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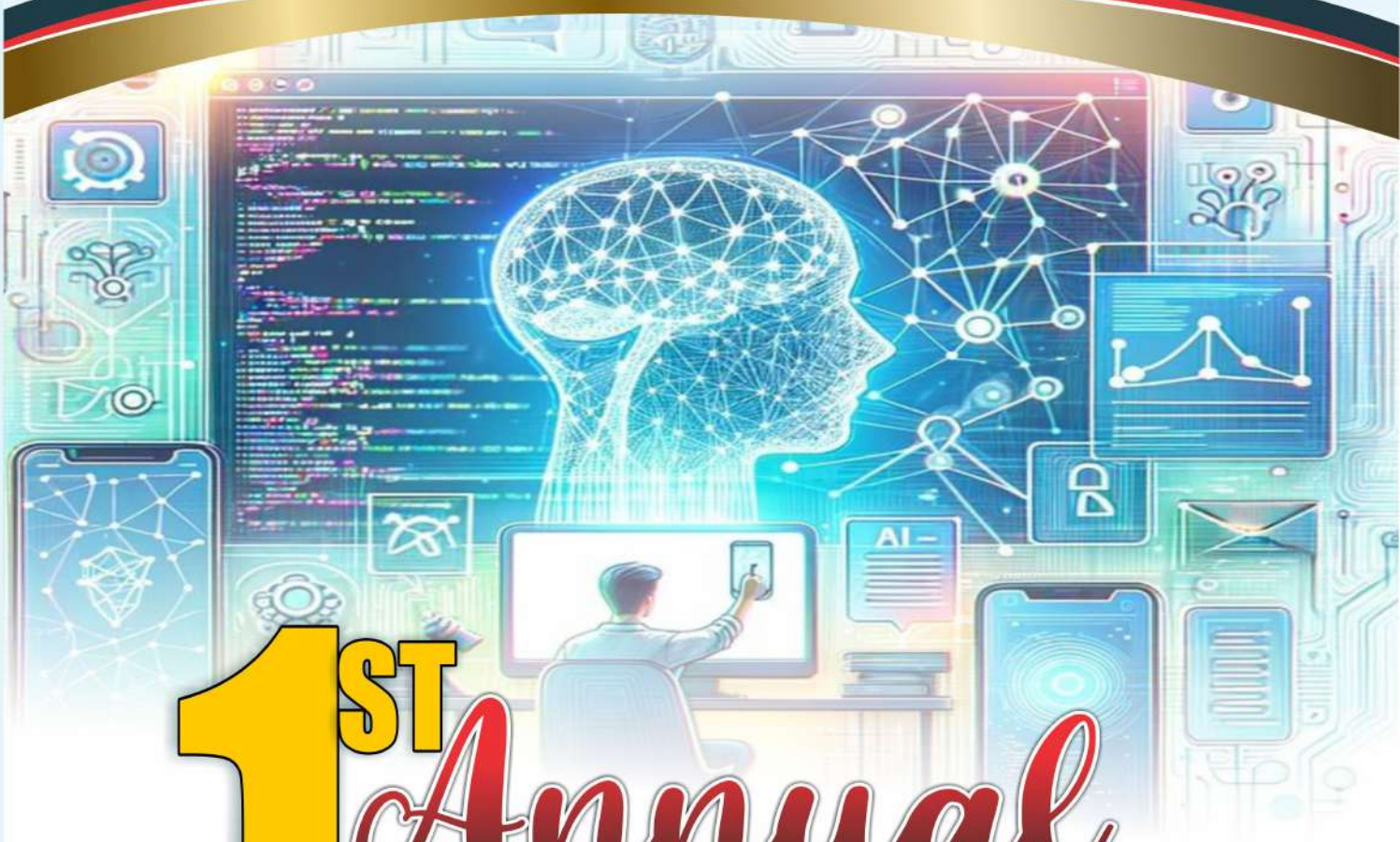
SCIENCE EDUCATORS AND DIGITAL LITERACY IN THE 21ST CENTURY



1ST Annual CONFERENCE

PROCEEDINGS 2025

Editor
Prof. Josephine N. Okoli

SCIENCE EDUCATORS AND DIGITAL LITERACY IN THE 21ST CENTURY
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ASSOCIATION OF SCIENCE EDUCTORS ANAMBRA (ASEA)

THEME: SCIENCE EDUCATORS AND DIGITAL LITERACY IN THE 21ST CENTURY

1ST ANNUAL CONFERENCE PROCEEDINGS, 2025

10- 12th July, 2025

Editor

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Printed in Nigeria by:

Love Isaac Consultancy Services
No 1 Etolue Street, Ifite Awka, Anambra State, Nigeria
+234-803-549-6787, +234-803-757-7391

Published in June, 2025
ISBN: 978-978-695-937-5

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MERITORIOUS AWARD
CITATION OF Dr SAMUEL ALFAYO BOH

It is my pleasure and singular honour to be called upon to read a citation on one of the eminent Doctor that the family of Alfayo has ever produced.

People are not chosen for their comfort, they most often to prepare for a life of self sacrifice and even sufferings on behalf of other. And most often their calling is not for privilege but for service. Whichever prism you use in view him, Dr Samuel Alfayo Boh a class teacher of high repute, a man of integrity and fear of God, sacrifices and service for the betterment and advisement of humanity.

May, 18, 1969 marked the beginning of the steadily progressive son of Boh colored mother and the Shongomite father. This account of this childhood and youth in Gombe State shows the prince he had to pay for such a birth. It did not take long before he was revealed as a man of vision and mission as every step he took in both early life and now was clogged with success, and a wide breath of accomplishment.

Dr.Samuel Alfayo Boh spends is early life in Boh with his parent. He attended Boh primary school from 1976 to1984 exposed his qualities as a gifted child enable him to proceed to Government Science Secondary School Kaltungo 1984 to 1987,Teachers College Gombe 1988 to 1990 the exceptional this qualities made way for him to enlist to College of Education Azare 1993 where he bagged National Certificate in Education (NCE) while in Azare, he was elected parliamentary student union 1994 to 1995 session and thereafter in the year 1987, he proceeded to famous University of Maiduguri Borno State and had a Bachelor of Education and passed with flying colours in 2000. Diploma in World Evangelism Mission Training Institute in Borno State in 1999. In 2001, the indefatigable Samuel was drafted in to the National youth service scheme in Tsafe, Zamfara State his service witnessed a continued story of one success after another like the Nehemiah of the Holy Bible. As a man who fully understand what benefits education could bring his way when tapped. Dr Samuel did not hesitate to define where he was headed for in that direction. In 2004, he gain admission to University of Maiduguri, Borno States as an intelligent

student, he graduated in 2008 with Master of Education in Curriculum and Instruction (M.ED).Diploma and Certificate in computer 2009. In the year between 2013 to 2016 he bagged Masters in Guidance and Counseling in Theological Seminary College Kaltungo in Gombe State. Moreover, the influence this celebrated academia exerted on him equipped him to master the techniques of research, the canons of interpretation and reconstruction of academic research, the craft and skills involved and teacher – students relationship in 2010 he proceeded to one of the best University in Nigeria University of Nigeria Nsukka in Enugu State and come out with Doctor of philosophy (Ph.D) in Curriculum and Instruction.

A man with a formidable profile charismatic personality, Dr Samuel is indeed an achieve per excellence he has not only carved a niche for himself, but has also made name and reputation in Nigeria. He has always impacted positively in the lives of everyone he meets. He has also shown high sense of professionalism and dedication to the service of humanity. On several occasion Samuel has interrupted his travels to attend to civilian, accident victims and he has truly saved a lot of lives.

Dr. Samuel Alfayo Boh started his civil service career as a classroom teacher; he had a little starting with the noble teaching profession. In 1996 he took appointment with Boh primary school, Labeke primary school in 1997, Kulishin primary school 1999, Pivotal Teachers Training Programme Lapan in 1999. In 2000 He moved to Government Day Secondary School Boh. In 2000 Tutor Senator T.U. Wada Educational Emancipation Scheme. Presently, lecturer with Federal University Kashere, in the Department of Educational Foundations

Dr. Samuel is a versatile personality of note and a man of many parts. He is fondly referred to as sport, Author and a born teacher of good repute. In his romance with great academics, he has received more than twenty awards, member of many associations, he has presented more than thirty academic papers in both international and national journals, he has published Ninety journals, sixteen book chapters, he has written eight books, presently chairman board of governors Jim Collis Kufai, fellow members of more than seven associations, former permanent commissioner sports commission Gombe State, chairman and secretary of many association, He is happily married to Mrs. Abigail Samuel and blessed with many children.

Having described himself as an enterprising person who has excellence attached to his name, Dr Samuel Alfayo Boh evinces a friendly disposition towards his students. He is a strong advocate of treating students with understanding and affection, Dr. Samuel incontestably mentors, counsels, reprimands, sympathizes and assists his young and old alike. Some of his students describe him as a luminous teacher whose passion for academic scholarship is infectious and whose pedagogical principle skills and friendly disposition are so admirable and endearing that attendance at his lectures is always high and far outstrips most others.

Ladies and gentlemen, Dr. Samuel Alfayo Boh is a small figure on the physical appearance. It is my great honour and privilege to call on this academic repute, erudite, scholar, indefatigable and inspirational mentor, community lover, and motivator ardent love of Shongomite culture and humanist to graciously joint the chairman and other for the formal presentation of this fabulous awards to acknowledge to celebrate his hard word, disciplines, kindness, humanness and commendable role he is playing in the academic careers and character-building

FOREWORD

It is with profound pride and optimism that I write this foreword to the maiden Book of Conference Proceedings of the Association of Science Educators Anambra State a timely and significant academic documentation that captures the robust engagements, research contributions, and transformative ideas presented at the 1st Annual Conference of the Association, scheduled for July 10, 2025, in Awka, Anambra State, Nigeria.

The conference, with the theme "Science Educators and Digital Literacy in the 21st Century," could not have come at a more opportune moment. In an age where digital transformation is rapidly redefining education, economy, and society, the role of science educators in equipping learners with not only scientific knowledge but also digital competencies has become more critical than ever. The conference offered a strategic platform for scholars, researchers, policy makers, and practitioners to interrogate, share, and shape new pedagogical paradigms that incorporate digital literacy into the fabric of science education.

In his address of welcome, the Acting President of ASEA, Dr. Johnbosco O.C. Okekeokosisi, delivered a compelling call to action. He set the tone by acknowledging the historical importance of the event and the noble mission of ASEA to champion science education across Anambra State and beyond. His words reflected a clear vision of collective progress, innovation, and institutional synergy. Most notably, Dr. Okekeokosisi emphasized that digital literacy in science education is not merely about embracing technological tools but about empowering both educators and learners to critically engage, create, and transform scientific knowledge for societal advancement.

This compilation of conference proceedings is more than a record of presentations—it is a testimony to the enduring commitment of Nigerian science educators to adapt to global educational trends. With insightful keynote and lead paper presentations by eminent scholars such as Prof. Cecilia O. Ekwueme and Prof. Telima Adolphus, participants were exposed to a breadth of ideas, models, and classroom innovations. These contributions are now immortalized in this volume, accessible to researchers, policymakers, and education stakeholders worldwide. The articles by contributors are of quality standard and intimately related to the conference theme.

The proceedings are also a celebration of collective effort. Dr. Okekeokosisi rightly acknowledged the contributions of past leaders of STAN, the Executive Principal of Igwebuike Grammar School, the Local Organizing Committee, and institutional partners who ensured the success of this pioneering event. Their efforts reflect a shared belief in the transformative power of science education when driven by vision, collaboration, and strategic digital integration.

This book also symbolizes the maturity and forward-thinking disposition of ASEA. With its proceedings published online in the Association's official website (www.jisepublications.org), ASEA is setting a benchmark for academic visibility, accessibility, and global relevance. The initiative aligns perfectly with the conference theme—leveraging digital platforms for knowledge dissemination.

As readers engage with the rich content within this publication, it is my hope that they find not only knowledge but also inspiration to further the cause of digital transformation in science education. May this volume serve as a resource, a reference, and a rallying point for continued innovation, research, and excellence in digital literacy, science teaching and learning.

Prof. Marcellinus C. Anaekwe
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National Open University of Nigeria,
Abuja.

PREFACE

Digital literacy in the 21st century is crucial for science educators to effectively teach and prepare students for a rapidly evolving scientific and technological world. Science educators must embrace digital tools and resources to enhance their teaching methods and 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 Universitry, Awka,
Anambra State, Nigeriascience

ADDRESS OF THE ACTING PRESIDENT OF ASSOCIATION OF SCIENCE EDUCATORS ANAMBRA (ASEA), DR. JOHNBOSCO O.C. OKEKEOKOSISI, AT THE OPENING CEREMONY OF THE 1ST ANNUAL CONFERENCE HELD IN AWKA, ANAMBRA STATE, NIGERIA ON 10TH JULY, 2025

Theme: "Science Educators and Digital Literacy in the 21st Century"

Distinguished Guests,
Mother of the Day, and Executive Provost of the Federal College of Education (Technical), Umunze, Prof. Tessy O. Okoli
Past and Immediate Past Chairmen of the Anambra State Chapter of the Science Teachers Association of Nigeria (STAN), Prof. C.V. Nnaka, Dr. Christiana U. Ezenduka Past and Immediate Past Secretary of the Anambra State Chapter of the Science Teachers Association of Nigeria (STAN), Dr. Chinwe B. Njelita, Mr. Kingsley N.C. Ezeokeke
The Executive Principal of Igwebuike Grammar School, Awka, Mrs. Amaka Ifebili
Our Esteemed Keynote and Lead Paper Presenters, Profs: Cecilia O. Ekwueme, Telima Adolphus
Meritorious Awardee, Dr. Samuel Alfayo Boh
Representatives of Educational Institutions, Pharm. Adauzoh C. Joe-Obasi
The Conference Planning Committee
The Local Organizing Committee (LOC),
My Fellow Science Educators,
Ladies and Gentlemen.

It is with deep humility and immense pleasure that I stand before you today as the Acting President of the Association of Science Educators Anambra (ASEA), to welcome you all to this historic gathering — the **1st Annual Conference** of our noble Association, taking place here in the vibrant capital city of Awka, Anambra State.

This moment marks a milestone in the life of our Association and in the educational landscape of our dear state. Today, we have gathered not just to deliberate on academic issues, but to collectively reflect on and shape the role of science educators in a rapidly changing digital world. The presence of each one of you here is a testament to your dedication to the advancement of science education in Nigeria, and in particular, in Anambra State.

Let me begin by extending heartfelt gratitude to our **Mother of the Day**, the erudite and distinguished **Executive Provost of the Federal College of Education (Technical), Umunze**, for honoring our invitation. Your presence is a great source of inspiration, and we are immensely grateful for your unwavering support towards science and technical education in the state. The Host and Board of Directors, Prof. Josephine N. Okoli, Prof. Isaac N. Nwankwo, Prof. M.C. Anaekwe

Chairman of the occasion Ass. Prof. Peter I.I. Ikokwu

To the **Past Chairman and Immediate Past Chairman of Anambra State STAN**, we salute you. You laid the foundation for excellence and integrity in science education upon which ASEA continues to build. We are proud to carry forward the torch of progress you lit. Your legacies continue to motivate and guide our mission as science educators.

We also sincerely appreciate the **Executive Principal of Igwebuike Grammar School, Awka**, for the enormous and selfless support towards the successful hosting of this conference. Your generosity and logistical assistance have played a crucial role in bringing this vision to reality. We are proud to host this conference within your institution, and we thank you for embracing the ASEA family.

Special thanks also go to our **Keynote and Lead Paper Presenters**, whose scholarship and insight will surely enrich our understanding of the conference theme: *"Science Educators and Digital Literacy in the 21st Century."* You are the thought leaders that will help us navigate this complex but exciting intersection between pedagogy and technology.

Meritorious Awardee, **Dr. Samuel Alfayo Boh**, whose contributions to teaching and learning in tertiary institutions lead to the foundation of our members.

The **representatives of educational institutions**, both public and private, we acknowledge your partnership and presence. Your contributions, ideas, and institutional support are essential in sustaining quality science education. Together, we can foster a generation of scientifically literate citizens equipped for the demands of the 21st century.

Let me also specially recognize the tireless efforts of the **Local Organizing Committee (LOC)**. You have worked round the clock, attending to logistics, communications, hospitality, and a host of behind-the-scenes responsibilities. This conference would not be possible without your selfless commitment. I say, "Well done!"

This conference has its theme **"Science Educators and Digital Literacy in the 21st Century".** The theme is very apt considering the fact that we are in the digital age. Thus, the committee on conference looked inward to provide this conference theme for science educators to understand, educate, re-educate, write and deliberate on the effective use of digital tools – technologies in our present time for effective instructional delivery. 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 Prof. Cecilia O. Ekwueme, the Dean Faculty of Science Education, University of Calabar, Cross-River State, Nigeria. Your continuous attention is also needed during the lead paper presentation of Prof. Telima Adolphus of Rivers State University, PortHarcourt, 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 digital literacy in science classrooms and curricula.

As we delve into this conference theme, let us remember that digital literacy is not just about the use of devices or softwares. It is about empowering both teachers and learners to navigate, create, and critically evaluate digital content. It is about transforming science education into an interactive, engaging, and accessible experience that prepares our students for global competitiveness. We must rise to this responsibility with courage, collaboration and innovation.

As we officially declare this conference open, let us do so with a shared sense of purpose and vision. Let us reflect deeply, discuss intelligently and leave this gathering better equipped to build a technologically savvy and scientifically vibrant society.

Ladies and Gentlemen, it may interest us to note that this young growing association has an online Journal, Electronic Book (e-book) and Conference Proceedings. The E-Book and Conference Proceedings were hosted online at the association's website (jisepublications.org) for its visibility. It is obvious that this association has come to stay. To God be the glory.

Once again, I welcome you all to the 1st Annual Conference of the Association of Science Educators Anambra (ASEA). May our deliberations be fruitful, and may the bonds we forge here today grow stronger for the benefit of science education in our state and beyond.

Thank you, and God bless you all.

Dr. Johnbosco O.C. Okekeokosisi
Federal College of Education (Tech) Asaba,
Delta State, Nigeria
Acting President, ASEA
10th July, 2025

PAPER 14

DIGITAL ASSESSMENT OF SCHOOL CLIMATE AND ITS PREDICTIVE INFLUENCE ON CHEMISTRY ACHIEVEMENT AMONG SECONDARY SCHOOL STUDENTS IN IMO STATE

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Abstract

This study examined digitally assessed school climate as a predictor of students' chemistry achievement in Ehime Mbano Local Government Area, Imo State, using a predictive correlational research design. The population comprised 1,203 senior secondary school chemistry students from 11 government-owned schools, with a randomly selected sample of 120 students (10%). Data were collected using two digital instruments: the Digital School Climate Description Questionnaire (D-SCDQ) and the Chemistry Achievement Proforma (CAP). The D-SCDQ was administered using online survey tools, and categorized school climate into six types: closed, paternal, familiar, controlled, autonomous, and open. Its face validity was confirmed by educational experts, and its reliability was established with a Cronbach's alpha of 0.87. The CAP was used to retrieve students' chemistry scores from school records. Data were analyzed using Pearson's correlation coefficient, coefficient of determination, and simple regression analysis. Findings showed that an open school climate positively influences students' chemistry achievement, while other climate types had no statistically significant impact. However, the predictive power of school climate was low, suggesting that factors such as teaching quality and resource availability may play a more substantial role in academic success. The study recommended that school authorities implement professional development programs for chemistry teachers, emphasizing modern teaching methods and integration of technology to improve students' learning outcomes.

Keywords: Digital assessment, School Climate, Achievement

Introduction

For a nation to achieve sustainable development, its educational system must align with both national aspirations and the needs of its citizens. Education serves as a catalyst for talent development, equipping individuals with essential knowledge and skills to navigate intellectual and cultural challenges (Eya, 2011). Science education, in particular, plays a crucial role in fostering scientifically oriented citizens, which is key to national development. Science is broadly defined as a systematically organized body of knowledge that explains natural phenomena through general laws (Abimbola, 2013). Its major branches include Chemistry, Physics, and Biology. Chemistry, as a fundamental discipline, focuses on the composition, properties, and uses of matter, as well as the principles governing chemical changes (Ababio, 2015).

Chemistry is integral to everyday life, as it involves both the utilization of natural substances and the creation of artificial ones. Everything we see, hear, taste, smell, or touch is influenced by chemical processes (Bear, Yang, Pell & Gaskins, 2014). Given its broad scope, a foundational understanding of chemistry is essential for comprehending the world around us. In Nigeria,

chemistry education is crucial for fostering a skilled workforce in research and industry. Chemistry is introduced at the secondary school level and pursued further in tertiary institutions, where students specialize in fields such as industrial chemistry, analytical chemistry, biochemistry, and chemical engineering. Despite its significance, students' achievement in chemistry has remained inconsistent and generally poor. This low performance reflects broader challenges in Nigeria's educational system. Several factors contribute to this trend, including socioeconomic conditions, inadequate infrastructure, teacher quality, ineffective teaching methods, limited access to technology, language barriers, and a lack of career guidance. Addressing these challenges is essential for improving chemistry achievement.

Academic achievement refers to the demonstration of knowledge and skills acquired in a school subject. It represents the measurable outcome of efforts to attain educational goals, often assessed through examinations or continuous assessments. Several factors influence academic achievement, including socioeconomic status, gender, school environment, teaching strategies, and available resources. Thapa, Cohen, Guffey, and Higgins-D'Alessandro (2013) identified school climate as a key factor affecting students' academic performance, emphasizing its potential to shape learning outcomes positively or negatively. School climate refers to the social characteristics of a school, including relationships among students and teachers, teaching and learning emphasis, institutional values and norms, and shared practices. Hoy and Miskel, as cited in Kpee (2013), define school climate as the internal characteristics that distinguish one school from another and influence the behaviour of individuals within the institution. Interactions among students, teachers, and administrators shape the overall environment, setting the tone for learning. A positive school climate fosters academic success, while a negative climate can impede students' performance.

The formation and development of school climate have been a subject of research for decades. Halpin and Croft's (1963) Dimensions of Organizational Climate (DOC) conceptualized school climate as the product of interactions between school principals and teachers. Their research identified six types of school climates: open, autonomous, controlled, familiar, paternal, and closed. An open climate fosters transparency, collaboration, and enthusiasm among students and teachers, whereas a closed climate is characterized by disengagement and high levels of control, which can hinder academic success. Cheng (2014) suggested that a combination of open, autonomous, controlled, and familiar climates is essential for creating a positive learning environment. Coda, DaSilva, and Custodio (2015) emphasized that an open climate enhances teachers' job performance, ultimately benefiting students' academic achievement. Research indicates that school climate significantly influences students' academic achievement, including their performance in chemistry. A positive school climate fosters motivation, engagement, and academic success by promoting supportive relationships, adequate resources, and effective teaching strategies. However, the extent to which school climate predicts students' chemistry achievement remains underexplored in science education.

With the increasing availability of digital tools and technologies, it is now possible to assess school climate more efficiently, accurately, and comprehensively. Digital surveys, mobile applications, online learning management systems, and data analytics platforms allow researchers and educators to collect real-time feedback from students, teachers, and administrators on the prevailing school climate. These tools also support more standardized data collection and broader outreach, especially in geographically diverse areas such as Ehime Mbano Local Government Area of Imo

State. By leveraging these technologies, school climate data can be more systematically analyzed in relation to student outcomes, particularly in subjects like chemistry.

The relationship between school climate and chemistry achievement can be examined through various educational and psychological theories. Social Learning Theory posits that students learn through observation and modelling, meaning that a supportive school climate fosters positive academic behaviours and attitudes. Self-Determination Theory highlights the role of autonomy, competence, and relatedness in motivating students, suggesting that a climate that nurtures these psychological needs enhances chemistry achievement. The Ecological Systems Theory explains how different environmental factors—ranging from immediate classroom interactions to broader societal influences—affect students' learning experiences and academic outcomes.

Understanding the interplay between digitally assessed school climate and students' chemistry achievement is crucial for developing effective educational policies and interventions. This study, therefore, seeks to investigate the extent to which school climate—measured using digital tools—predicts students' chemistry achievement in Ehime Mbano LGA. The findings provide empirical evidence to inform context-specific strategies for improving science education outcomes in Nigeria. By identifying the specific aspects of school climate that influence chemistry achievement, the study aims to offer actionable recommendations for policymakers, educators, and school administrators to enhance both digital data practices and learning environments in secondary schools.

Statement of the Problem

Despite numerous efforts to improve Chemistry achievement among secondary school students in Imo State, achievement in the subject remains consistently low as revealed from WACE result analysis according to states from 2020 – 2024. Thus, existing interventions have largely focused on teaching methods and instructional materials, with limited attention given to the role of school climate—a key factor influencing academic outcomes. Furthermore, traditional methods of assessing school climate are often subjective and lack real-time feedback, making it difficult to identify specific areas needing improvement. With the growing availability of digital tools for assessment, there is an opportunity to measure school climate more accurately and objectively. However, there is lack of empirical research in Imo State examining whether school climate, when assessed digitally, can predict students' achievement in Chemistry. This gap leaves educators and policymakers without adequate data to make informed decisions about how the school environment influences science achievement. Therefore, the problem this study addresses is the limited use of digital assessment in evaluating school climate and the lack of evidence on its predictive influence on Chemistry achievement among secondary school students in Imo State.

Purpose of the Study

The purpose of this study is to examine the predictive influence of digitally assessed school climate on students' achievement in Chemistry among secondary school students in Ehime Mbano Local Government Area of Imo State. Specifically, the study seeks to:

1. Determine the extent to which each of the four dimensions of school climate—open, closed, autonomous, and controlled—relate significantly to students' Chemistry achievement.

2. Assess the relative predictive power of each school climate variable (open, closed, autonomous, and controlled) on students' Chemistry achievement.
3. Evaluate the joint predictive power of the four school climate variables on students' Chemistry achievement in secondary schools.

Research Questions

The study provides answers to the following research questions;

1. To what extent does each of the four variables of school climate (open, close, autonomous and controlled) relate significantly with students' chemistry achievement in secondary school in Ehime Mbano LGA of Imo State?
2. What are the relative predictive powers of each of the four variables of school climate to students' chemistry achievement in secondary school in Ehime Mbano LGA of Imo State?
3. What is the joint predictive power of the four variables of school climate to students' chemistry achievement in secondary school in Ehime Mbano LGA of Imo State?

Methodology

This study adopted a predictive correlational research design and was conducted in Ehime Mbano Local Government Area of Imo State, Nigeria. The population comprised all 1,203 senior secondary school chemistry students in the 11 government-owned secondary schools within the LGA. A sample of 120 chemistry students, representing 10% of the population, was selected using a simple random sampling technique. Data for the study were collected using two digital-based instruments. The first was the Digital School Climate Description Questionnaire (D-SCDQ), a web-based adaptation of the instrument originally developed by Halpin and Croft (1963). This digital version was designed using online survey tools (e.g., Google Forms) to allow for broader access, ease of administration, and real-time data collection. The D-SCDQ categorizes school climate into six types: closed, paternal, familiar, controlled, autonomous, and open. The instrument was reviewed by experts in science education and educational technology to ensure face validity, and its reliability was confirmed using Cronbach's alpha, which yielded a coefficient of 0.87 for the overall school climate construct. The second instrument was the Chemistry Achievement Proforma (CAP), which was digitally compiled from school records to assess students' achievement in chemistry. Students' scores from standardized end-of-term chemistry examinations were used to measure academic achievement. Data collected from both instruments were analyzed using Pearson's correlation coefficient to determine the strength and direction of the relationship between school climate and chemistry achievement. The coefficient of determination (R^2) was used to estimate the proportion of variance in chemistry achievement explained by school climate. In addition, multiple regression analysis was conducted to determine the predictive power of the different school climate types on students' achievement in chemistry.

Results

Research Question 1: To what extent does each of the four variables of school climate (open, close, autonomous and controlled) relate significantly with students' chemistry achievement in secondary school in Ehime Mbano LGA of Imo State

Table 1: Correlation Matrix

Pearson Correlation		CAS	Open	Close	Autonomous	Controlled
CAS	R	1	.251**	.107	.100	.015
	Sig.		.007	.252	.287	.873
Open	R	.251**	1	.531**	.683**	.143
	Sig.	.007		.000	.000	.126
Close	R	.107	.531**	1	.547**	.093
	Sig.	.252	.000		.000	.319
Autonomous	R	.100	.683**	.547**	1	-.213*
	Sig.	.287	.000	.000		.022
Controlled	R	.015	.143	.093	-.213*	1
	Sig.	.873	.126	.319	.022	
	N	116	116	116	116	116

****.** Correlation is significant at the 0.01 level (2-tailed).

Table 1 shows that among the four school climate variables, only Open school climate has a statistically significant positive correlation (r = .251, p = .007) with students' chemistry achievement (CAS). The Close, Autonomous, and Controlled climates do not have significant correlations with chemistry achievement, as their p-values are greater than 0.05. This implies that students in schools with an Open climate tend to perform better in chemistry, while the other climate types do not show strong relationships with achievement.

Research Question 2: What are the relative predictive powers of each of the four variables of school climate to students' chemistry achievement in secondary school in Ehime Mbano LGA of Imo State

Table 2: Relative predictive powers of each of the four variables of school climate to students' chemistry achievement in secondary school

Model	R	R-Square	Adjusted R Square	Std. Error of the Estimate
Open	.251	.063	.055	21.244
Close	.107	.011	.003	21.819
Autonomous	.100	.010	.001	21.836
Controlled	.015	.000	-.009	21.943

Data in Table 2 presents the R-squared values, which show the extent to which each climate variable individually explains the variance in chemistry achievement. Open school climate has the highest R^2 value (0.063 or 6.3%), meaning it explains 6.3% of the variance in students' chemistry achievement. Close (1.1%), Autonomous (1.0%), and Controlled (0.0%) climates have much lower predictive power. The Controlled climate has the lowest predictive ability ($R^2 = 0.000$), indicating that it does not contribute to predicting chemistry achievement. Thus, Open climate is the strongest individual predictor of chemistry achievement, while the other school climate types have minimal or no predictive influence.

Research Question 3: What is the joint predictive power of the four variables of school climate to students' chemistry achievement in secondary school in Ehime Mbano LGA of Imo State

Table 3: Joint predictive power of the four variables of school climate to students' chemistry achievement in secondary school

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	39.861	15.409		2.587	.011
Open	1.311	.476	.382	2.756	.007
Close	.069	.575	.014	.120	.905
Autonomous	-.775	.614	-.186	-1.263	.209
Controlled	-.291	.375	-.080	-.776	.439

R=.278, R-Square=.077, Adj R-Square=.044, Std. Error of the Estimate=21.361

In Table 3, the R value is 0.278, and $R^2 = 0.077$ (7.7%), meaning that collectively, the four school climate variables explain 7.7% of the variance in students' chemistry achievement. Among the four predictors, only Open climate (B = 1.311, p = .007) has a significant contribution to chemistry achievement. The other three (Close, Autonomous, and Controlled) have non-significant contributions (p-values > 0.05). Autonomous and Controlled climates even have negative Beta values, indicating slight negative effects on chemistry achievement.

Table 4: Joint Significant prediction of school climate to students' chemistry achievement

Sources of variation	Sum of squares	df	Mean square	F	Sig.
Regression	4254.097	4	1063.524	2.331	.060
Residual	50646.869	111	456.278		
Total	54900.966	115			

In Table 4, the F-value is 2.331, with p = .060, which is slightly above the 0.05 threshold. This suggests that while the combined school climate variables have some predictive power, the overall model is not statistically significant at the 5% level.

Discussion

The findings of this study reveal that among the four school climate variables examined, only an open school climate, as assessed using digital tools, has a significant positive relationship with students' achievement in chemistry. This suggests that a school environment characterized by openness, inclusiveness, and supportive teacher-student interactions—when systematically measured through digital surveys and tools—fosters better academic outcomes in chemistry. The insignificant correlations observed for closed, autonomous, and controlled climates indicate that these types of school environments may lack the support, motivation, or conducive learning atmosphere necessary for students to excel in a subject that demands both conceptual clarity and analytical reasoning. These results align with previous research by Hoy, Tarter, and Kottkamp (2021), who argue that open climates enhance student performance by encouraging free expression, creativity, and constructive feedback within academic settings. Conversely, restrictive climates, often marked by rigidity and top-down control, may limit students' ability to explore and engage meaningfully with the subject matter.

The analysis of the predictive power of each digitally assessed school climate variable revealed that open school climate was the strongest predictor of students' chemistry achievement,

accounting for 6.3% of the variance. In contrast, closed, autonomous, and controlled climates showed negligible predictive ability, with the controlled climate contributing nothing statistically significant. This suggests that collaborative practices, democratic leadership, and academic encouragement within an open climate are instrumental in enhancing student engagement and performance in chemistry. These findings are consistent with the work of Thapa, Cohen, Guffey, and Higgins-D'Alessandro (2013), who emphasized the positive influence of a supportive and open school climate on academic achievement. The lack of predictive strength among the other climate types may be due to their restrictive, rigid, or disorganized nature, which does not support the kind of intellectual stimulation and critical thinking required for success in chemistry.

When all four school climate variables were considered together through digital regression modeling, they jointly explained 7.7% of the variance in students' achievement in chemistry. However, this joint prediction was not statistically significant, indicating that factors beyond school climate—such as teaching methodology, laboratory availability, prior academic foundation, and home background—may play a more prominent role in determining students' chemistry performance. This finding aligns with the conclusions of Wang and Degol (2016), who noted that while school climate contributes to academic outcomes, it must be reinforced by effective instructional strategies, high teacher quality, and adequate educational resources to generate measurable improvements in student achievement. Simply classifying school climates, therefore, is not sufficient to drive academic success; instead, the quality of interaction and support within those climates, especially as revealed through digital feedback tools, is crucial.

A particularly notable result from the regression analysis is that only the open school climate made a statistically significant contribution to students' chemistry achievement when all four climate types were analyzed collectively. This underscores the importance of fostering a school environment where students feel encouraged, respected, and intellectually supported—as confirmed through real-time digital assessments of climate perceptions. The findings resonate with the work of Bear, Yang, Pell, and Gaskins (2014), who found that school environments marked by mutual respect, collaborative learning, and academic motivation enhance both student engagement and performance. The lack of significance among other climate types further suggests that rigid, overly autonomous, or control-oriented environments may not support the level of academic engagement necessary for optimal achievement in chemistry.

These findings reinforce the conclusion that cultivating an open and supportive school climate—measured and monitored through digital tools—is essential for improving students' performance in chemistry. Nonetheless, school climate alone cannot drive academic excellence. It must be integrated with broader educational strategies, including effective pedagogy, teacher training, access to digital and laboratory resources, and individualized student support systems. Future research should consider examining the interactions between digitally assessed school climate and other academic success indicators, such as instructional quality, socio-emotional support, and technology use, to gain a more comprehensive understanding of how to optimize learning environments. Overall, these findings hold significant implications for school administrators, educators, and policymakers, highlighting the need to adopt digital tools for ongoing climate evaluation and to focus on creating open, student-centered learning environments that support not just performance in chemistry but also holistic academic growth in science education.

Conclusion

The findings of this study underscore the importance of digitally assessed school climate in understanding students' achievement in chemistry. Among the four school climate types examined—open, closed, autonomous, and controlled—only the open climate, as measured through digital tools, demonstrated a positive and significant relationship with chemistry achievement. This indicates that when students learn in a supportive, interactive, and engaging digital environment, their academic performance, particularly in chemistry, tends to improve. However, the overall predictive power of the school climate variables was relatively low, suggesting that while school climate plays a role, other critical factors such as teaching quality, access to instructional resources, and student motivation may exert a stronger influence on academic outcomes. The joint predictive strength of all climate types was not statistically significant, further reinforcing that school climate alone is not a sole determinant of student success in chemistry. Therefore, to enhance students' chemistry achievement, educators and policymakers should prioritize cultivating an open and learner-friendly school climate using digital tools for monitoring and improvement, while also integrating broader educational strategies such as teacher development, technology integration, and motivation-enhancing practices that holistically support student learning.

Recommendations

Based on the findings of this study, the following recommendations were made;

1. Use digital tools (e.g., Google Forms, KoboToolbox) to regularly assess school climate, and school administrators should act on the data to promote openness, collaboration, and student engagement.
2. Since school climate has limited predictive power, schools should provide functional chemistry laboratories, ensure access to relevant instructional materials, and adopt learner-centered methods such as inquiry-based and hands-on learning to enhance chemistry achievement.
3. Train teachers on how digital feedback on school climate can guide classroom practices. Professional development should focus on building inclusive, supportive, and motivational learning environments that improve student performance in chemistry.

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