific literacy, critical thinking and problem-solving skills. This includes leveraging online platforms, using educational technologies and digital content to create engaging and meaningful learning experiences.

In this conference proceedings efforts has been made towards promoting the use of digital tools in science education.

Prof. Josephine N. Okoli
Science Education Department
Nnamdi Azikiwe University, Awka,
Anambra State, Nigeria.

ADDRESS OF THE ACTING PRESIDENT OF ASSOCIATION OF SCIENCE EDUCATORS ANAMBRA (ASEA), DR. JOHNBOSCO ONYEKACHUKWU OKEKEOKOSISI; AT THE OPENING CEREMONY OF THE 2ND ANNUAL CONFERENCE HELD AT ARCHBISHOP ALEXANDER IBEZIM COLLEGE OF EDUCATION NIBO-NISE, ANAMBRA STATE, NIGERIA ON 9TH APRIL, 2026.

The chairman of the occasion, Dr.Ven. Nnamdi Emendu,
Mother of the Day, Dean School of Science Education, Federal College of Education (Technical) Umunze, Dr. Stella O. Okoli.
Special Guest of Honor, Deputy Mayor Anambra East, Hon. Lady Dr. Martina Nwawube
The Executive Provost of ArchBishop Alexander Ibezim College of Education, Nibo- Nise, Revd. Canon Dr. H.O.N. Bosah
Our Esteemed Keynote and lead Paper Presenters, Drs: Peter I.I. Ikokwu, Emmanuel O. Okonta
Meritorious Awardee: Suleiman Dambai Mohammed
The Local Organizing Committee (LOC)
My Fellow Science Educators,
Distinguished Guests,
Ladies and Gentlemen

I am highly delighted to extend awarm royal welcome to you all at the opening ceremony of the 2nd Annual Conference of Science Educators Anambra (ASEA) on the **Theme: Innovations, Digital Transformation and Sustainable Science Education in the 21St Century.**

I welcome most heartily the Executive Provost of ArchBishop Alexander Ibezim College of Education, Nibo- Nise, Revd. Canon Dr. H.O.N. Bosah, the chairman of the occasion Dr.Ven. Nnamdi Emendu, Special Guest of Honour, Deputy Mayor Anambra East, Hon. Lady Dr. Martina Nwawube, our erudite mother of the day Dr. Stella O. Okoli, Dean School of Science Education, Federal College of Education (Technical) Umunze for honoring our invitation. Your presence is a great source of inspiration and we are grateful for your unwavering support towards science education in the state.

To our Host, Board of Directors Prof. Josephine N. Okoli, Prof. Isaac N. Nwankwo and Prof. M.C. Anaekwe, Local Organizing Committee (LOC),I say thank you for you have worked round the clock towards the success of this years' conference.

Special thanks also go to our Meritorious Awardee, Dr. Suleiman Dambai Mohammed whose contributions to teaching and learning in tertiary institutions lead to the foundation of our members.

We have gathered not just to deliberate on academic issues but to collectively reflect and shape our minds on possible ways to educate learners and re-educate ourselves on **"innovations, digital transformation and sustainable science education in the 21st century".** The stated conference theme is very apt considering the fact that we are in the digital age and are advocating for possible ways to educate learners for fast, easy understanding and recall.

Participants will be taken through hands-on and minds-on activities in various sessions and they will find the conference package very rewarding. I invite you to pay attention during keynote address to be presented by Dr. Peter I.I. Ikokwu, Nwafor Orizu College of Education, Nsugbe, Anambra State, Nigeria. Your continuous attention is also needed during the lead paper presentation of Dr. Emmanuel O. Okonta, Dean Students Affairs, Federal College of Education (Technical) Asaba Delta State, Nigeria.

To all participants – educators, researchers, students, policy makers – thank you for making out time to be here. Your presence signifies hope for the future of science education. I urge you to make the most of this gathering by networking, exchanging ideas and exploring new strategies to embed innovative and digital practices in science classroom and curricula.

As we officially declare this conference open, let us do so with a shared sense of purpose and vision. Let us reflect, discuss intelligently and leave this gathering better equipped. May our deliberations be fruitful and beneficial to all .

Thank you and God bless you all.

Dr. JohnBosco O.C. Okekeokosisi

Ag. President ASEA

9th April, 2026

A KEY NOTE ADDRESS PRESENTED AT 2ND CONFERENCE OF THE ASSOCIATION OF SCIENCE EDUCATORS ANAMBRA ON APRIL 09, 2026

THEME: INNOVATION, DIGITAL TRANSFORMATION AND SUSTAINABLE SCIENCE EDUCATION IN THE 21ST CENTURY.

Harnessing Innovation and Digital Transformation for Sustainable Science Education in the 21st century

I am honored and indeed humbled to speak at this esteemed conference of the Association of Science Educators Anambra . As we gather here today, we recognize the pivotal role science education plays in shaping the future of our nation. The theme of this conference, "Innovation, Digital Transformation and Sustainable Science Education in the 21st century" is particularly apt, as it highlights the need for a paradigm shift in our approach to science education. I also see it as a veritable follow up on the theme of our maiden conference, "Science Education and Digital Literacy in the 21st Century", which provided the tools for the implementation of the obvious demands of this conference. I commend the organizers proper articulation

The Challenge Before Us

Nigeria's science education sector faces numerous challenges, including inadequate infrastructure, outdated curricula, and a shortage of skilled teachers. These challenges hinder our ability to produce globally competitive scientists and innovators. According to UNESCO(2022), Nigeria has one of the lowest science literacy rates in the world, with only 22% of students achieving a minimum level of proficiency in science. This is unacceptable, given the critical role science plays in driving economic growth and development. To give a broader look at the theme, the key factors in the were briefly discussed.

Innovation in Science Education

Innovation is key to driving sustainable science education. We must:

1. ***Foster inquiry-based learning***: Encourage curiosity, creativity, and problem-solving skills. This involves shifting from a teacher-centered to a student-centered approach, where students are encouraged to explore, investigate, and discover concepts on their own.
2. ***Industry-academia collaboration:*** Foster partnerships to develop relevant curricula and provide real-world experiences. This includes collaborations with industries to provide internships, mentorship, and research opportunities for students.
3. ***STEM education:*** Emphasize science, technology, engineering, and mathematics to equip students with skills for the future. This includes promoting interdisciplinary approaches to learning, where students work on real-world problems that require integration of multiple subjects.

Digital transformation

Digital transformation is the strategic integration of digital technologies into all areas of an organization to improve operations, enhance customer experience, a nd sustain competitive advantage.

Definition and Purpose

Digital transformation involves **rewiring an organization** to continuously deplo y technology at scale, enabling improved efficiency, innovation, and value creati on. It is not a onetime project but an ongoing journey that reshapes how businesses operate, inter act with customers, and

deliver products or services. The ultimate goal is to **me et evolving customer expectations** edge in a rapidly changing digital landscape.

Key Components

1. **Strategy and Roadmap**: A clear digital transformation strategy focuses o n specific domains such as customer journeys, processes, or functions that generate significant business value. A detailed roadmap guides the imple mentation of solutions and allocation of resources.
2. **Technology Integration**: Organizations adopt technologies like **cloud co mputing, big data analytics, AI, mobile applications, and social media platforms** to modernize operations and create new revenue streams.
3. **Talent and Culture**: Successful transformation requires a strong inhouse digital talent pool, agile HR processes, and a culture that encourage s innovation and collaboration.
4. **Operating Model**: Scalable operating models, such as digital factories, pr oduct and platform models, or enterprisewide agility frameworks, support cross-functional teams and largescale digital initiatives.
5. **Change Management**: Digital transformation is as much about **organizational change** as technology adoption. Leadership alignment, employee engagement, and continuous monitoring of key performance indicators (KPI s) are essential.

Benefits

- **Enhanced Customer Experience**: Personalized, seamless interactions across channels.
- **Operational Efficiency**: Streamlined processes and reduced costs.
- **Innovation and Growth**: Ability to create new products, services, and business models.
- **Resilience and Agility**: Faster adaptation to market changes and emerging technologies.

Sustainable Science Education

Sustainable science education is a critical component of the 2030 Agenda for Sustainable Development, aiming to equip learners with the knowledge, values and s kills necessary to address complex environmental and social challenges. Taylor in Emendu(2018) presented sustainable development as development that continues to meet today's needs in ways that will not jeopardize future generations. UNESCO(2023) observed that sustainable science education requires a multifaceted approach:

1. Curriculum reform: Develop curricula that address local challenges and global trends. This includes incorporating emerging fields like artificial intelligence, biotechnology, and renewable energy into the curriculum.

2. Teacher training: Provide continuous professional development for educators. This includes training on digital literacy, pedagogical in integrates learning, skills, and knowledge to achieve global goals and promote sustainable development.

3. Development: Invest in modern laboratories and equipment. This includes leveraging public-private partnerships to upgrade infrastructure and provide access to cutting-edge technology. The 2030 agendaintegrates learning, skills, and knowledge to achieve global goals and pro mote sustainable development

UNESCO's ESD for 2030: This program produces and shares knowledge, offers policy guidance, and implements projects on the ground to strength en countries' capacity to provide quality climate change education and 'green' every aspect of learning.

- **Science Education in Nigeria:** Functional science education is urgently required to promote scientific knowledge for sustainable development, with a focus on practical skills for individual and national development.
- **Science on Stage Germany:** This project offers STEM teachers wide range of hands-on teaching materials to develop 21st century skills and promote skills and knowledge in the classroom.

These initiatives reflect a global commitment to integrating sustainability into science education, ensuring that students are equipped to make informed decision s that benefit both the environment and society.

Innovation, Digital Transformation and Sustainable Science Education in the 21st Century

The 21st century is characterized by rapid technological advancements and evolving societal needs, prompting a significant transformation in education systems globally. This includes the integration of technology, the development of essential 21st century skills, and the prioritization of student centered learning. These shifts enhance student engagement and performance while contributing to more inclusive and equitable learning environments. Innovative practices and adaptive strategies are essential for addressing these challenges. They promote creativity, critical thinking, collaboration, and resilience, which are vital for preparing learners to navigate the complexities of a rapidly changing world.

The integration of digital technologies in education is a powerful tool for advancing Sustainable Development Goals (SDGs) and fostering behavioral shifts toward sustainability. Digital education offers opportunities to integrate SDGs across
all levels and forms of education, responding to evolving needs and challenges. UNESCO supports the use of digital innovation to expand access to educational opportunities, advance inclusion, and enhance the relevance and quality of learning. It promotes digital inclusion and guides international efforts to accelerate pr ogress toward education goals.

By embracing these changes, education systems can better equip students for success in a complex, interconnected global landscape. Recent innovations in science education are transforming teaching and learning through technology integration, personalized learning, and immersive experiences**.**

Key Innovations in Science

Technology Integration: The use of **virtual reality (VR)** and **augmented reality (AR)** is becoming increasingly prevalent in science classrooms. These technologies allow students to engage in immersive learning experiences, such as exploring the human body or conducting virtual experiments, which enhance understanding of complex scientific concepts.

Artificial Intelligence (AI): AI driven personalized learning systems are being implemented to tailor educational experiences to individual student needs. These systems can adapt the difficulty of materials based on performance, provide real time feedback, and automate grading, making learning more efficient and effective.

Interactive Simulations: Interactive simulations are being used to create engaging learning environments where students can experiment and visualize scientific phenomena. This handson approach helps students grasp difficult concepts an d fosters critical thinking skills.

Interdisciplinary Approaches: There is a growing recognition of the importance e of integrating science education with other disciplines, such as technology, engineering, and mathematics (STEM). This interdisciplinary approach prepares students for real world challenges and promotes a more holistic understanding of scientific principles.

Focus on Equity and Inclusion: Innovations in science education are also addressing issues of equity and inclusion. Programs are being developed to recruit an d retain diverse educators and to create inclusive learning environments that support all students, particularly those from underrepresented backgrounds.

Science Education Innovations - Full Analysis (Updated 2024)

1. **Babbel - Innovative Language Learning for Science Education**
2. **PIMSLEUR** - Innovative Language Learning for Science Education
3. **MONDLY** - Revolutionizing Science Education Globally
4. **Rosetta Stone** - Master Language Learning with Ease
5. **LingQ** - Innovative Language Learning Platform
6. **Memrise** - Innovative Language Learning Platform
7. **Busuu** - Language Learning Made Simple and Effective
8. **ITALKI** - Personalized Language Learning Platform
9. **Skillshare** - Empowering Creative Learning Worldwide
10. **VARSITY TUTORS** - Personalized Learning Solutions

Conclusion

The landscape of science education is rapidly evolving, driven by technological a advancements and a commitment to improving learning outcomes. By embracing these innovations,

educators can create more engaging, effective, and inclusive science learning experiences that prepare students for the challenges of the future. As these trends continue to develop, they will play a crucial role in shaping the future of science education.

The Digital Imperative

The digital revolution has transformed every aspect of our lives, including education. To remain relevant, science education must leverage digital tools and technologies. They include:

1. **E-learning platforms:** Online resources and virtual labs can enhance learning outcomes and increase access to quality education. For instance, platforms like Coursera and edX have democratized access to global knowledge, allowing students to access top-class courses from anywhere in the world.
2. **Digital literacy:** Educators must develop skills to effectively integrate technology into their teaching practices. This includes using tools like simulations, animations, and games to make learning more engaging and interactive.
3. **Data-driven instruction**: Leveraging data analytics to inform teaching and learning. By analyzing student performance data, educators can identify areas of strength and weakness, tailor instruction to meet individual needs, and improve learning outcomes.

Case Studies: Success Stories in Nigeria

There are several success stories in Nigeria that demonstrate the impact of innovation and digital transformation in science education. For instance:

1. The African Leadership in Science Program (ALSP) has trained over 1,000 science teachers in Nigeria, improving science education in over 500 schools.
2. The Nigeria Science Foundation has invested over ₦1 billion in science education projects, including the development of science clubs and competitions.

As educators, we have a critical role in shaping Anambra and indeed Nigeria's future. By harnessing innovation and digital transformation, we can create a sustainable science education system that produces globally competitive scientists and innovators.

Let us work together to:

3. Develop a digitally enabled science education system
4. Foster a culture of innovation and inquiry
5. Build partnerships for sustainable science education

Together, we can create a brighter future for Nigeria through science education.

Recommendations

The national education sector should:

1. Establish a national policy on science education that prioritizes innovation and digital transformation.
2. Invest in digital infrastructure and teacher training programs.
3. Foster partnerships with industries and international organizations to support science.

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LEAD PAPER PRESENTATION OF THE CONFERENCE

THEME: INNOVATION, DIGITAL TRANSFORMATION AND SUSTAINABLE SCIENCE EDUCATION IN THE 21ST CENTURY.

Okonta, Okechukwu Emmanuel (PhD, FNCS, MCPN, MIAENG)

The Symbiotic Triangle: Weaving Innovation, Digital Transformation, and Sustainability into 21st Century Science Education

Introduction

The 21st century is defined by its dual, often contradictory, nature. It is an era of breathtaking innovation and Digital Transformation, where artificial intelligence can diagnose diseases and virtual reality can transport a student to the surface of Mars. And it is also an era of profound, interconnected crises—climate change, biodiversity loss, and persistent social inequality—that collectively threaten the sustainable future of our planet. At the crossroads of this paradox lies education, specifically Science Education. The central challenge for educators and policymakers is no longer simply about equipping students with scientific facts, but about fostering the complex competencies needed to navigate an uncertain future.

In this context, science education cannot remain static. It must evolve to prepare learners not just to consume knowledge, but to innovate solutions, leverage digital tools responsibly, and act sustainably at all times. Therefore, there must be a pedagogical shift towards sustainability competencies and a deep, structural integration of digital technology.

However, as evidence from international bodies and cutting-edge research makes clear, ***technology alone is not a panacea***. True transformation occurs not when digital tools are used as a substitute for traditional methods, but when they are deliberately deployed to enable inquiry-based, collaborative, and real-world learning that prepares students to become active agents of a more sustainable world.

Furthermore, we can assert that the future of effective science education lies at the intersection of three powerful forces: ***Innovation, Digital Transformation, and Sustainability.*** These are not isolated trends but rather the vertices of a symbiotic triangle. Innovation provides the pedagogical drive to rethink how we teach; digital transformation offers the tools and infrastructure to scale and deepen this new pedagogy; and sustainability provides the critical purpose and context—the "why"—those grounds learning is the most pressing challenges of our time. This lead paper will explore each vertex and demonstrate how their convergence creates a robust framework for preparing a generation of uncompromising scientists, digital citizens, and undeterred innovators capable of thriving in and healing the world.

Innovation as the Catalyst for Modern Science Education

For decades science education was often a didactic transfer of facts, formulas, and established theories. In today's world, this is no longer sufficient. The 21st century, demands a different approach. Innovation in pedagogy means shifting the focus from learning about science to doing science.

Redefining the "Scientific Method" for the 21st Century

The traditional, linear scientific method is being augmented by more iterative, collaborative, and interdisciplinary approaches. Projects across Europe exemplify this shift. The **InNature** project,

for instance, introduces biomimicry as a core pedagogical framework. Instead of simply reading about natural phenomena, students are challenged to "understand, learn from and copy the strategies used by living things, with the intention of creating sustainable, innovative designs and technologies". This is innovation in action—teaching students to view nature not just as a subject to be studied, but as a database of proven solutions to be emulated.

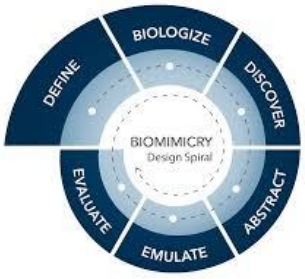

Diagram 1: Biomimicry Design Spiral

From Rote Learning to Inquiry-Based Exploration

Biomimicry

Biomimicry is the innovation method of studying nature's models, systems, and processes to solve complex human problems sustainably. By emulating natural forms (design), processes (chemistry), and ecosystems, it aims to create more efficient and regenerative technologies. Common synonyms include bio-inspired design. biomimetics, and nature-based innovation

LESTO (Learn and Experience Science Together Online) - Education

- ***Context:*** *This project was developed as a direct response to the COVID-19 pandemic, which forced school closures and interrupted practical science teaching.*
- ***Focus:*** *It aimed to create a "Hands-on Science Education Platform" to combine practical, physical science kits with digital tools, aimed at students aged 10–14.*
- ***Post-COVID Impact:*** *Even beyond the immediate pandemic, the project addresses ongoing needs for digital tools, improved student engagement, and increased equity in education for disadvantaged students and girls.*

Innovation also means breaking down the classroom walls. The TASTE project uses planetariums as immersive learning environments, allowing students to "'move closer' to distant objects, feel the enormity of space or speed up time". This experiential framework moves learning from abstract reception to tangible, emotional experience, dramatically increasing motivation.

Similarly, the LESTO project, born out of the necessity of the COVID-19 pandemic, developed an online platform for hands-on science experiments. This ensures that even in remote settings, or for students from disadvantaged backgrounds, science learning remains an active, inquiry-based process. These examples demonstrate that pedagogical innovation is about creating active, engaging, and context-rich experiences that foster genuine curiosity and deeper cognitive processing.

TASTE Project (Erasmus+): *The Teaching ASTronomy at educational level (TASTE) project is a European initiative involving planetariums and science centres that uses digital dome technology to teach topics like seasons and space sciences to students.*

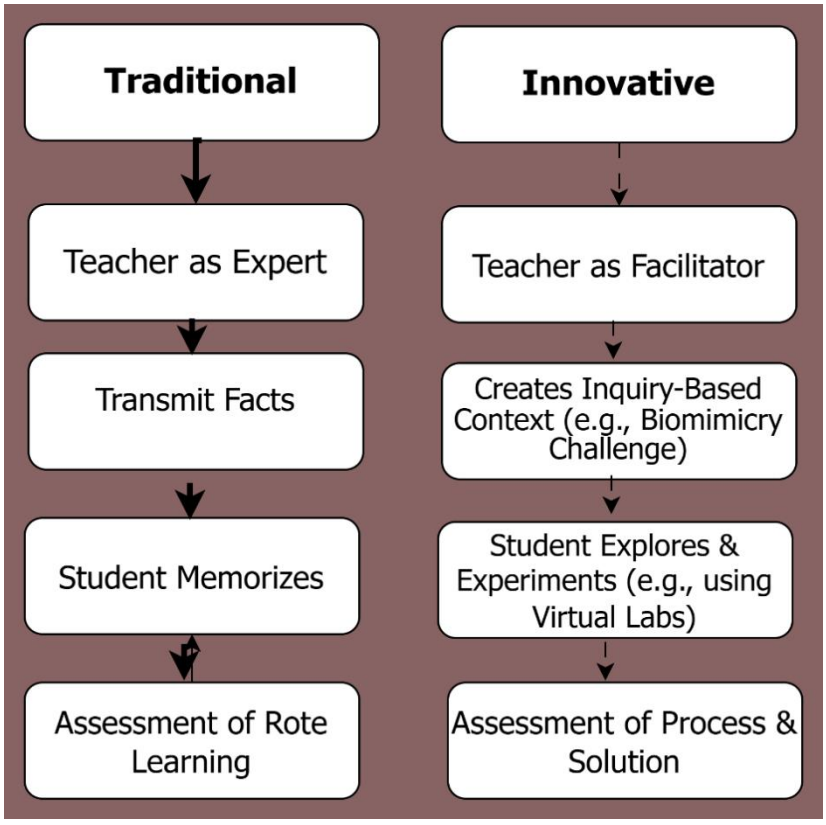

Diagram 2: The Shift from Traditional to Innovative Pedagogy

Digital Transformation—The Scaffolding for Deeper Learning

If innovation is the catalyst, digital transformation provides the essential scaffolding. It is the ecosystem of tools, platforms, and data that makes new forms of learning possible, accessible, and scalable. This goes far beyond simply replacing chalkboards with interactive whiteboards; it is a fundamental shift in the infrastructure of learning.

The Digital Toolkit: From Virtual Labs to Satellite Data

The modern science classroom is no longer confined to a single room. It extends into virtual spaces and draws upon professional-grade data. The LESTO project's online portal for science experiments allows students to safely "carry out science experiments online and receive feedback from teachers and peers". Even more powerful is the use of authentic scientific data. The CDEC (Climate Data Entrepreneurial Club) project at the University of Paderborn brings "freely available European geo and earth observation data" directly into the hands of students. Learners in grades 10-13 use actual satellite data to develop their own sustainability projects, acquiring expertise in computer science and data analysis in the process. This is digital transformation at its most potent—democratizing access to the same tools that professional climate scientists use.

Fostering Collaboration and Visual Literacy

Digital tools also revolutionize how students interact with information and each other. The ability to create, manipulate, and annotate visual representations is a key 21st-century skill. Tools like Draw.io enable students to build "concept maps," "scientific illustrations," and "process flows," which are high-impact instructional strategies with significant effect sizes on learning. Concept mapping, for example, helps students move towards the "Relational" and "Extended Abstract" levels of understanding by visually linking ideas.

Furthermore, collaborative annotation tools like Hypothesis now allow for "image annotations," enabling students and teachers to place pins and comments directly on "charts, graphs, and other visuals in online PDFs". This "brings the full page into the conversation," allowing for rich, collaborative deconstruction of complex scientific diagrams and data visualizations. The Victorian government's educational strategy even formalizes this as "joint construction of visual representations," where students collaboratively annotate maps and diagrams to design solutions for local environmental problems.

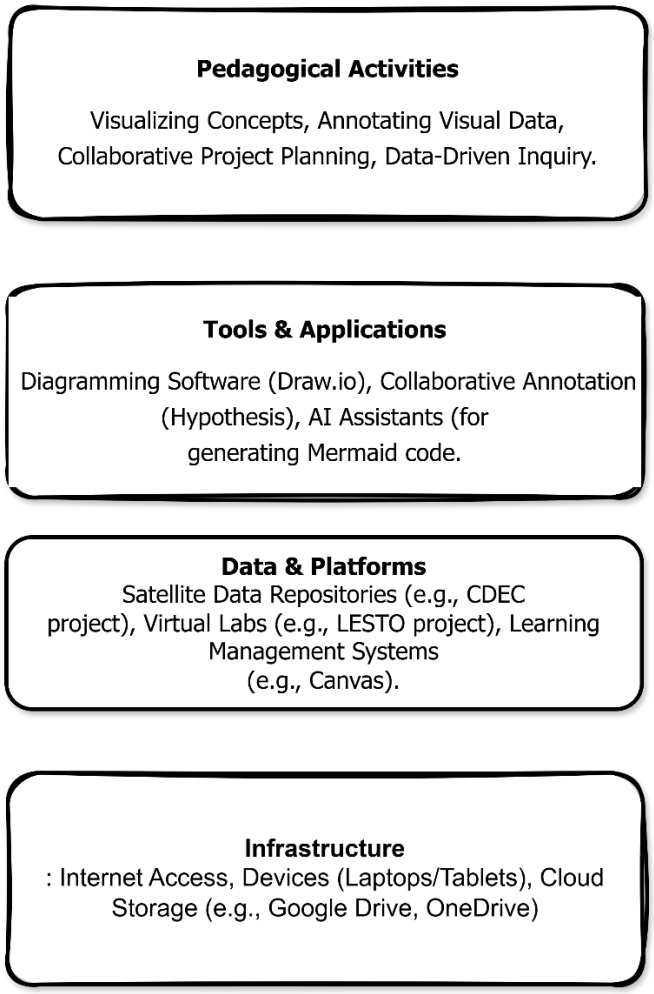

Diagram 3: The Layers of Digital Transformation in Education

Sustainable Science Education—The Guiding Light

Innovation and digital tools, while powerful, remain directionless without a guiding purpose. In the 21st century, that purpose must be sustainability. A Nature Collection on "Education in the Anthropocene" argues that education is the key to "producing sustainability-oriented technologies, and their integration with everyday societal needs". It posits that a misalignment between technological innovation and societal understanding risks creating a world with advanced green technologies that populations cannot afford, integrate, or accept.

Education in the Anthropocene focuses on fostering ecological literacy, systemic thinking, and agency to prepare learners for a rapidly changing planet were human activity shapes Earth's systems. It moves beyond traditional curricula to emphasize interconnectedness, sustainability, and action-oriented approaches that foster resilience, ethics, and "planetary health" in response to environmental crises. ScienceDirect.com

Education for the Anthropocene: A New Foundational Ethos

Sustainable science education, therefore, is not just an add-on topic about recycling or climate change. It is a foundational principle that frames all scientific inquiry. It asks students to consider the socio-economic realities, ethical implications, and long-term impacts of scientific and technological solutions. The ***SHORE*** project embodies this by aiming to "increase scientific literacy about European seas and rivers" and directly supports the EU Mission to "Restore our Oceans and Waters". Students are not just learning marine biology; they are engaging in "blue curricula" to actively safeguard biodiversity.

Developing Competencies for a Green and Digital Transition

The Shore Project (Shore - School Outreach for Ocean Restoration) Is A Horizon Europe-Funded Initiative Empowering Schools to Promote Blue Sustainability in Five Key European Regions: Baltic, Black, Mediterranean, Danube, And Rhine. It Provides Up To €10,000 In Grants Per School Project to Foster Ocean Literacy, Empowering Youth to Become Agents **of Change in Water Protection.**

This new focus demands a new set of competencies. Students must learn to navigate the "interconnected matrix (human-economic-societal)" that determines whether a sustainability-oriented technology succeeds. This involves critical thinking about "values embedded in the transition economy" and understanding the "societal barriers" to change. The interdisciplinary approach of the CDEC IT/ Technology Services, which brings together geography, computer science, and entrepreneurial education, is a direct response to this need, training teachers to help students become "data literate" and apply that literacy to climate action. The goal is to create citizens who can not only understand a graph of rising CO_2 levels but can also use data to advocate for and implement local solutions.

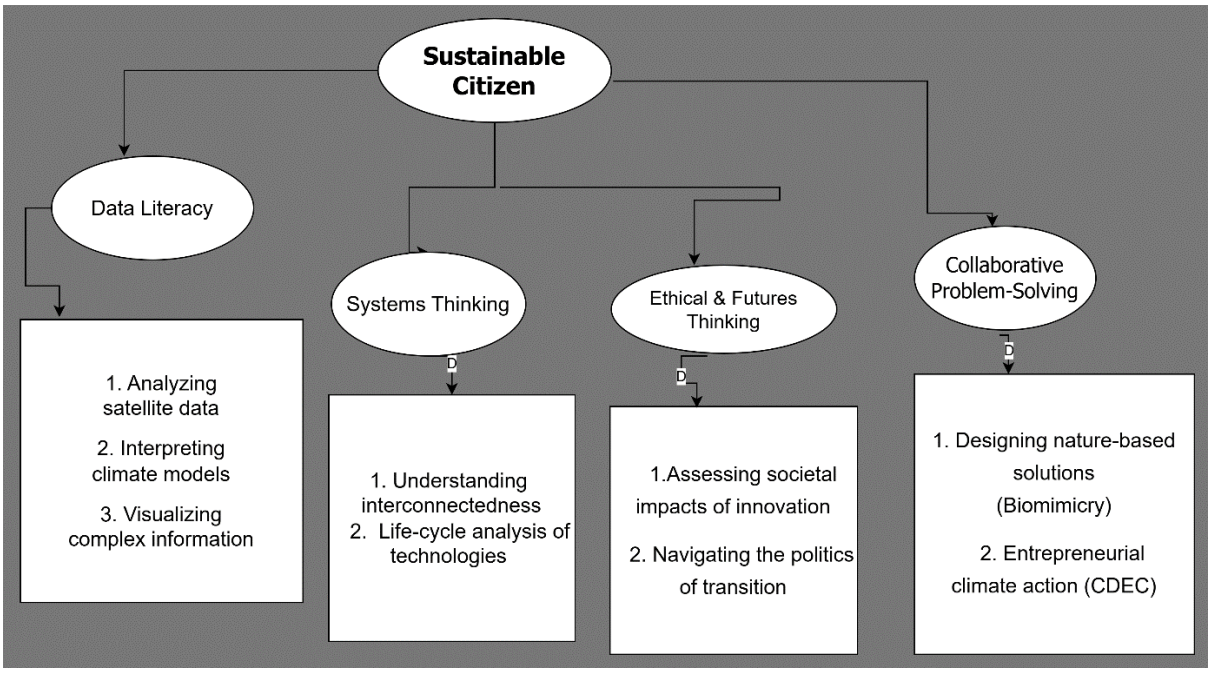

Diagram 4: Competencies for the Green-Digital Transition

Synthesis: The Symbiotic Triangle in Action

The true power of this framework is revealed when all three vertices—Innovation, Digital Transformation, and Sustainability—converge. They do not operate in silos but in a state of dynamic synergy.

- Digital tools enable innovative pedagogies for sustainability. The CDEC project is a perfect illustration. It uses digital transformation (satellite data, AI tools) to fuel pedagogical innovation (project-based, entrepreneurial learning) with the explicit goal of sustainability (climate action projects). The digital data is the raw material, the innovative project format is the process, and climate protection is the purpose.
- Innovation redefines how we use digital tools. The move towards "joint construction" and "image annotation" represents a pedagogical innovation in how we use technology. It shifts students from passive consumers of digital diagrams to active, collaborative constructors of visual knowledge, a skill essential for tackling complex environmental problems.
- Sustainability provides the context for innovation. The challenge of "restoring our oceans" or designing a biomimetic solution provides a rich, meaningful, and urgent context that drives student engagement and justifies the use of sophisticated digital tools. It answers the student's question: "Why are we learning this?"

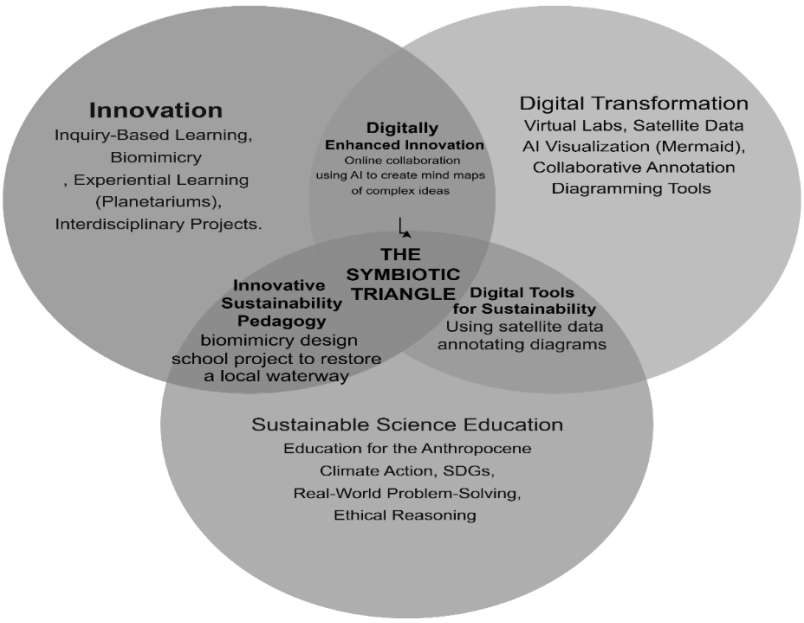

Diagram 5: The Symbiotic Triangle (Venn Diagram)

Description: A three-circle Venn diagram, each circle representing one core concept.
Circle A: Innovation. Keywords: Inquiry-Based Learning, Biomimicry, Experiential Learning (Planetariums), Interdisciplinary Projects.
Circle B: Digital Transformation. Keywords: Virtual Labs, Satellite Data, AI Visualization (Mermaid), Collaborative Annotation (Hypothesis), Diagramming Tools (Draw.io).
Circle C: Sustainable Science Education. Keywords: Education for the Anthropocene, Climate Action, SDGs, Real-World Problem-Solving, Ethical Reasoning.
Overlap A+B (Digitally Enhanced Innovation): Online collaboration spaces for project design, using AI to create mind maps of complex ideas.
Overlap B+C (Digital Tools for Sustainability): Using satellite data to monitor local deforestation, annotating diagrams of carbon capture technologies.
Overlap A+C (Innovative Sustainability Pedagogy): A biomimicry design challenge, a school project to restore a local waterway.
Centre (A+B+C - THE SYMBIOTIC TRIANGLE): The CDEC project—students using digital satellite data (B) in an innovative, project-based format (A) to develop entrepreneurial solutions for climate sustainability (C).

Conclusion: Educating Symbiotic Thinkers for an Interconnected WorldThe challenges of the 21st century are too complex to be addressed by single-discipline, rote-learned knowledge. They demand a new kind of thinker—one who is as comfortable with a satellite data stream as they are with the principles of biomimicry, and who approaches every technological problem with an ethical and sustainable mindset.

The symbiotic triangle of Innovation, Digital Transformation, and Sustainable Science Education provides a roadmap for cultivating this new generation. ***Innovation*** sparks the curiosity and drive to explore; ***digital transformation*** provides the powerful, real-world tools for that exploration; and ***sustainability*** anchors the entire endeavour in the urgent task of building a better, more equitable, and more resilient society. By consciously weaving these three threads together, educators can transform science education from a compulsory subject into a vital, empowering, and hopeful discipline—one that equips learners not just to understand the world, but to innovate within it and sustain it for the future.

Thank you for your patience in listening.

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PAPER 4

ENHANCING TERTIARY STUDENTS' MINDSET TOWARDS LEARNING APPROACH

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Abstract

This study sought to examine tertiary students' mindset towards learning approach. The study was a descriptive survey carried out in south-east Federal Government Universities in Nigeria. The population consisted of all undergraduate students of south-east Federal universities. Purposive sampling were employed to select 3 out of 6 Federal universities in the south east geo-political zones. The researchers in collaboration with co-researchers utilized spontaneous interview method to access undergraduate students' mindset. The level of students utilized were 200 level students and above whose academic programme is for four years. The study utilized multiple response of Strongly Agree (SA) - 4 points, Agree (A) – 3 points, Disagree (D) - 2 points and Strongly Disagree (SD) – 1 which was rated in simple percentages. The instrument adapted for the study was "Enhancing Tertiary students' mindset towards learning (ETSMTL)''. The instrument were validated by experts. Its reliability indices were established to be 80% using Cronbach Alpha. The instrument were administered to undergraduate students by research assistants (co-researchers) and researchers. The administered instrument were recorded on a tape with permission from Director Students Affairs of various institutions. Already collected instrument were handed over to the researchers on the spot. Data were analysed using simple percentages. A criterion percentage rating of 50% was used for decision taking. 50% and above were regarded as stable (fix) mindset while below 50 % were regarded as unstable (growth) mindset. The findings of the study revealed among others that there is need for individual learner to understand himself, his environment and work towards achieving the stated purpose of being in the environment. The study recommended among others that there should be a change on how one perceive challenges, mistakes and feedback.

Keywords: Tertiary Students' Mindset, Learning Approach

Introduction

Learning is an act of communication that involves all forms of behaviours. Learners' behaviour could be viewed by their teachers either verbal communication or non-verbal communication or both during instructional process (Uyoata in Okekeokosisi, Mbaegbu, Nchikwo; 2023). It is the surest way through which learners could acquire knowledge, retain, safeguard knowledge and hand over the acquired knowledge –information to generation after them. The goals of education are not achievable without proper construction of learners' mindset towards learning approach.

Mindset is a set of attitudes and beliefs about one's self in relation to learning and the environment in which one learns. Mindset is defined as an orientation toward frequently asking

oneself questions that elicit the access and use of task-appropriate methods, such as “What can I try to be better at this?”, “How else can I do this?”, or “Is there a way to do this even better?”, especially when faced with difficulty or unproductivity (Chen, Powers, Katragadda, Cohen & Dweck, 2020). Suman (2026) defined mindset as person’s perceptions and beliefs about their capacities, intelligence and potential for success. It is seen as assumptions that shape how an individual perceives, interprets, and responds to situations. Boaler and Dieckmann (2026) opined that mindset aids communication to students that learning is a journey and that times of struggle and challenge are valuable for student brain development, growth and societal benefit. Furthermore, research on mindset conducted by Bjork (1994) suggests that mathematics classrooms should provide students with challenge, and teachers should value struggle and mistakes, reorienting them as “desirable difficulties”. Kapur (2014) investigated the impact of students grappling with complex problems before being shown ways to solve them. In the “productive failure” condition, students worked in small groups to generate their own solution methods to challenging mathematics problems. In the control group, students received direct instruction first and practiced worked examples, the more typical approach of mathematics classrooms. Thus, the research work is anchored on Carol Dweck’s theory *of Mindset: The New Psychology of Success***.** The theory was popularized in the year 2006. The theory states that individuals hold fundamental beliefs about their own intelligence and abilities, which can be categorized into two primary types: a *fixed mindset* and a *growth mindset***.** These mindsets determine how people approach challenges, respond to failures and ultimately, how they achieve success. The theory further emphasized that some learners’ or individual believes intelligence is either fixed (innate) or malleable (growth), profoundly influencing academic motivation, resilience, and achievement. Growth-minded learners embrace challenges and persist through setbacks, while fixed-minded students fear failure and avoid challenges. Educators can cultivate a growth mindset by praising effort and strategies over intelligence, encouraging "yet," and modeling learning from mistakes. This study would anchor on mindset not minding its types.

Tertiary institution in Nigeria could be referred to as post-secondary education. They include Universities, Colleges of Education, Polytechnics and Monotechnics. These institutions have specific goals set for them to achieve by the Federal Government of Nigeria in her National Policy of Education (2014) but generally, its goal is to prepare graduates for the world of work for societal upliftment. Contrary to the general goal of tertiary institutions in Nigeria, quite number of graduates are produced but could not compete in the field of work. Studies conducted by Egielewa 2022), Okwudili (2024) and Akinola and Ashafa (2025) revealed that Nigeria tertiary institutions’ education centers on theoretical knowledge over practical applications. This findings could have resulted to change in learners’ mindset, gap between the training received in their various institutions and labour market demands. This could have led to unstable mindset and contribute to unemployable graduates resulting to mismatch in skill set possessed and work environment. These identified backdrops have necessitated the need for the study.

Statement of the Problem

Unemployability of graduates from Nigeria tertiary institutions from 2015 till 2025 as revealed by National Bureau of Statistics (NBS) could be linked to economic recession, a sharp drop in oil price, lack of professional skills and requisite knowledge on the part of employed graduates. These unsatisfactory results have been a source of concern to stakeholders, researchers and educationist because of the vital role graduates play in economic, social, political, human and national development. This study therefore investigate tertiary institution students’ mindset towards learning.

Purpose of the Study

The purpose of the study is to investigate tertiary institution students' mindset towards learning. Specifically, this study investigated:

1. The percentage of tertiary institution students that retained their mindset in learning approach

Research Questions

The following research questions were formulated to guide the study;

1. What is the percentage of tertiary institution students that retained their mindset in learning approach?

Methodology

This research study employed descriptive survey. The study was carried out in south-east Federal Government Universities in Nigeria. South-east region has 5 states. Each state may have one or two federal universities. The population consisted of all undergraduate students of south-east Federal universities. Purposive sampling were employed to select 3 out of 6 Federal universities in the south east geo-political zones. The selected institutions of higher learning were established for over ten years ago and had graduated students under first degree – undergraduate program. The researchers in collaboration with co-researchers utilized spontaneous interview method to access undergraduate students' mindset. The level of students utilized were 200 level students and above whose academic programme is for four years. Their responses are either Strongly Agree (SA) - 4 points, Agree (A) – 3 points, Disagree (D) - 2 points and Strongly Disagree (SD) - 1 which was rated in simple percentages. The instrument adapted for the study was "Enhancing Tertiary students' mindset towards learning (ETSMSTL)''. The instrument were validated by experts. The validated instrument was made up of two sections. Section A contains the introductory aspect of what is expected of the respondents. Section B contains four options to choose from. Its reliability indices were established to be 80% using Cronbach Alpha. The instrument were administered to undergraduate students by research assistants (co-researchers) and researchers. The administered instrument were recorded on a tape with permission from Director Students Affairs of various institutions. Already collected instrument were handed over to the researchers on the spot. Data were analysed using simple percentages. A criterion percentage rating of 50% was used for decision taking. 50% and above were regarded as stable (fix) mindset while below 50 % were regarded as unstable (growth) mindset.

Results

Research Question 1: What is the percentage of tertiary institution students that retained their mindset in learning approach?

Table 1: Percentage of tertiary institution students that retained their mindset in learning approach

N/S	Questionnaire question	Strongly Agree (SA) %	Agree (A) %	Disagree (D) %	Strongly Disagree (SD) %
1	Have you ever attend any lecture since you got admission	79.6	12.4	5.0	3.0
2	I enjoy the challenge of learning	5.5	43.3	44.3	6.9
3	Your intelligence is something basic about you cannot change very much	3.6	10.5	30.6	55.3
4	Have you seen all your results since you got admission	71.9	6.1	18.0	4.0
5	No matter how much intelligence	61.3	10.0	20.8	7.9

	you have, you can always change it quite a bit				
6	I often get angry when I get feedback about my performance	26.4	38.0	4.8	30.8
7	Truly smart people do not need to try hard to be successful towards learning	10.0	10.8	58.8	20.4
8	The harder you work in learning, the better you will master it	25.3	34.7	9.4	30.6
9	You can change how intelligent you are	40.0	21.4	28.6	10.0
10	I appreciate when parents, coaches or lecturers (academic adviser) give me feedback about my performance	10.0	10.0	60.5	19.5

Table 1 shows the distribution of responses, providing information about participants' opinions regarding mindset in learning approach. The options answered mark it evident where people stand on various issues regarding their personal opinion.

Discussion

The results demonstrate a mental framework that guides how people think, feel and act in achievement contexts. The findings of Mireka, Kissi, Adwoa, Acheampong and Armah (2025) on mental toughness stresses the need for individual learner to understand himself, his environment and work towards achieving the stated purpose of being in the environment. Dhindsa & Anderson in Onah, Anamezie and Nnadi (2022) linked Mindset construction to mind-mapping in that it encourages the learner to think radically before executing any task. This shows the difference between man and animals. It allows the student to build upon existing knowledge when new information is presented that enables meaningful learning to take place. Studies conducted by Onah etal proofed that mind mapping showcases human intelligibility. This is equally what mindset construction does. In line with the findings of Onah etal Akanbi, Olayinka, Omosewo & Mohammed (2021) portray that the study of the mind has significant positive effect in promoting students' conceptual understanding of subject matter.

Conclusion

As individual grows and develops along with learning experiences, environment and personal reflection he is subject to change. Thus, enhancement of a mindset is not a fixed, innate trait but a dynamic in nature.

Recommendation

For an individual to grow in mind, the study recommended that;

1. There should be a change on how one perceive challenges, mistakes and feedback
2. Choose to associate with motivated individuals who value learning, which can inspire your own growth and provide support during learning.

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