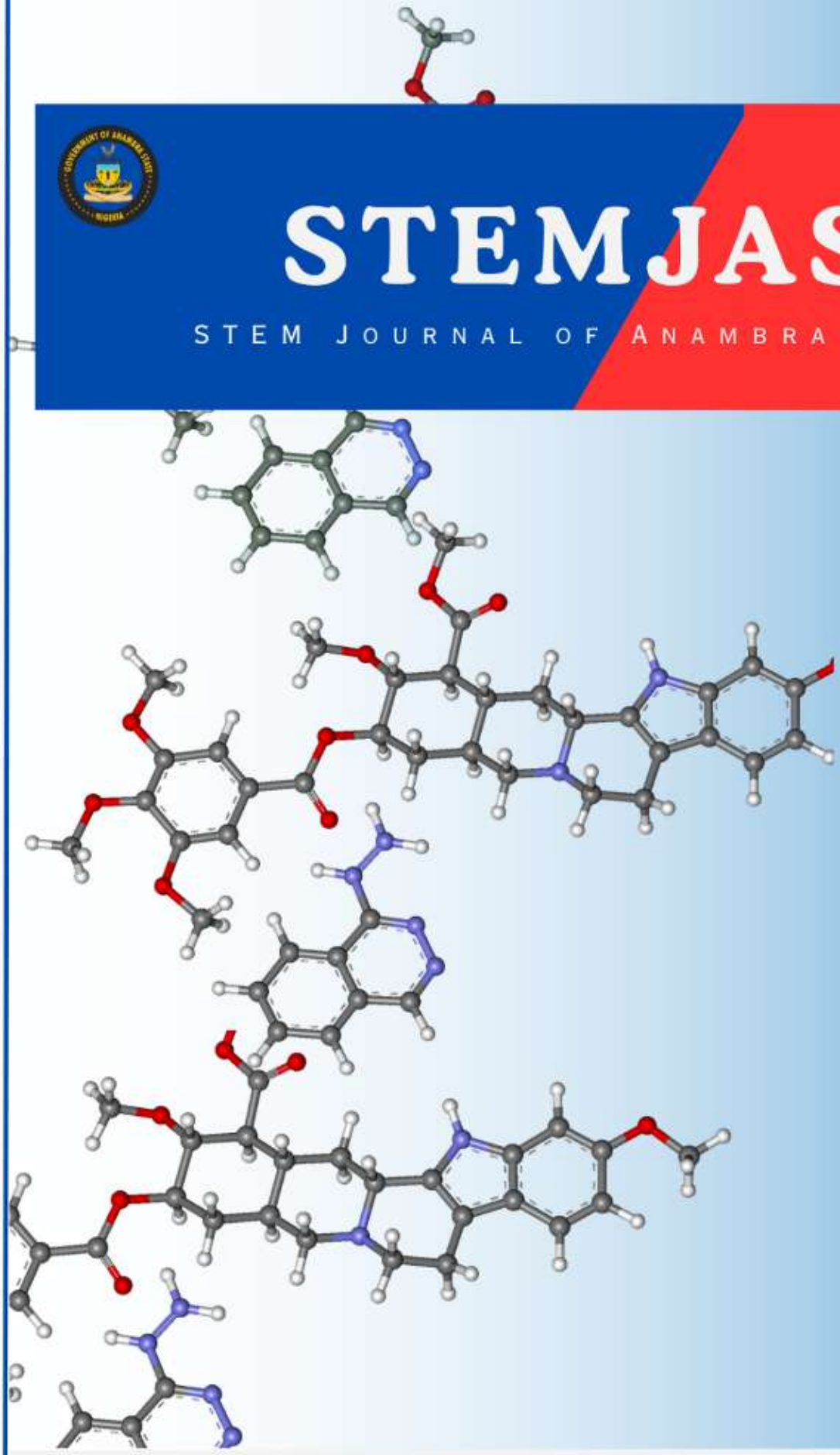
STEM Journal of Anambra State (STEMJAS) Volume 6(1);2026 EDITOR IN CHIEF : PROF. EBELE .C. OKIGBO

STEMJAS

STEM JOURNAL OF ANAMBRA STATE



STEM JOURNAL OF ANAMBRA STATE
Original work of excepional STEM Researchers

VOLUME 6(1);2026 | ISSN : 2705 -1579

EDITOR IN CHIEF
PROF. EBELE .C. OKIGBO

STEM JOURNAL

OF ANAMBRA STATE STAN (STEMJAS), 6(1); 2026

All right reserved
No part of this journal should be reproduced, stored in a retrieval system or transmitted
in any form or by any means in whole or in part without he prior written approval of the copyright owner(s) except in the internet

ISSN: 2705-1579

Published & printed by:

FAB ANIEH NIGERIA LIMITED
Fab Anieh House
Opposite COFI Premium Lounge
Okpuno, Awka
Tel: 08035619395
G-mail: fabprezz82@gmail.com

EDITORIAL BOARD

Editor-in-Chief
Prof. Ebele C. Okigbo

Editors
Dr. Christiana U. Ezenduka
Dr. Chinwe B. Njelita
Dr. Nkiru N.C. Samuel
Dr. JohnBosco O.C. Okekeokosisi
Dr. Okonkwo Ifeoma G.A
Dr. Ifeoma B. Okafor
Mr. Kingsley N.C. Ezeokeke

Managing Editor
Dr Nkiru N.C. Samuel

Consulting Editors
Prof. Emmanuel O. Akuezuilo - Nnamdi Azikiwe University, Awka
Prof. Uchenna Nzewi - University of Nigeria, Nsukka
Prof. Sunday Abonyi Ebonyi - State University,Abakaliki

Officers of Science Teachers Association of Nigeria, Anambra State Chapter

Dr. Bibiana C. Okoli - Chairman
Mr. JohnBosco O.C. Okekeokosisi - Vice Chairman
Dr. Nkiru N.C. Samuel - Secretary
Mr. Arinze Enekwechi - Assistant Secretary
Mr. Clement Okpala - Financial Secretary
Dr. Blessing I. Okafor - Treasurer
Mr. Friday Peter Usang - Science Fair Coordinator
Mr. Solomon C. Okoli - Assistant Science Fair Coordinator
Mrs. Grace N. Okpata - PRO I
Mrs. Ndidamaka P. Okafor - PRO II
Dr. Christiana U. Ezenduka - Immediate Past Chairman
Prof. E.O. Akuezilo - Member Board of Trustee
Prof. Edwin Akusoba – Patron

EDITORIAL

STEM Journal of Anambra STAN (STEMJAS) is a publication of **Science Teachers Association of Nigeria, Anambra State Chapter.** STEMJAS is developed to disseminate information on Science, Technology, Engineering and Mathematics (STEM) Education to teachers, teacher-trainers, researchers and other interested persons. Articles that are of relevance to STEM education are published in this journal. We are grateful to the contributors and hope that our readers will enjoy reading these contributions.

Prof. Ebele C. Okigbo
Editor-in-Chief

Pages vi

TABLE OF CONTENT

1. Mentorship and Professional Development for Science Teachers
Prof Adedibu Aderemi Abass FSTAN FMAN

2. Effect of Graphic Advance Organizer on Senior Secondary School Students' Academic Achievement in Cell Biology in Enugu State
Regina Ijeamasi. Enebechi ;Amobi Uchenna Vivian

3. Pre-service Science Teachers' Perceived Influence of Over-Reliance on Artificial Intelligence on their Academic Performance in Tertiary Institutions in Anambra State
Opeyemi F. **Awosika;** Izunna S. **Nwuba;** Chiamaka N. **Oguejiofor;** Bamidele A. **Ikusika;** Onyebuchi M. **Ndinyelum;** Victory E. **Ogadimma**

4. The Role of Biology Education in Promoting Environmental Literacy and Sustainability Practices in Cross River State, Nigeria
Agbor, Catherine Kuko;Agbor, Catherine Kuko;Etim, Asukwo Okon;Umoh, Inyene-Obong Sunday

5. Implementing the Flipped Classroom in STEM: Perceptions And Challenges Of Teachers at a Nigerian College of Education
Okafor Ndidiamaka p., [2] Okoroafor Alice o. [3]ezeani Jude o and Ahmed Alhassan Abdulrahman.

6. Perceived Influence of the Use of Mother Tongue in the Learning of Mathematics in Secondary Schools in Awka Education Zone
Okafor-Agbala, Uzoamaka Chimuanya ; Onyeka, Edith Chinyere; Nwuba, Izunna Shedrack & Okoye, Grace Nwakaego

7. Reconceptualizing Teacher Education Through The Lens of Essential Digital Skills and Professional Competencies: A Review
Agbasi Obioma l; Onyewuchi Paschal C; Ibebuilo Ifeoma H; Okoli Jacinta C; Okafor Ndidiamaka P.

RECONCEPTUALIZING TEACHER EDUCATION THROUGH THE LENS OF ESSENTIAL DIGITAL SKILLS AND PROFESSIONAL COMPETENCIES: A REVIEW

Agbasi Obioma L.
Department Of Biology Education, Federal College of Education (Technical) Umunze, Anambra State.

Onyewuchi Paschal C.
Department Of Physics Education, Federal College of Education (Technical) Umunze, Anambra State

Ibebuilo Ifeoma H.
Department Of Biology Education, Federal College of Education (Technical) Umunze, Anambra State.

Okoli Jacinta C.

Department Of Chemistry Education, Federal College of Education (Technical) Umunze, Anambra State.

Okafor Ndidiamaka P.
Department of Biology Education, Federal College of Education (Technical) Umunze, Anambra State.

Corresponding Author Email: ndidiamaka.okafor@fcetumunze.edu.ng

Abstract

In the context of rapid digital transformation and evolving educational demands, this paper argues for a reconceptualization of teacher education in Nigeria that places digital skills and professional digital competencies at its core. Drawing on empirical studies of Nigerian teachers' digital readiness, policy analyses, and international competence frameworks (such as Constructivist Learning Theory and TPACK), the paper identifies current gaps in pre-service and in-service teacher preparation. Researchers propose an integrated model for embedding digital competence into teacher education programs, undergirded by capacity building, assessment, and policy alignment. The paper concludes with actionable recommendations for Nigerian teacher training institutions, policymakers, and professional bodies, and suggests future research directions to evaluate implementation efficacy.

Keywords: Teacher Education, Digital Competencies, Nigerian Teachers, Digital Skills, Capacity Building.

Introduction

Education systems worldwide are undergoing rapid digital transformation, driven by the proliferation of digital technologies, e-learning platforms, and artificial intelligence. Teacher education, as a foundational pillar of national educational development, must adapt to these transformations. In Nigeria, the need to enhance teacher effectiveness through digital skills acquisition has become more urgent, particularly in the post-pandemic era, when technology-mediated learning has become central to instruction.

Recent global developments underscore that effective teaching in the 21st century demands more than subject knowledge: digital literacy and professional competencies have become central to high-quality education. For Nigeria, this need is especially urgent. As the digital divide narrows and educational technology becomes more entrenched in schools, teachers must possess not only functional technical skills but also the pedagogical fluency to integrate technology for meaningful learning.

However, despite national policy frameworks and growing awareness, teacher education programs in Nigeria often treat digital skills as peripheral. Many pre-service teachers receive minimal technology training, and in-service professional development is often fragmented. Without systemic reform, Nigeria risks graduating teachers who are ill-prepared for digitally rich learning environments.

Nigeria's educational policy landscape recognizes the importance of ICT in learning. For example, curriculum reforms and educational initiatives increasingly mention digital literacy as a strategic priority. Yet, policy and practice remain misaligned. While the national education system may articulate digital goals, teacher training institutions often lack structured programs to develop the requisite competencies.

Empirical research shows that many Nigerian teachers have low digital competence. In Lagos, for instance, a study found that although teachers were somewhat aware of online teaching modalities during the COVID-19 pandemic, their competence was hampered by limited resources and technical skills (Alasoluyi, 2021). Further, mathematics teachers in Ondo State showed a strong correlation between digital training, self-efficacy, and readiness, indicating that competence is not uniform and depends on targeted interventions (Abdulazeez, Akinyemi, & Aremu, 2025).

Moreover, university-level teachers also report challenges. A survey of university lecturers in Nigeria revealed high basic digital competence but significant barriers, including a lack of continuous training, insufficient ICT infrastructure, and funding (Ogunbodede, Ewata, Kumar, & Okediji, 2023).

Given these challenges, treating digital competence as a "nice-to-have" rather than as a foundational component of teacher training is no longer viable. Without core integration, Nigeria's teacher education system risks producing educators who are poorly equipped to deliver digitally mediated instruction, thereby limiting the quality and equity of education.

This paper argues that teacher education in Nigeria must be reconceptualised through a digital-competency lens to equip future teachers with the skills required for productivity, innovation, and pedagogical excellence. It explores the role of essential digital skills, global competency frameworks, and professional standards in shaping teacher preparation for the 21st century.

Theoretical Framework

The present study is anchored on constructivist and technological pedagogical content knowledge (TPACK) frameworks, which provide a robust lens for understanding how teacher education can integrate essential digital skills and professional competencies.

1. Constructivist Learning Theory

Constructivist theory, as proposed by Piaget (1970) and further developed by Vygotsky (1978), emphasizes that learning is an active, contextualized process in which learners construct knowledge through interaction with their environment and social collaboration. Within teacher education, this perspective underscores the need for teachers to acquire professional competencies that enable them to facilitate learner-centered classrooms, engage students in critical thinking, and foster problem-solving skills. By reconceptualizing teacher education through constructivism, teacher preparation programs prioritize experiential learning, reflective practice, and collaborative engagement, which are critical for developing digital literacy and instructional proficiency in the 21st century (Ertmer & Ottenbreit-Leftwich, 2010).

2. Technological Pedagogical Content Knowledge (TPACK) Framework

The TPACK framework (Mishra & Koehler, 2006) provides a theoretical basis for integrating technology into effective teaching. TPACK posits that effective teaching with technology requires the interplay of three knowledge domains: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). In teacher education, essential digital skills are conceptualized as part of TK, while professional competencies relate to PK and CK. The framework asserts that teachers' ability to integrate these knowledge domains enables them to design, implement, and assess instructional strategies that leverage technology to achieve meaningful learning outcomes (Koehler et al., 2013). This integration is especially pertinent in science education, where digital tools facilitate simulations, data visualization, and inquiry-based learning.

Relevance to Teacher Education

By situating teacher education within constructivist and TPACK paradigms, the study emphasizes that the development of digital skills and professional competencies is mutually reinforcing. Teacher education programs that incorporate digital literacy, collaborative learning, and reflective practices equip pre-service teachers to navigate technology-rich classrooms and respond to evolving educational demands. Moreover, the theoretical framework highlights that professional competencies—such as classroom management, instructional planning, and assessment literacy—must be embedded alongside digital skill acquisition to ensure effective pedagogical practice (Voogt et al., 2015).

Conceptual Integration

Figure 1 illustrates the conceptual integration of digital skills and professional competencies within teacher education. Digital skills enable access to instructional technologies, content creation, and learner engagement tools, while professional competencies ensure that these tools are applied pedagogically to enhance learning outcomes. The intersection of these domains fosters a holistic,

competency-based approach to teacher education, reconceptualising teacher preparation for the demands of contemporary and future classrooms.

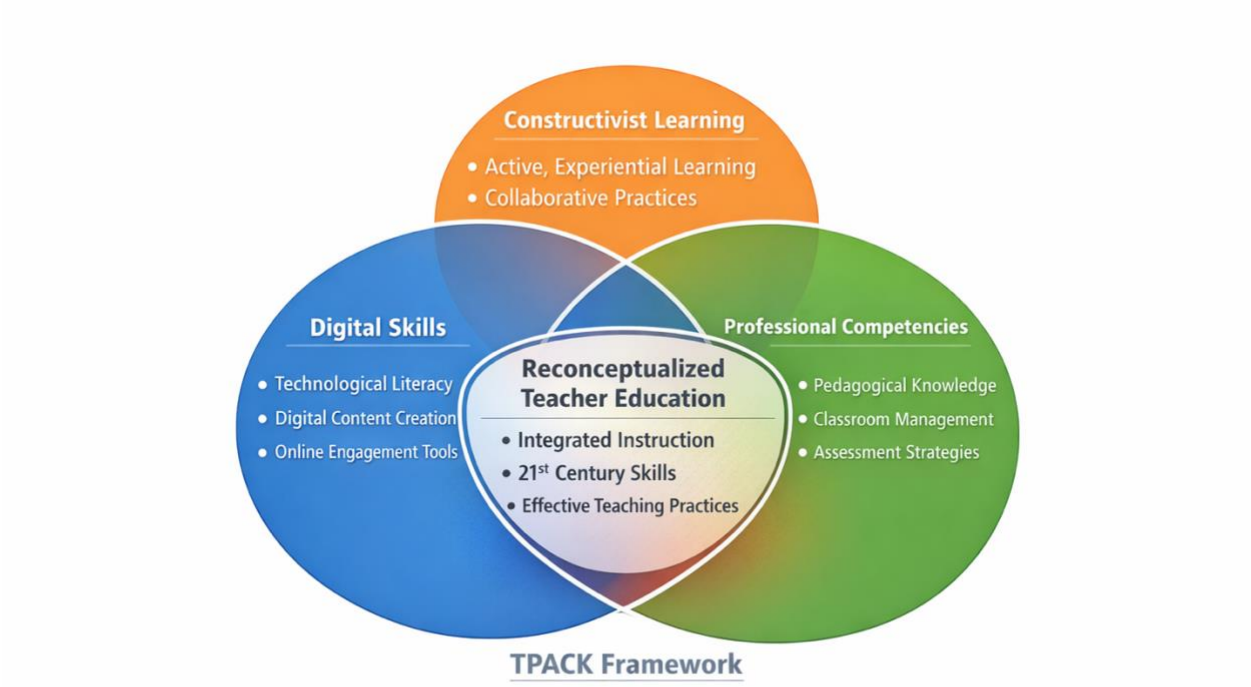


Figure 1: Reconceptualsed Teacher Education Framework

Conceptual Framework

Digital Skills

Digital skills encompass the ability to use digital devices, applications, and networks effectively and responsibly. According to the European Commission's Digital Competence Framework (DigComp), digital competence includes information literacy, communication, content creation, safety, and problem-solving (Vuorikari et al., 2022).

Professional Competencies in Teacher Education

Professional competencies refer to the integrated knowledge, skills, and attitudes that enable teachers to perform effectively in diverse educational contexts. The TPACK framework illustrates the interrelationship between technological, pedagogical, and content knowledge (Mishra & Koehler, 2006), emphasizing that effective teaching in a digital age requires synergy between technology use and pedagogical design.

The Nigerian Teacher Education Landscape

Teacher education in Nigeria is primarily delivered through Colleges of Education, Faculties of Education in universities, and the National Teachers' Institute. Despite reforms, digital integration remains limited due to inadequate infrastructure, insufficient ICT training, and limited professional development opportunities (Afolabi, 2021).

Digital competency gaps among teacher trainees contribute to poor technology adoption in classrooms and reduce instructional quality. Consequently, reconceptualization is necessary to align teacher education with global digital standards.

Reconceptualizing Teacher Education Through Digital Competencies.

A critical intervention towards reconceptualizing Teacher Education Through Digital Competencies, must take into consideration the following;

Curriculum Redesign for Digital Integration

Teacher education curricula should embed digital literacy modules, virtual pedagogy, cyber safety, and AI-assisted learning tools. Studies indicate that curriculum redesign correlates positively with teachers' digital readiness (Koehler et al., 2014).

Enhancing Institutional Capacity

Institutions must invest in modern ICT infrastructure, including smart classrooms, learning management systems, and broadband connectivity. UNESCO (2023) emphasizes that institutional digital readiness directly affects the quality of teacher preparation programmes.

Continuous Professional Development

Ongoing training enables educators to maintain updated digital skills. According to Adeoye and Alagan (2020), many Nigerian teachers feel unprepared for technology-enabled instruction, underscoring the need for targeted digital competency workshops.

Emphasis on Digital Pedagogical Competence

Beyond basic ICT skills, teachers must understand how to apply technology pedagogically. This includes interactive content creation, adaptive learning tools, digital assessment strategies, and online collaborative learning models. The TPACK framework provides a strong basis for this integration.

Empirical studies

In a study on Digital Competence in Universities, Ogunbodede et al. (2023) found that while Nigerian university lecturers demonstrated relatively high foundational digital competence, they faced major constraints such as inadequate training opportunities, infrastructure, and institutional support.

In Kwara State, Ilorin South, a study on Perception of Digital Literacy, found that teachers generally perceive digital literacy as important for 21st-century teaching, but differences exist by age and gender (Agarry, Babalola, & Jacob, 2024).

A study of a UNESCO MGIEP digital teacher training intervention demonstrated statistically significant improvements in educators' digital pedagogy competence and confidence after a 5-week hybrid course (Olurinola & Olugbade, 2024)

Some Challenges Faced in Developing Digital Skills

The term 'digital competence' has become a key component in curriculum development, educational policy and research during the last decade (Erstad & Voogt, 2018). However, these developments are embedded with uncertainty and tensions concerning conceptual clarity, how digital competence relates to technological developments, what role research has in defining policy and practice, and the broader implications this new curriculum area might have for school practices. Developing digital skills can pose several challenges for educators. Some of the common challenges faced in developing digital skills include:

limited access to technology: Limited access to technology, such as computers, tablets, or reliable internet connectivity, can hinder educators' ability to develop digital skills. Inadequate infrastructure and unequal distribution of resources can create a digital divide, making it difficult for some educators to access and utilize digital tools effectively.

Limited Training and Professional Development Opportunities: Many educators may not receive adequate training and professional development opportunities to develop their digital skills. Lack of comprehensive and ongoing training programs can impede educators' ability to effectively integrate technology into their teaching practices.

Resistance to Change: Some educators may resist embracing technology and developing digital skills due to a fear of change or a lack of confidence in using digital tools. Overcoming resistance to change and fostering a positive mindset towards technology integration is crucial for developing digital competencies among educators.

***Time Constraints*:** Teachers often face time constraints due to their workload and various responsibilities. Finding dedicated time for professional development focused on developing digital skills can be challenging. Limited time availability may make it difficult for educators to engage in training programs or explore new digital tools.

Technological Obsolescence: The rapid pace of technological advancements can lead to the obsolescence of digital tools and skills. Educators must continuously update their skills to keep pace with emerging technologies and adapt to new digital platforms, which can be demanding and time-consuming.

Digital Equity and Inclusion: Addressing issues of digital equity and inclusion is crucial in developing digital skills. Ensuring that all educators have equal opportunities to access technology and training is essential to bridge the digital divide and promote equitable digital skill development.

Solutions to The Challenges Faced in Developing Digital Skills

Addressing these challenges requires a comprehensive approach that includes providing adequate access to technology, offering ongoing professional development opportunities, encouraging a very supportive and conducive environment for technology integration, and ensuring equitable access to digital resources and training. Collaboration among policymakers, educational institutions, and stakeholders is necessary to overcome these challenges and promote the development of digital skills among educators (Erstad & Voogt, 2018). Solutions to problems faced in developing digital competencies include;

Comprehensive Training and Professional Development: Providing educators with programs focused on developing digital skills is crucial. These programs should cover a range of topics, including technology integration strategies, digital tools and platforms, pedagogical approaches for technology-enhanced instruction, and effective use of educational software.

Supportive Learning Environment: Creating a supportive learning environment that encourages risk-taking and experimentation with technology is essential. Educators should have access to mentors, coaches, and peer support networks to help them develop digital skills. Offering a safe space for educators to explore and learn from their mistakes fosters a growth mindset and encourages continuous improvement.

Collaboration and Sharing Best Practices: Encouraging educators to collaborate and share best practices is an effective strategy for developing digital skills. Establishing communities of practice, both within schools and through online platforms, allows educators to learn from one another, share resources, and exchange ideas. Collaborative environments promote professional growth and provide opportunities for peer feedback and support.

***Access to Technology and Resources*:** Ensuring equitable access to technology and resources is crucial for developing digital skills. Schools and educational institutions should provide educators with the necessary hardware, software, and internet connectivity. Additionally, offering access to a variety of educational resources, such as online courses, webinars, and digital libraries, supports self-directed learning and skill development.

Integration of Digital Skills into Teacher Education Programs: Teacher education programs should integrate digital skills development into their curricula. Pre-service teachers should receive training on technology integration, digital pedagogies, and instructional design with technology. Teacher education institutions can collaborate with schools and districts to provide practical experiences and field placements that allow pre-service teachers to apply their digital skills in real classroom settings.

***Continuous Learning and Adaptation*:** Digital skills are continually evolving, so educators must adopt a continuous learning mindset. Encouraging educators to engage in ongoing professional development, attend conferences, participate in webinars, and join online learning communities helps them stay abreast of emerging technologies and pedagogical approaches. Encouraging a culture of lifelong learning helps educators adapt to the changing digital landscape.

***Partnerships and Collaboration with Industry and Technology Experts*:** Collaborating with industry partners and technology experts can provide valuable resources, expertise, and guidance in developing digital skills. Educational institutions can establish partnerships with technology companies, non-profit

organizations, and educational technology providers to access training programs, mentorship opportunities, and resources for educators.

By implementing these solutions, educators can overcome challenges and develop the digital skills necessary for effective technology integration in education. It requires a collaborative effort between policymakers, educational institutions, and educators themselves to create a supportive environment and provide the necessary resources for skill development

Proposed Model for Reconceptualized Teacher Education

Based on the existing literature and theoretical frameworks, the researchers propose a four-pillar model for redesigning teacher education in Nigeria:

1.Curriculum Integration

Adequate curriculum integration should consider the following;

- Map pre-service teacher education curricula to international competence frameworks (e.g., DigCompEdu).
- Include explicit learning outcomes for digital competence in methodology courses, practicum, and assessment.
- Ensure that digital competence is not a separate elective but integrated into core pedagogical training.

2.Practice-based Learning (TPACK in action)

To encourage practice based learning the following areas must be noted;

- Use micro-teaching, lesson rehearsals, and supervised practicum to help pre-service teachers plan and deliver lessons that integrate technology.
- Encourage reflection on digital pedagogy using video review, peer feedback, and digital portfolios.
- Develop rubrics that assess not just technical use but pedagogical quality and alignment with content.

3.Continuous Professional Development (CPD)

Continuous professional development of teachers must be achieved through;

- Implementing sustained in-service training pathways (e.g., blended learning, coaching, communities of practice) structured around a competence framework.
- Use of micro-credentials (digital badges) for mastery in domains such as digital assessment, resource design, and learner empowerment.
- Provision of incentives for participation in CPD, such as career progression, recognition, or certification.

4.Policy Alignment and Monitoring

Compliance must be upheld and monitored through;

- Encouraging national and institutional adoption of a digital competence framework.
- Link digital competence attainment to accreditation and teacher evaluation systems.
- Establish mechanisms for monitoring implementation, such as digital competence audits, teacher self-assessments, and institutional evaluation.

Recommended implementation strategy

In order to translate this model into practice, the researchers recommend the following steps:

1. Baseline Assessment: Conduct a nationwide digital competence audit for both pre-service and in-service teachers to identify strengths, gaps, and regional disparities.
2. Capacity Building for Teacher Educators: Ensure teacher educators and faculty in colleges/universities are themselves digitally competent and trained to teach using the model.
3. Infrastructure Investment: Prioritize equipping training institutions and schools with stable internet, hardware, and teaching tools.
4. Design and Launch Pilot Programs: Start with pilot teacher education programs that fully embed digital competence. Use them to refine curriculum, training modalities, and assessment strategies.
5. Scale and Institutionalize: Based on pilot outcomes, scale the model across institutions. Align with accreditation agencies (e.g., National Universities Commission, National Commission for Colleges of Education) to embed competence in accreditation.
6. Monitoring and Evaluation: Create a feedback loop using quantitative (surveys, assessments) and qualitative (teacher narratives, case studies) data to evaluate the impact of the reconceptualized program and continuously improve

Suggestions for further studies.

To support and validate the proposed reconceptualization of teacher education, future research should:

- ✓ Evaluate pilot implementations using mixed-methods studies to examine outcomes such as teacher competence, student engagement, and learning quality.
- ✓ Investigate the cost-effectiveness of different CPD delivery models in the Nigerian context.
- ✓ Develop and validate digital competence assessment instruments tailored to Nigeria's educational system.
- ✓ Explore the long-term career trajectories of teachers who undertake micro-credentialing in digital competencies

Conclusion

Digital skills and professional digital competencies must be reframed from a peripheral concern to a core pillar of teacher education in Nigeria. By adopting an integrated model rooted in international frameworks and local empirical realities, Nigeria's teacher education institutions can prepare educators who are pedagogically adept, technologically fluent, and ready to navigate the evolving educational landscape.

Reconceptualizing teacher education in Nigeria through essential digital skills and professional competencies is pivotal for improving instructional quality and ensuring global competitiveness. A digitally competent teacher workforce will accelerate national educational transformation and equip Nigerian learners with the skills required for the 21st century.

References

Abdulazeez, I. O., Akinyemi, A. L., & Aremu, A. (2025). Technology literacy, computer self-efficacy and digital training as correlates of secondary school mathematics teachers' technology readiness in Ondo State, Nigeria. EAUED-JMS: Emmanuel

Adedoyin, O. B., & Soykan, E. (2020). COVID-19 pandemic and online learning: The challenges and opportunities. Interactive Learning Environments.

Adeoye, I. A., & Alagan, O. R. (2020). Technology integration in Nigerian schools: Issues and prospects. Journal of Education and Practice.

Afolabi, F. (2021). Digital readiness of Nigerian teacher education institutions: Challenges and possibilities. *African Journal of Teacher Education*.

Agarry, R. O., Babalola, M. O., & Jacob, P. A. (2024). Teachers' perception of digital literacy skills as a tool for 21st century teaching in Nigeria. *University of Dar es Salaam Library Journal*, *19(1).*

Alasoluyi, O. E. (2021). Teachers' awareness and competence in the switch from classroom-based to online teaching during COVID-19 pandemic in Lagos, Nigeria. *Interdisciplinary Journal of Education Research, 3.*

Erstad, O. & Voogt, J. (2018). The 21st Century Curriculum: Issues and challenges. In: Voogt, J., Knezek, G., Christensen, R. & Lai, K.-W. (Eds.) Second Handbook of Information Technology in Primary and Secondary Education, Volume 1. Springer. Pp. 19-36.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. Journal of Research on Technology in Education, 42(3), 255–284.

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? Journal of Education, 193(1), 13–19.

Koehler, M. J., Mishra, P., & Cain, W. (2014). What is technological pedagogical content knowledge (TPACK) *Journal of Education 7(2).*

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record.

Ogunbodede, K. F., Ewata, T. O., Kumar, A., & Okediji, O. G. (2023). Digital competencies and the 21st century skills of university teachers in Nigeria. European Journal of Interactive Multimedia and Education, 4(2).

Olurinola, O., & Olugbade, D. (2024). The impact of UNESCO MGIEP digital teacher training on Nigerian educators' digital pedagogy competence and confidence. African Journal of Teacher Education vl 3.

Piaget, J. (1970). Science of education and the psychology of the child. New York: Viking Press.

UNESCO. (2023). Digital learning and teacher readiness report.

Voogt, J., Fisser, P., Good, J., Mishra, P., & Yadav, A. (2015). Computational thinking in teacher education: Integration of knowledge, skills, and attitudes. Computers & Education, 82, 74–85.

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). DigComp 2.2: The Digital Competence Framework for Citizens. Publications Office of the European Union.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.