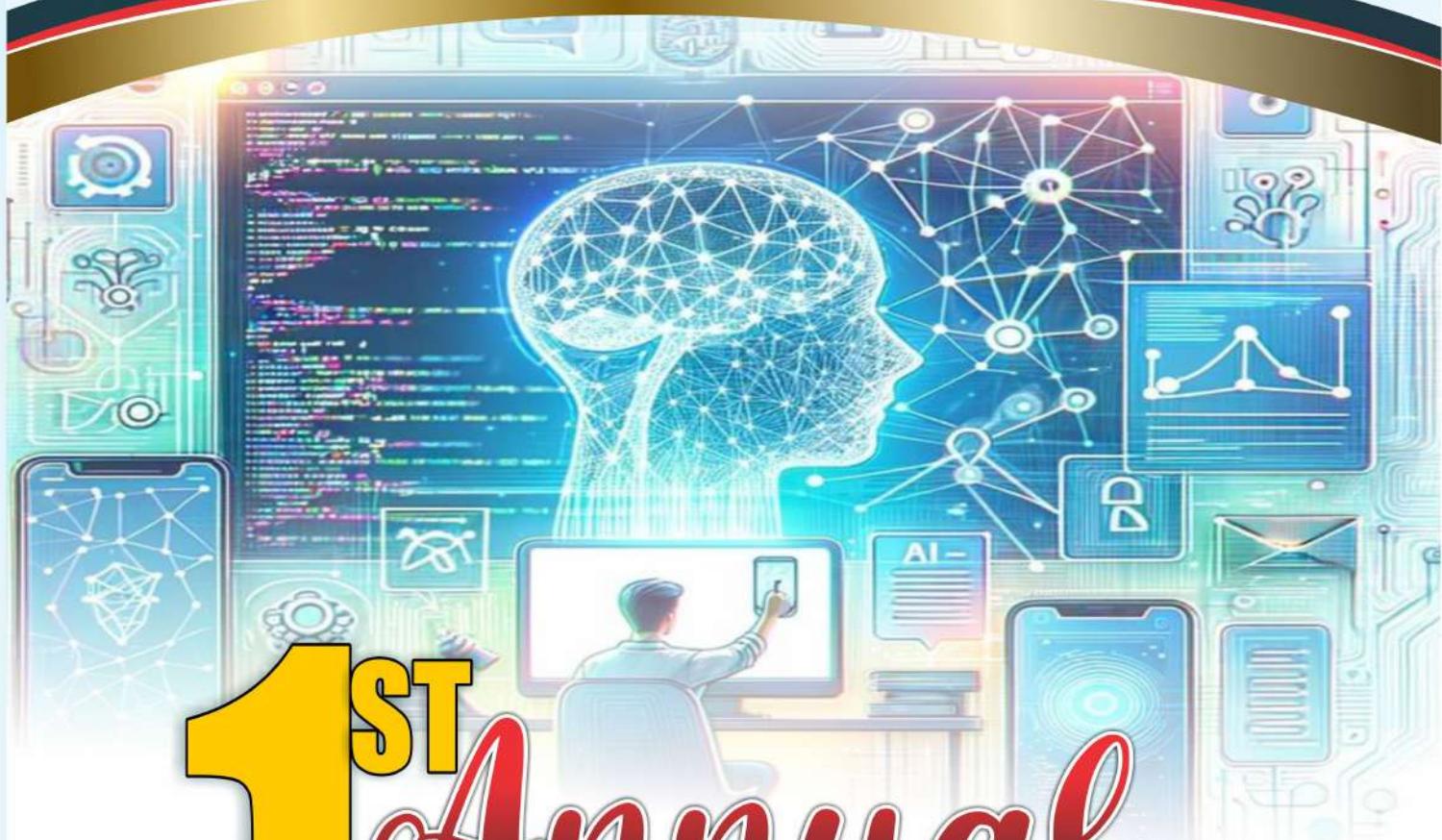




ASSOCIATION OF SCIENCE EDUCATORS ANAMBRA (ASEA)

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**SCIENCE EDUCATORS AND DIGITAL LITERACY
IN THE 21ST CENTURY**



1ST
Annual
CONFERENCE
PROCEEDINGS 2025

Editor
Prof. Josephine N. Okoli

ASSOCIATION OF SCIENCE EDUCATORS ANAMBRA (ASEA)

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

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10- 12th July, 2025

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Usan Peter

Chemistry Department
Federal Technical College, Awka,
Anambra State, Nigeria

PROGRAMME OF EVENTS

- Opening Praying
- Chairman's Opening Remark
- Breaking of Kola nut
- Welcome Address by the acting President of the Association
- Keynote Presentation by Prof. Cecilia O. Ekwueme
- Lead Paper Presentation by Prof. Telima Adolphus
- About the Electronic Book / Unveiling of Book Chapter – E-Book launch
- Item 7
- Meritorious Award
- Paper Presentations

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 University, Awka,

Anambra State, Nigeriascience

ADDRESS OF THE ACTING PRESIDENT OF ASSOCIATION OF SCIENCE EDUCATORS ANAMBRA (ASEA), DR. JOHN BOSCO O.C. OKEKEOKOSI, 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. Ikoku

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 Igwebuik 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 10

DIGITAL LITERACY AND TEACHERS' EFFECTIVE TEACHING OF MATHEMATICS IN PUBLIC SECONDARY SCHOOLS IN ORON LOCAL GOVERNMENT AREA OF AKWA IBOM STATE, NIGERIA

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Abstract

This study adopted correlational survey design to establish the relationship existing between digital literacy and teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria. It was guided by two research questions and two null hypotheses. A sample of 248 (230 students and 18 Mathematics teachers) in five public secondary schools in Oron Local Government of Akwa Ibom State, Nigeria were selected and used for the study. One instrument titled "Digital literacy and teachers' effective teaching of Mathematics (DLTETMQ) was used for data collection. The reliability of the questionnaire, established using Cronbach Alpha which gives an average index of .80. The hypotheses were tested using Pearson Product Moment correlation Coefficient at .05 level of significance. The findings of the study revealed that content-specific digital literacy, pedagogical digital literacy individually significantly relate with teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria. It was concluded that effective teaching of Mathematics in public Secondary Schools depend on content-specific digital literacy, pedagogical digital literacy. It was recommended amongst others that Governments and educational institutions should implement ongoing training programs focusing on both content-specific and pedagogical digital skills, tailored to secondary mathematics teachers.

Keywords: Digital literacy, Teacher digital literacy, Teachers' effective teaching, Pedagogical digital literacy

Introduction

Mathematics is a foundational subject crucial for the development of critical thinking, problem-solving skills, and scientific literacy among students. Effective teaching of mathematics in secondary schools is vital for ensuring students achieve meaningful understanding, foster interest, and perform well in assessments, ultimately preparing them for higher education and careers in STEM fields(OECD, 2019). The rapid integration of technology and innovative pedagogical approaches demands that mathematics teachers are equipped with the skills and strategies necessary for effective instruction (Akinbolati & Ajayi, 2021; Ogar, Ibok, & Williams, 2024). Although mathematics is recognized as a core subject in secondary education, its effective teaching remains a challenge across many educational contexts. Traditional teacher-centered approaches

often dominate classrooms, limiting student engagement and conceptual understanding (Ojo & Olaoluwa, 2021, Ibok, Ogar, Bassey, James & Udo, 2024). Moreover, insufficient teacher training, lack of access to technological resources, and inadequate pedagogical competence contribute to ineffective instructional delivery (Akinbolati & Ajayi, 2021). As a result, students often exhibit low motivation, poor performance, and diminished interest in mathematics, which can have long-term implications for their academic and career prospects (Nwosu & Ijeoma, 2020). Hence, understanding and addressing the factors that influence effective teaching practices in mathematics are critical for improving learner outcomes and ensuring that secondary education meets the demands of a rapidly evolving world (Ekpenyong, Ogar, Obogo, & Unoh, 2024; Ojo & Olaoluwa, 2021). In order to enhance effective teaching of Mathematics in secondary, teacher digital literacy was identified as one of the factors that influence effective teaching of mathematics in secondary schools. Despite efforts to improve instructional quality by government support in staff in services training, recruitment of new staff, regular incentive to Mathematics teachers, it have been observed by researchers that many students continue to underperform in mathematics, indicating gaps in effective teaching practices and teacher digital literacy (OECD, 2020).

Teacher digital literacy is a set of competencies that enable teachers to access, evaluate, and apply digital tools and resources to enhance instructional effectiveness, student engagement, and learning outcomes (Hague & Payton, 2019). It is the ability of educators to effectively utilize digital technologies, tools, and resources to support teaching, learning, and professional development (Ertmer & Ottenbreit-Leftwich, 2019). Digital literacy has emerged as a fundamental competency in the 21st century, essential for active participation in a digital society and workforce. It encompasses the skills required to access, evaluate, utilize, and create digital information ethically and responsibly (Redecker et al., 2019). In secondary education, teachers' digital literacy enable teachers to prepares students not only for academic success but also for lifelong learning, informed citizenship, and competitive employment in an increasingly technology-driven world (Vuorikari, Punie, Carretero & Bruno, 2020). Schools are thus tasked with integrating digital literacy into curricula, equipping teachers with effective pedagogical strategies, and fostering environments that promote responsible digital engagement. However, the integration of digital literacy into secondary education faces challenges, including limited teacher training, infrastructural deficits, and curriculum gaps (Wu & Wilcox, 2021). To fully realize the benefits, educational systems must prioritize systematic approaches to impart digital literacy skills, ensuring that students are capable of navigating, analyzing and creating digital content critically and ethically. In order for this study to have direction, content-specific digital literacy and pedagogical digital literacy are examined.

Content-specific digital literacy involves teachers' ability to leverage digital tools and resources tailored to specific subject content area in mathematics to facilitate conceptual understanding and skill development (Vroubel & Ng, 2020). It is the capacity to select, interpret, and utilize digital technologies that are directly relevant to mathematics instruction for example, graphing software, online manipulative, and simulation tools to enhance content mastery and instructional accuracy (Kozma & Maher, 2021). Uşak and Orhan (2020) conducted a qualitative case study in Turkey examining mathematics teachers' perceptions of technology integration and found that teachers with higher levels of digital literacy employed more sophisticated digital tools such as graphing software and virtual manipulatives leading to more interactive and effective lessons.

Similarly, Kandel and Miao (2021) found that teachers who were proficient in digital content-specific tools, like GeoGebra and Desmos, reported greater confidence and success in enhancing students' conceptual understanding through technology-supported activities. In the United States, research by Bano and Zafar (2020) found that teachers with advanced digital literacy skills utilized online simulations and visualizations to clarify complex mathematical concepts, which positively impacted student performance.

In Nigeria, Afolabi, Olumide, and Adeyemi (2021) investigated the relationship between teachers' digital literacy and instructional effectiveness in mathematics classrooms. The study revealed that secondary school teachers with content-specific digital skills, especially in using computer algebra systems and online graphing tools, improved lesson delivery and student understanding. However, it also pointed out that many teachers lacked sufficient training in these tools, limiting their potential to facilitate meaningful technology-based instruction. Similarly, Ojo and Olatunji (2022) examined secondary school teachers in Ghana and found that digital literacy particularly in manipulating mathematical software was instrumental in improving instructional quality and student engagement. Teachers who integrated digital tools regularly reported higher levels of student participation and conceptual clarity.

Pedagogical digital literacy refers to teachers' ability to design, implement, and adapt teaching strategies using digital tools to promote active, inquiry-based, and student-centered learning environments (Tondeur et al., 2020). It encompasses skills related to integrating digital resources into pedagogical practices effectively, such as employing virtual manipulatives, flipped classrooms, and formative assessments to maximize student engagement and deepen understanding in mathematics instruction (Ashwin & McVitty, 2021). Pedagogical digital literacy is the capacity of teachers to select, adapt, and deliver instruction through digital platforms which is a critical determinant of teaching effectiveness in secondary mathematics education (Kozma, 2019). Teachers with high pedagogical digital literacy can transform traditional lessons into interactive, student-centered learning experiences that foster deeper understanding and engagement. In a study conducted by Lim and Lee (2020) in Singapore, secondary mathematics teachers who possessed strong pedagogical digital literacy skills demonstrated a greater ability to employ digital formative assessments and personalized learning analytics. Their findings revealed that such teachers created more dynamic lessons, which led to measurable improvements in student motivation and problem-solving skills. Similarly, in Australia, Limberg, Thompson and Bryant (2021) found that teachers who integrated digital pedagogical strategies such as flipped classrooms, online collaborative platforms, and virtual manipulatives observed significant gains in student achievement and conceptual understanding in secondary mathematics. In Europe, a longitudinal study by García-Sánchez and López (2022) found that teachers with advanced pedagogical digital literacy in Spain were more effective at designing inquiry-based lessons that utilized digital tools like Desmos and GeoGebra, leading to increased student participation and higher test scores. In Nigeria, Adeyemi and Oladipo (2021) explored how secondary school teachers' pedagogical digital literacy affects their instructional practices in mathematics. The study revealed that teachers who could design digitally-enabled inquiry-based lessons using tools such as online graphing and problem-solving platforms enhanced student engagement and understanding. However, many teachers lacked the pedagogical training necessary to effectively combine digital tools with innovative pedagogies. Similarly, in Ghana, Ofori-Duah, Agyeman and Sarpong (2022) found that secondary teachers who demonstrated higher pedagogical digital

literacy implemented more collaborative and inquiry-driven lessons, which improved students' problem-solving abilities and conceptual grasp of mathematics. Nonetheless, the studies highlight ongoing challenges, such as limited professional development opportunities, infrastructural constraints, and the need for targeted training in instructional design with digital technologies.

Statement of the Problem

In the contemporary educational landscape, digital technology plays a pivotal role in enhancing teaching and learning processes, particularly in mathematics education at the secondary school level. However, many secondary school teachers face challenges in effectively integrating digital tools into their instructional practices due to limited digital literacy skills, inadequate training, and infrastructural deficits. This gap hampers the timely and effective use of educational technologies such as interactive software, online resources, and virtual simulations, which are increasingly necessary to foster active learning and improve students' conceptual understanding in mathematics. Most teachers' are insufficient digital literacy constraints in their pedagogical repertoire, reducing opportunities for engaging, student-centered instruction that is critical in developing problem-solving and analytical skills among secondary school learners. Most teachers struggled to adapt to remote teaching modalities due to inadequate digital competencies, affecting instructional quality and student achievement. Many secondary school teachers still lack the necessary skills to leverage technology effectively in mathematics teaching. This situation hampers the realization of the full benefits of digital tools in improving learning outcomes and preparing students for a technology-driven society. Therefore, addressing the gaps in teachers' digital literacy is essential to ensure that mathematics instruction remains relevant, engaging, and effective in the digital age.

Purpose of the Study

The main purpose of this study is to establish the relationship between digital literacy and teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria. Specifically, the study seek to establish;

1. the relationship between content-specific digital literacy and teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria
2. the relationship between pedagogical digital literacy and teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria

Research Questions

To direct the investigation, the following research questions are posed;

1. To what extent does the content-specific digital literacy relate with teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria?
2. To what extent does pedagogical digital literacy relate with teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria?

Hypotheses

1. There is no significant relationship content-specific digital literacy relate with teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria
2. There is no significant relationship between pedagogical digital literacy and teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria

Methodology

The research design used for this study was the correlational survey design. The correlation survey design was used to establish the relationship between the variables of study.. Correlational research design is a non-experimental research method used to assess the relationships between two or more variables. It aims to determine whether an increase or decrease in one variable corresponds to an increase or decrease in another variable. This type of research does not imply causation; rather, it identifies patterns and associations. The researchers used this design to establish the relationship between digital literacy (in terms of content-specific digital literacy and pedagogical digital literacy) and teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria. The population of this study comprised all the 1102 SS2 students and 13 teachers across all the five public secondary schools in Oron Local Government Area of Akwa Ibom State, Nigeria. A multi-stage sampling technique involving century approaches and proportional sampling technique were adopted in selecting 230 students and 13 teachers for the study. Out of a total of 1102 SS 2 students public secondary schools, a sample of 230 (20.9%) of the students and all the 18 mathematics teachers for the study. The students were also used to avoid teachers being bias. The instruments used for data collection were the questionnaire titled "Digital literacy and teachers' effective teaching of Mathematics. The questionnaire was made of 28 items, with 9 items to measure each sub-level in terms of content-specific digital literacy and pedagogical digital literacy and 10 items to measure teachers' effective teaching of Mathematics . The questionnaire was based on four point scale of strongly agreed, agreed, disagreed and strongly disagreed. The instrument was face-validated by two experts in Measurement and Evaluation and two Mathematics Educators, both from the University of Calabar. Corrections were pointed out by the experts and adjusted by the researchers and the document was considered valid. The reliability of the questionnaire using Alpha Cronbach Method gives an average index of .80 while the reliability estimate of the high ability. The Statistical Package for Social Sciences (SPSS) computer programme was used to analyze the data collected. Research questions were answer using descriptive statistics and coefficient of determinant while the two hypotheses were tested using Pearson Product Moment Correlation Coefficient at -05 level of significance.

Results

Research Question 1: To what extent does the content-specific digital literacy relate with teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria

Table 1: Co-efficient of determinant using r- value on the extent to which content-specific digital literacy relate with teachers' effective teaching of Mathematics

Variables	No. of item	Mean	SD	R-value	Decision
Content-specific digital literacy	9	28.892	3.874	.872	Positively related
Teachers' effective teaching of Mathematics	10	34.987	4.732		

The result in Table 1 shows the extent to which content-specific digital literacy relate with teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria with r- value of .872 which measures the direction and effect size or the strength of a relationship between the two variables. This means that content-specific digital literacy positively contributed 87.2 % which is high determinants of teachers' effective teaching of Mathematics public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria.

Research Question 2: To what extent does pedagogical digital literacy relate with teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria

Table 2: Co-efficient of determinant using r- value on the extent to which pedagogical digital literacy relate with teachers' effective teaching of Mathematics

Variables	No. of item	Observed mean	SD	r- value	Decision
Pedagogical digital literacy	9	27.123	3.432	.809	Positively related
Teachers' effective teaching of Mathematics	10	34.987	4.732		

Table 2 shows the extent to which pedagogical digital literacy relate with teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria with r- value of .809 which measures the direction and effect size or the strength of a relationship between the two variables. This means that pedagogical digital literacy positively contributed 80.9 % which is high determinants of teachers' effective teaching of Mathematics public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria.

H01: There is no significant relationship content-specific digital literacy relate with teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria.

Table 3: Person Product Moment Correlation of the relationship between content-specific digital literacy and teachers' effective teaching of Mathematics (N= 248)

Variables	N	Mean	SD	r-value	p-value
Content-specific digital literacy	248	28.892	3.874	.872	.000
Teachers' effective teaching of Mathematics	248	34.987	4.732		

*Significant at the .05 level, df =246

In Table 3, it shows the high positive significant relationship between content-specific digital literacy and teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria ($r=.872$; $p=.000$). With this result, the null hypothesis was rejected while the alternative was retained at the 0.05 level of significance. The positive r-value indicated that the more teacher acquired content-specific digital literacy, the effective teaching of Mathematics tend to be. On the other hand, teachers lack of content-specific digital literacy lead to ineffective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria

H02: There is no significant relationship between pedagogical digital literacy and teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria.

Table 4: Person Product Moment Correlation of the relationship between pedagogical digital literacy and teachers' effective teaching of Mathematics (N= 248)

Variables	N	Mean	SD	r-value	p-value
Pedagogical digital literacy	248	27.123	3.432	.809	.000
Teachers' effective teaching of Mathematics	248	34.987	4.732		

*Significant at the .05 level, df =246

Data in Table 4 points at the high positive significant relationship between pedagogical digital literacy and teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria ($r=.809$; $p=.000$). With this result, the null hypothesis was rejected while the alternative was retained at the 0.05 level of significance. The positive r-value indicated that the more teacher acquired pedagogical digital literacy, the effective teaching of Mathematics tend to be. On the other hand, teachers lack of pedagogical digital literacy lead to ineffective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria

Discussion

The result of hypothesis one revealed there is a significant relationship content-specific digital literacy and teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria. This is because it enables teachers to manipulate and interpret mathematical content through digital tools such as graphing calculators, online algebra systems, and simulation software, making abstract concepts concrete. Supports accurate and efficient use of digital resources tailored to mathematics curriculum, enhancing clarity and conceptual grasp. Teachers with high digital literacy can quickly adapt to new technologies,

ensuring that instruction remains current, relevant, and effective amidst rapid technological advancements. Digital literacy helps teachers interpret student data from online assessments and adjust teaching strategies accordingly, leading to personalized instruction and improved learning outcomes. The finding agreed with Uşak and Orhan (2020) who found that teachers with higher levels of digital literacy employed more sophisticated digital tools such as graphing software and virtual manipulatives leading to more interactive and effective lessons. Similarly, Kandel and Miao (2021) found that teachers who were proficient in digital content-specific tools, like GeoGebra and Desmos, reported greater confidence and success in enhancing students' conceptual understanding through technology-supported activities. The finding aligned with Bano and Zafar (2020) who found that teachers with advanced digital literacy skills utilized online simulations and visualizations to clarify complex mathematical concepts, which positively impacted student performance. The finding is in line with Afolabi, Olumide, and Adeyemi (2021) who found that secondary school teachers with content-specific digital skills, especially in using computer algebra systems and online graphing tools, improved lesson delivery and student understanding. Similarly, Ojo and Olatunji (2022) found that teachers who integrated digital tools regularly reported higher levels of student participation and conceptual clarity.

The result of hypothesis two revealed there is a significant relationship between pedagogical digital literacy and teachers' effective teaching of Mathematics in public Secondary Schools in Oron Local Government Area of Akwa Ibom State, Nigeria. This is because digital literacy enables teachers to adopt diverse, interactive, and student-centered pedagogies such as flipped classrooms, online collaborative learning, and real-time formative assessments, which improve understanding and retention of mathematical concepts. Teachers proficient in digital tools can make lessons more engaging and visually appealing, motivating students to participate actively in learning activities. Digital literacy allows teachers to access a vast array of online resources—simulations, tutorials, and data analysis tools—that make abstract mathematical ideas tangible and accessible. The finding agreed with Limberg et al. (2021) who found that teachers who integrated digital pedagogical strategies—such as flipped classrooms, online collaborative platforms, and virtual manipulatives—observed significant gains in student achievement and conceptual understanding in secondary mathematics. The finding agreed with a longitudinal study by García-Sánchez and López (2022) who found that teachers with advanced pedagogical digital literacy in Spain were more effective at designing inquiry-based lessons that utilized digital tools like Desmos and GeoGebra, leading to increased student participation and higher test scores. In agreement to this finding Adeyemi and Oladipo (2021) found that teachers who could design digitally-enabled inquiry-based lessons using tools such as online graphing and problem-solving platforms enhanced student engagement and understanding. In line with this finding Ofori-Duah et al. (2022) found that secondary teachers who demonstrated higher pedagogical digital literacy implemented more collaborative and inquiry-driven lessons, which improved students' problem-solving abilities and conceptual grasp of mathematics.

Conclusion

Teacher digital literacy is a critical factor that significantly influences the quality and effectiveness of mathematics instruction in secondary schools. Teachers equipped with robust digital skills can employ innovative teaching strategies, utilize interactive digital tools, and create engaging learning environments that foster deeper understanding and student success. As technology becomes integral to education, enhancing teachers' digital literacy is essential for improving mathematical

outcomes and preparing students for a digital world. Content-specific and pedagogical digital literacy are fundamental components that significantly enhance the effectiveness of secondary school mathematics instruction. Teachers proficient in these areas can design and deliver innovative, engaging, and personalized lessons that improve student understanding, participation, and academic achievement. As digital tools and resources become integral to modern education, fostering comprehensive digital literacy among teachers directly impacts instructional quality and learner success in mathematics.

Recommendations

Based on the findings of the study, the following were recommended;

1. Governments and educational institutions should implement ongoing training programs focusing on both content-specific and pedagogical digital skills, tailored to secondary mathematics teachers.
2. Curriculum planner should embed digital literacy skills into teacher education and continuous professional development curricula, emphasizing content mastery and pedagogical strategies. Educational policies should promote the integration of digital literacy standards into teacher education curricula, ensuring new teachers are prepared for digital-age classrooms.
3. Government should ensure schools are equipped with appropriate digital tools and resources for mathematics teaching, alongside support for proper integration.
4. School should establish communities of practice where teachers can share best practices, digital resources, and pedagogical strategies related to mathematics.
5. They should be regularly assess teachers' digital literacy levels and pedagogical application, providing mentorship and feedback to foster continuous improvement.

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