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A Framework for Education Technology Integration in Nigerian Basic School System: Digital Framework for Technology Integration in Education (DiFTIE) for Basic School System

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Abstract
The integration of technology into education has gained significant attention globally, however, the existing frameworks such as: Technological Pedagogical Content Knowledge (TPACK), Substitution, Augmentation, Modification, Redefinition (SAMR) and (Technology Integration Matrix (TIM) failed to address the unique challenges faced by technology resource-limited contexts like Nigeria. This study designed and developed a contextual model termed Digital Framework for Technology Integration in Education (DiFTIE) to address the unique challenges facing technology integration in Nigerian basic schools. It was also developed to bridge the existing digital divide among students by improving educational performance of students from diverse socio-economic backgrounds and to promote equitable access to technology-enhanced learning. The DiFTIE Framework fills a major gap by suggesting a realistic, actionable, and adaptable model that is tailored to Nigeria's socio-economic realities. DiFTIE framework surpasses traditional frameworks such as TPACK, SAMR and TIM by emphasizing on policy alignment, foundational readiness and community involvement (major elements in resource-limited contexts to enhance sustainable integration of technology). Components of DiFTIE Framework include developing localized educational content, enhancing ICT infrastructure, provision of teacher training programs and strengthening policy support. The DiFTIE Framework also provides well-structured and sustainable strategies for integrating educational technology into pedagogic experiences due to the fact that the framework recognizes the specific needs of Nigerian educational system and its challenges. Therefore, it is recommended that implementing the DiFTIE Framework would promote equitable access to technology-enhanced learning for all students irrespective of gender and socio-economy background, display a transformative role in bridging the digital divide in Nigerian basic education and to improve educational performances of students across diverse socio-economic backgrounds.

Keywords: Digital Framework for Technology Integration in Education (DiFTIE)**,** Nigerian Basic Schools System, Education Technology Integration

1 Introduction

Globally, educational technology has been known for playing a transformative role in bridging the digital divide, promoting equitable access to technology-enhanced learning, improving educational outcome of students irrespective of their gender and socio-economic backgrounds; supporting digital literacy, interactive learning and skill acquisition [1]. Schleicher [2] attested that COVID-19 pandemic underscored the need for robust digital infrastructures which compelled schools to adapt remote instruction and accelerated the demands for digital learning solutions worldwide. The effects of this pandemic on pedagogic experiences was not much felt by countries with established Educational Technology (EdTech) frameworks that could transit relatively smooth to online learning. However, some developing nations of the world like Nigeria, faced significant disruptions due to limited technology infrastructure to cushion this effects on education. The International Society for Technology in Education [3] averred that effective EdTech integration requires the provision of adequate technology resources, supportive policies, trained educators and frequent monitoring of technology impact on students' improved performance based on their engagements with the technological tools.

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Contextualizing the integration of educational technology to Nigerian basic school system as it is operational in other nations of the world is instrumental to improving access to qualitative education for underprivileged and rural residents [4]. UNESCO [4] further affirmed to the inherent potential of EdTech to personalize learning, facilitate remote education, and improve access to quality learning materials has been widely acknowledged. However, despite global enthusiasm for technology integration in education, many developing countries like Nigeria is facing substantial challenges on effective adoption of EdTech in enhancing instructional delivery [5]; and increase student engagement.

Nigeria is grappling with significant demand for quality education, limited digital instructional resources, poor infrastructural facilities, and unequal access to digital tools; which create obstacles to integrating technology into teaching and learning [6]. Studies conducted by Adomi and Kpangban [7] revealed that most schools in rural areas of Nigeria are facing perennial challenges on lack of infrastructure facilities, such as high internet subscription, unstable internet access and unreliable electricity that are very germane for EdTech integration and adoption. Yusuf and Yusuf [8] found out that urban areas are relatively better-off equipped, however, the integration and adoption of educational technology remains inconsistent due to limited teacher competence, gaps in policy, and insufficient technical support that encourage their utilization.

Related studies reveals that major challenges facing Nigerian basic education system in the widespread adoption of educational technology, includes lack of teacher training programmes on integration of digital resources, inadequate infrastructure facilities, insufficient funding, policy related lacuna [9]; unreliable internet access, lack of functional computer laboratories [24]; lack of trained personnel to support the use of digital tools, and lack of technical skills required by the teachers on technology integration [10]. Studies conducted by Yusuf and Balogun [5] revealed that Nigerian basic school teachers are most times felt hesitant in adopting educational technology due to their limited digital literacy and insufficient professional development opportunities. This lack of training has direct impact on the efficacy of technology in classrooms, as teachers are challenged to leverage digital tools for active learning and student engagement [10]. Subsequently, Olele [9] found out that absence of monolithic national policy framework on integration of educational technology has led to disjointed approach, where each school and state government attempt various strategies with limited success. These challenges underscores the need for a structured framework that will support technology integration across Nigerian basic schools.

The familiar educational technology integration models are the: Technological Pedagogical Content Knowledge (TPACK) framework; Substitution, Augmentation, Modification, Redefinition (SAMR) framework; and Technology Integration Matrix (TIM) frameworks have proven effective in guiding technology adoption and integration. The existing frameworks for educational technology integration have largely been developed in western contexts, focusing on very recent emerging resources and technologies, well-structured instructional environments with excellent infrastructure facilities and policy support that are comparatively advanced in nature. These frameworks failed to address the unique infrastructural, socio-economic, and policy-related challenges found in Nigerian basic education. Implementing these frameworks in Nigeria has been limited, as they often do not account for critical gaps such as inconsistent power supply, insufficient ICT resources in rural schools, and limited teacher training.

In response to these challenges, this study proposes the Digital Framework for Technology Integration in Education (DiFTIE). A model designed to enhance the systematic integration of educational technology in Nigerian basic schools. This framework is built on the premise that effective EdTech adoption requires a multi-dimensional approach encompassing capacity building, continuous evaluation, infrastructure development and policy support [1]. Each component of the DiFTIE Framework (Capacity Building, Methodology, Tools and Support, Policy and Evaluation, Teachers' Productivity, Learners' Outcomes, Platform, and Education Statistics) addresses a major aspect of technology integration and suggest ways to overcome the existing perennial challenges facing integration of technology into instruction. Tondeur, Van Braak, Ertmer and Ottenbreit-Leftwich [11] opined that DiFTIE Framework could be employed to contextualise the

integration of technology in any nation as it focus on a holistic approach that advocates for capacity-enhancement, policy-supported, and resource-driven models in order to help in overcoming the related barriers in resource-limited contexts of educational technology integration and adoption. Johnson, Becker, Cummins, Estrada,

Freeman and Hall [12] affirmed that capacity building in the integration of educational technology has to do with developing teachers' digital competencies and providing teachers with the necessary professional training on effective use technology for instruction. Similarly, Olumuyiwa and Femi [6] attested that the integration of educational technology should focus on the policy component in the framework to advocates for national and local government policies that could support infrastructure maintenance, EdTech funding and digital literacy programs. Therefore, this study proposed DiFTIE Framework as a strategic model for addressing these challenges, in order to provide Nigerian basic schools with a practical pathway to effective and sustainable educational technology integration.

1.1 Statement of the Problem

The integration of educational technology in basic education has been globally acknowledged as a means to foster student engagement, improve the quality of teaching, and prepare learners for a digital future. In the developing nations like Nigeria, the benefits of educational technology integration remain largely unexploited due to infrastructural, systemic, and policy-related challenges. Ogunleye [13] affirmed that majority of the developed nations of the world have attained remarkable progress in integrating technology into their education systems. However, Nigerian schools continue to grapple with inadequate teacher training, lack of ICT infrastructure related facilities and insufficient policy support. As a result these perennial challenges, Nigerian education system is at risk of falling further behind in achieving equitable and quality education for all and dry.

The Nigerian government has implemented various initiatives, such as the National ICT Policy and National Policy on Education to promote the use of digital technologies in schools [14]. However, these policies have not effectively translated into widespread adoption or integration of technology in the classroom due to limited funding, poor implementation, and lack of inclusive frameworks that can tailor Nigeria's unique educational landscape [15]. Studies reveal that the benefits derived from technology as having potential of bridging gaps in accessing quality education are often restricted to urban schools with better resources, thereby leaving rural and under-resourced schools due digital divide that creates disparities in learning outcomes [16]; as students in rural areas lack the technological resources necessary for modern education.

Teachers' attitudes and competence in technology integration are strongly influenced by their access to training and continuous support. However, most teachers in Nigerian schools are not readily prepared in utilizing technology for instruction. Without adequate training and support, teachers are not likely to adopt digital tools and limits the potential impact of technology on students' learning experiences. Also, lack of structured and context-sensitive framework for technology integration contribute to the problem. The existing models for educational technology integration was largely developed in western contexts and do not account for the cultural, unique socio-economic, and infrastructural challenges that is facing Nigerian schools [17]. As a result, attempts to adopt foreign models often fail to achieve the intended outcomes due to a mismatch between the framework and the local realities of Nigerian schools.

Various frameworks for educational technology integration that were studied revealed absence of a model that is specifically designed for Nigerian basic education system that takes into account the unique local challenges; such as cultural contexts, infrastructural inadequacies, socio-economic limitations and adaptable framework for technology integration that can guide policy and practice in Nigerian schools ([16]; [18]). This gap underscores the need for a specific approach that can address the systemic challenges and could enhance the capacity of both students and teachers to meaningfully engage with technology in education. Therefore, this study proposed DiFTIE Framework as a strategic model for addressing the pedagogical, absence of a structured framework, locally tailored framework for technology integration that can account for the infrastructural facilities, and policy-related challenges specific to the Nigerian basic education system; thereby,

providing Nigerian schools with a practical pathway for effective and sustainable educational technology integration.

2.0 Related Works

Technology integration Frameworks: TPACK, SAMR and TIM Framework

Out of many technology integration frameworks, TPACK Framework (Technological Pedagogical Content Knowledge), SAMR Framework (Substitution, Augmentation, Modification, Redefinition) and TIM Framework (Technology Integration Matrix) were reviewed based on the fact that they are having direct relationship with this study.

Technological Pedagogical Content Knowledge (TPACK) Framework: was developed by Mishra and Koehler [19], which provides conceptual framework for integrating technology into teaching and learning. The framework was built on Shulman's [20] notion of Pedagogical Content Knowledge (PCK) and added the technological dimension. The framework consists of three primary domains of knowledge and their intersections - **Technological Knowledge (TK): it is** understanding how to use technology tools effectively;

Pedagogical Knowledge (PK): is knowing how to teach and manage classroom processes, and **Content Knowledge (CK):** which is the mastery of the subject matter being taught. The intersections of these domains result in: **Technological Content Knowledge (TCK) – that is** how technology enhances specific content delivery; **Technological Pedagogical Knowledge (TPK) –** it is how technology supports teaching methods; and **Pedagogical Content Knowledge (PCK) – which has to do with** effective ways to teach specific content.

At the core lies **TPACK,** which represents the integration of these knowledge areas to create meaningful, technology-enhanced learning experiences. TPACK stresses the blending of pedagogy, technology, and content knowledge for effective teaching. It serves as a base to show teachers that effective technology integration requires better understanding of how technology supports both pedagogy and content. TPACK provides a broad base knowledge that informs decisions at every SAMR level (Substitution, Augmentation, Modification, and Redefinition) by considering how the pedagogy and content influence the use of technology. This framework can also be applied within the TIM framework by ensuring that the use of technology aligns with both the learning goals and teaching strategies across TIM levels.

Substitution, Augmentation, Modification, Redefinition (SAMR) Framework: was developed by Puentedura [21] and it is a model that categorizes different levels of technology integration in education. It is structured as a four-tier hierarchy: **Substitution -** technology acts as a direct tool that substitute with no significant change in functionality.

Augmentation: technology acts as direct substitute but with functional improvements.
Modification: technology allows for significant task redesign.
Redefinition: technology enables entirely new tasks that were previously inconceivable. SAMR helps teachers to evaluate how deeply technology is integrated into teaching and encourage moving beyond mere substitution to transformative learning experiences. It help teachers to analyze the depth of their technology integration - from merely substituting traditional methods (Substitution) to completely transforming the learning experience (Redefinition). SAMR works as a bridge between TPACK and TIM. TPACK's framework guides teachers in making informed choices about how technology, content, and pedagogy align at each SAMR level. Furthermore, SAMR aligns with TIM's levels of integration, supporting teachers as they move from basic integration (Substitution and Augmentation) to more sophisticated use (Modification and Redefinition).

Technology Integration Matrix (TIM) Framework: Technology Integration Matrix (TIM) was developed by the Florida Center for Instructional Technology (FCIT), which provides a framework for assessing and guiding technology integration in classrooms. It combines five levels of technology integration with five interdependent characteristics of meaningful learning environments.

The Levels of Integration are: *Entry*: basic technology is used to deliver content,
Adoption: technology use is routine but teacher-directed,
***Adaptation*:** technology is integrated flexibly and allow for student to explore, ***Infusion*:**

technology use is seamless and readily accessible and ***Transformation*****:** technology enables significant and innovative learning experiences.

The characteristics of learning environments are: active, collaborative, constructive, authentic and goal-directed. The TIM framework stresses moving from teacher-centered to student-centered learning environments in order to promote deep and meaningful engagement with technology.

These frameworks (TPACK, SAMR, and TIM) provide theoretical and practical models for integrating technology into education. While **TPACK** focuses on the knowledge that the teachers need to integrate technology, **SAMR** provides way out for increasing the transformative use of technology, and **TIM** offers a structured guide to evaluate and enhance the quality of technology integration in diverse learning environments. The TPACK, SAMR, and TIM frameworks are complementary models that provide teachers with different perspectives on integrating technology in teaching. Their interrelationships shows that TIM describes levels of technology integration and aligns these levels with instructional goals and student engagement. It provides a practical model with specific characteristics at each level (Entry, Adoption, Adaptation, Infusion, Transformation), supports student-centered learning, and help teachers to understand the depth of technology integration. TIM incorporate TPACK's principles by applying pedagogically sound approaches to each level of integration. TIM's levels of technology use has good deal of relationship with SAMR, where TIM's Entry/Adoption levels align with SAMR's Substitution/Augmentation, and TIM's Infusion/Transformation levels align with SAMR's Modification/Redefinition.

Summarily, TPACK offers a foundational framework of knowledge that informs choices about content and pedagogy at each SAMR and TIM level; while SAMR provides a pathway for understanding the transformation of learning through technology, aligning with TIM's levels to show depth in technology use; and TIM describes specific characteristics of technology use in the classroom, which can be enhanced with TPACK knowledge and SAMR's transformational goals. Together, these frameworks help teachers develop a well-rounded and progressive approach to integrating technology in ways that are pedagogically meaningful, content-driven, and deeply transformative for students.

3.0 Contextualization of DiFTIE Framework in Nigeria Basic Education

The need for Digital Framework for Technology Integration in Education (DiFTIE) is driven by critical gaps in Nigeria's basic education system, which existing technology integration models fail to address. Current educational technology frameworks, such as TPACK SAMR and TIM, were developed in contexts with strong policy support, advanced infrastructures, and extensive teacher training opportunities. Applying these (TPACK SAMR and TIM) models in Nigerian schools has faced significant challenges due to unique local factors, widening of the digital divide and leading to minimal impact.

Infrastructure Deficiencies: Most Nigerian schools in rural areas are challenged with limited access to basic infrastructure like electricity, internet, and digital devices. Disparities in learning opportunities exist between urban and rural schools. The DiFTIE Framework specifically prioritizes adaptable infrastructure solutions, such as mobile-friendly resources and offline digital tools to bridge this gap; thereby ensuring students in both urban and rural areas benefits from technology-enhanced education.

Insufficient Teacher Training and Digital Competency: Many Nigerian teachers were not given sufficient training and support needed to use educational technology effectively. This is compounded by the fact that professional development programs in ICT are infrequent and insufficient. DiFTIE emphasizes on capacity building by equipping teachers with the skills and confidence to use digital tools effectively; thereby empowering educators and improve teaching quality across the nation.

Limited Policy Implementation: Nigerian government has developed a lot of policies to encourage the use of ICT in schools, however, implementation has been weak due to limited resources and lack of cohesive frameworks guiding policy execution. The DiFTIE Framework addresses this need by integrating policy guidance and monitoring mechanisms, thereby ensuring that policies are not only created but effectively implemented and adapted over time to meet evolving educational needs.

Context-Sensitive Solutions: The DiFTIE Framework is specifically designed to include strategies for deploying low-cost and sustainable technologies that can operate under challenging conditions. The framework will provide a scalable and context-sensitive solution that other frameworks lack in order to address the variability in resources across Nigerian schools.

Equity and Inclusion: DiFTIE is built to ensure that technology integration reaches all students and promote equitable access to all students irrespective of gender and geographic or socioeconomic challenges.

Sustainable and Adaptive Framework: The DiFTIE Framework addresses current infrastructural, training needs and it is designed to adapt over time. DiFTIE framework has the tendency to be adjusted in order to update policy directions, accommodate new tools and enhanced training modules, based on the premised that Nigeria's educational technology landscape evolves. This adaptability is essential for building a future-proof foundation for educational technology integration in Nigeria.

Localized Professional Development for Teachers: DiFTIE Framework provides a structured approach to professional development that is tailored towards Nigerian educational systems, including specialized modules that address infrastructure gaps, limited electricity, and culturally relevant pedagogy. This localized training is paramount in enhancing teacher confidence and efficacy, particularly to Nigerians that are living in rural environments. TPACK and other models emphasize broad pedagogical and technological skills but often lack culturally relevant training that addresses specific challenges that are facing teachers in Nigeria.

Cultural Relevance and Community Engagement: DiFTIE Framework prioritizes cultural relevance and community engagement, aligning technology integration with local values and involving community stakeholders. By engaging parents, leaders, and local stakeholders, DiFTIE fosters an environment that is supportive of sustained technology adoption

Real-World Readiness and Practical Emphasis: DiFTIE Framework incorporates real-world digital skills that ensures students acquire the needed competencies beyond classroom use. It prepares students for the Nigerian digital economy by integrating technology with career-relevant competencies, thereby addressing a gap left by previous frameworks that lack practical and local related relevant components. Models like TIM focus on improving technology use in the classroom but lack elements for preparing students for real-world digital engagement, which is very paramount to students' need in Nigeria.

Summarily, DiFTIE Framework fills a critical gap by providing a realistic, actionable, and adaptable model for technology integration in Nigerian basic schools. It offers a structured approach tailored to the unique needs and challenges of Nigeria, impactful educational technology adoption and promoting equitable, sustainable. Through DiFTIE, Nigerian schools can make meaningful progress toward providing students with the digital skills that are needed for success in the modern world. The DiFTIE Framework is proposed as a solution tailored to address these gaps by offering a comprehensive, Nigeria-specific approach to educational technology integration. It emphasizes the importance of capacity building, tailored methodologies, infrastructure, tools, and continuous policy evaluation to ensure sustainable technology integration in Nigerian schools. Without a contextually relevant framework, the Nigerian basic education system is unlikely to achieve the transformative benefits of educational technology, risking a failure to equip students with the digital skills that are necessary for the future workforce. The uniqueness depicts the outstanding adoption to be contextualized in Nigeria and other developing countries of the world. The proposed DiFTIE Framework for Education Technology Integration for Nigerian Basic Education is as shown in Figure 1.

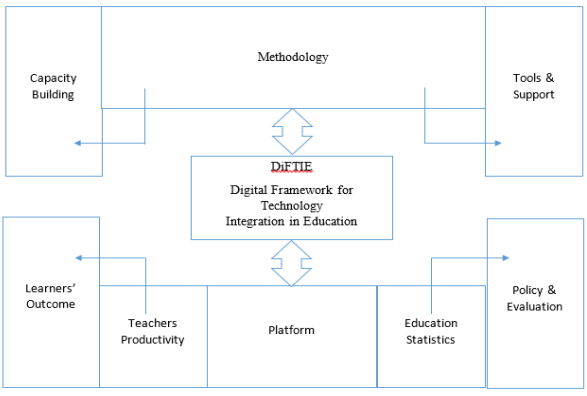

Figure 1: The **DiFTIE** Framework for Digital Education Technology Integration

The DiFTIE Framework for Education Technology Integration, as illustrated in Figure 1, is a holistic approach designed to facilitate the effective adoption of technology within the educational system. The framework organizes key components necessary for successful EdTech integration, with each element synergistically supporting others to enhance the overall educational experience and outcomes. Here's an in-depth look at the various components and their interactions:

Central Component (DiFTIE Framework)**:** The DiFTIE sits at the heart of the model and act as the core guiding structure for technology integration. This central placement emphasizes that all other components revolve around and interact through this framework, aiming for an optimized, and collaborative approach to EdTech adoption. The bi-directional arrow indicates that the DiFTIE Framework not only influences other components but is also influenced by them, adapting to changing needs, feedback, and results.

3.1 Core Components of the DiFTIE Framework

Methodology: refers to pedagogical strategies employed to effectively integrate technology into the teaching-learning process. It focuses on learner-centered to enhance critical thinking, creativity, and problem-solving skills among students.

Platform: is technological foundation that supports implementation of digital learning. This includes software (LMS like Moodle), hardware (computers, tablets), and network infrastructure (internet connectivity). The platform ensures scalability, accessibility, and sustainability of educational technology tools in diverse learning environments.

Capacity Building: methodology is linked to capacity building which involves continuous professional development programs for administrators, teachers, and support staff to enhance their digital competencies. Capacity building focuses on training teachers only not to use technology but to effectively integrate it into their teaching practices, in order promote culture of innovation.

Tools and Support: methodology is also linked to capacity building which is refer to the range of digital tools (apps, software, devices – laptop, and other related mobile devices) and the technical support systems necessary to maintain them.

Policy and Evaluation: from the platform, education statistics links policy and evaluation which encompasses the development of policies like digital literacy standards, data privacy regulations, and ICT policies that guides the integration of technology in education. Evaluation mechanisms enable assessing the effectiveness of technology integration in achieving educational goals through feedback loops, monitoring, and performance reviews.

Learners' Outcome: from the platform, it is the teachers' productivity that determines learners' outcome. Learners' outcome focuses on the measurable impact of technology on students' skill acquisition, improved academic performance, and personal development. It ensures that technology use translates into improved learning experiences and outcomes via affective, cognitive, and psychomotor domains assessments.

Teachers' Productivity: it is how productive the teachers are that will determines the learners' improved outcome. Teachers' productivity examines how technology enhances teachers' efficiency to include instructional delivery, lesson planning, assessment, and classroom management.

Education Statistics: refers to collection, analysis, and use of data related to student performance, teacher effectiveness, and institutional management. This data-driven approach supports informed decision-making, policy formulation, and continuous improvement in educational practices.

3.2 Platform and Methodology as Prime Mover of other components in DiFTIE Framework

DiFTIE is locally structured to enhance pedagogical practices, bridge infrastructural gaps and promote sustainable technology integration. The framework is built on two interrelated pillars: Platform and Methodology that are supported by major components to ensure effective implementation and sustainability.

1. Platform (The Digital Infrastructure for Learning): refers to technological foundation

that facilitates learning, teaching, and administrative processes. It focuses on creating an environment where digital tools can effectively be deployed, engaged and utilized to enhance educational outcomes.

The key components driving the platform are:
Infrastructure Readiness: This includes physical infrastructure (e.g., internet connectivity, reliable electricity and procurement of ICT devices) that are essential for supporting digital learning.

Software and Digital Tools: has to do with the selection of educational apps, learning management systems (LMS) and other digital resources that should align with the curriculum and be adaptable to local contexts.

Accessibility and Inclusivity: the platform must cater for diverse learners needs; including students with disabilities. Features like translation tools, text-to-speech and offline functionalities ensure that technology is accessible regardless of location or learner needs.

Data Security and Privacy: safeguarding student data is crucial with the growing use of digital platforms. The DiFTIE Framework incorporates data protection policies that comply with both international standards and national regulations.

Technical Support Systems: this includes training local technicians, setting up IT help desks and establishing partnerships with tech providers for maintenance and upgrades.

2. Methodology (Pedagogical Approaches for Digital Learning): The Methodology pillar focuses on how technology is integrated into teaching and learning practices. This incorporates the use of digital tools to improve student-centered learning, promote students' active learning performance and innovative instructional strategies.

The key components driving the methodology are:
Teacher Capacity Building: the DiFTIE Framework advocates for continuous professional development (CPD) programs focusing on instructional design, digital pedagogy, and classroom management in tech-enhanced environments; in order to improve teachers' digital competence.

Curriculum Alignment: the framework promotes curriculum redesign that incorporates ICT competencies across subjects, creativity, enhancement of critical thinking, and problem-solving skills.

Active Learning Strategies: flipped classrooms, project-based learning, and inquiry-based learning are emphasize and encourage students to take ownership of their learning, apply knowledge in real-world contexts and collaborate with peers.

Assessment and Evaluation: DiFTIE incorporates digital assessment tools for both formative and summative evaluations.

Context-Sensitive Pedagogy: recognizing Nigeria's socio-economic landscape, and diverse cultural heritage, the framework supports the adaptation of teaching strategies to local contexts. This includes integrating indigenous knowledge, use of local languages and leveraging community resources.

3.3 Synergy between Platform and Methodology

Platform provides the technological infrastructure, while Methodology ensures that technology is effectively used to enhance learning outcomes. These two pillars work interdependent that without a robust platform the best pedagogical strategies will falter due to technical limitations. Subsequently, technology risks being misapplied or underutilized, thereby leading to superficial integration without effective methodologies.

The DiFTIE Framework bridges this gap by creating a dynamic interaction between technology infrastructure and pedagogical practices, ensuring that both evolve together in response to changing educational needs. It presents a dynamic approach to educational technology integration, emphasizing the synergy between methodology and platform. It promotes effective support systems, continuous improvement through capacity building and data-driven policies to enhance both teaching and learning outcomes. DiFTIE Framework focus on both Platform (infrastructure, digital tools) accessibility, and Methodology (pedagogy, teacher development curriculum alignment) in order to address the systemic challenges that have been hindering effective adoption

educational technology in Nigeria system of education.

3.4 Advantages Derived from the DiFTIE Framework

Advantages derived from the DiFTIE Framework are:

i. **Holistic Integration:** DiFTIE Framework highlights the importance of balancing methodology (how technology is applied) with the platform (the supporting infrastructure) to achieve effective educational technology integration.
ii. **Interconnected Components:** tools and support, capacity building, learners' outcomes, teachers' productivity, policy and evaluation, and education statistics are interconnected, working together to enhance the impact of technology in education.
iii. **Focus on Capacity Building:** it emphasizes on teachers continuous professional development to effectively adopt and adapt to evolving educational technologies.
iv. **Supportive Tools and Infrastructure:** pointed out the importance of availability of relevant tools and robust infrastructure for sustainability of technology-driven learning environments.
v. **Policy and Evaluation:** effective technology integration relies heavily on clear policies and continuous evaluation in ensuring proper alignment with educational goals and to promote accountability.
vi. **Learner-Centered Outcomes:** the framework place high priority on improved learning outcomes by encouraging the engagement of technology-enhanced educational experiences.
vii. **Enhancing Teacher Productivity:** technology is leveraged to reduce administrative burdens, streamline instructional processes and boost teachers' efficiency.
viii. **Data-Driven Decisions:** Education statistics derived from technology use provide valuable insights for informed decision-making, curriculum adjustments, and resource allocation.

The DiFTIE Framework presents a dynamic approach to educational technology integration, emphasizing on the synergy between methodology and platform. It promotes continuous improvement through capacity building, effective support systems, and data-driven policies, ultimately aiming to enhance both teaching and learning outcomes.

4.0 Comparative Analysis between DiFTIE Framework with TPACK, SAMR, and TIM Frameworks

The comparative analysis between DiFTIE Framework with TPACK, SAMR, and TIM Frameworks revealed that the DiFTIE's unique relevance to Nigeria's educational systems is evident, particularly in its adaptability to local challenges and its emphasis on readiness and policy support. The breakdown of DiFTIE uniqueness to foundational studies and research on these frameworks:

i. Contextual Relevance: DiFTIE is designed specifically for Nigerian context to address socio-economic, infrastructural, and policy related challenges that are unique to Nigerian schools. Studies conducted by Oladosu [22] encourage local adaptation of technology in low-resource settings. DiFTIE's framework is sensitive to urban-rural disparities and variable technology readiness that is labelled as unique constraints in Nigeria. TPACK, SAMR, and TIM are models that are developed primarily in western contexts and emphasizes on a broad and generalized frameworks for technology integration without specific adaptations for the underdeveloped countries with limited resources.

ii. Focus on Policy Integration and Foundational Readiness: DiFTIE emphasizes on a structured assessment of foundational readiness in the aspects of infrastructure, teacher preparedness, community involvement and policy support. These elements are crucial to the developing nations like Nigeria where many schools are challenged with inconsistent limited supply of devices, epileptic power supply and low level ICT literacy among teachers {[23]; [24]}. The inclusion of readiness related factors in DiFTIE aligns with research conducted by Mbah and Obi [25] buttressing the need for foundational technology support in low-income settings. However, TPACK, SAMR, and TIM frameworks essentially delve on how technology integrates with content and

teaching methods to exemplify a certain level of readiness. In TPACK the focus was on teacher knowledge [19], which aspects of readiness was omitted entirely. TIM framework focuses on levels of integration without explicitly focusing on initial infrastructure.

iii. **Structured for Progressive Implementation:** DiFTIE framework adopts stage-by-stage strategy to guide policymakers and educators from assessing level of readiness to implement and evaluate technology integration. The progression in DiFTIE is designed to accommodate variables like levels of access to technology and provision of help to various schools to advance to full digital integration and utilization of technology as resources allow. In SAMR, movement from Substitution to Redefinition is facilitated in its progression model, however, it lacks initial readiness phase and assumes schools should be prepared to commence this progression. TIM describes integration levels without really focusing on progressive scaling or readiness. while TPACK offers foundational knowledge and failed to provide structured stages,

iv. **Emphasis on Community Involvement and Collaborative Support:** DiFTIE incorporates community engagement based on the importance and recognition given to it. This vital component is crucial in low-resource educational environments in facilitating the provisions for collaboration among community members, educators and policymakers. The involvement and collaborative support of key stakeholders (community members, educators and policymakers) are paramount to DiFTIE to locally supported technology and goal of integration sustainability. TPACK, SAMR and TIM models overlook the roles played of policy support and broader community. However, gives high priority to teacher-student interactions during pedagogic experiences in the classroom. Hence, DiFTIE's approach suggests long-term sustainability of educational technology in resource-constrained environment that relies on policy and active community engagements.

v. **Adaptability to Resource Constraints:** DiFTIE framework uniquely put into consideration the resource limitations like internet availability, access to technological devices, low-cost technology solutions, disparities in teacher trainings and blended approaches that are suitable for developing nation schools like Nigeria. This flexibility makes DiFTIE uniquely relevant for rural, developing and under-resourced nation schools like Nigeria. TPACK, SAMR, and TIM models consider basic infrastructure facilities and excellently defines pedagogical role in technology integration. However, these framework does not offer targeted guidance for adapting significant resource limitations. DiFTIE framework incorporates unique adaptations in filling this gap by making it more viable for schools in the developing countries like Nigeria with limited resources.

The DiFTIE Framework presents a contextually progressive, relevant, and adaptable approach to technology integration in education for developing countries like Nigeria by filling the gaps left unfilled by TPACK, SAMR and TIM. DiFTIE's structure emphasizes on the policy integration, foundational readiness and community involvement, which are crucial for technology integration and adoption sustainability in Nigeria and other developing nations of the world with resource limitations and capable of engaging the community stakeholders.

The DiFTIE Framework stands out to address the localized perennial challenges such as socio-economic disparities, infrastructural facilities constraints and limited policy support that are facing Nigeria system of educational. It integrates policy alignment, equity, localized teacher training, and scalability into its design, thereby distinguishing itself from global models like TPACK, SAMR, and TIM. It also offer practical and inclusive solutions to pedagogic experiences thereby ensuring a sustainable path for technology integration in Nigeria's basic education system. It contextually presents relevant, progressive, and adaptable approach to technology integration for Nigerian education by emphasizing on policy integration, foundational readiness, and community involvement. These constructs are gaps left by TPACK, SAMR, and TIM that crucial for sustainable integration and adoption of technology in Nigeria

5. Conclusion

The DiFTIE Framework emerges as a transformative approach to integrating technology into Nigeria system of educational to bridge technology integration and adoption gaps left by traditional frameworks like TPACK, SAMR, and TIM. Unlike the previous Framework, DiFTIE is contextually designed in addressing unique challenges such as socio-economic disparities, infrastructural facilities limitations and policy related inadequacies that are facing education system in Nigeria and other developing countries. The framework incorporates equity, community engagement, and localized teacher development into its design in order to enhance inclusive and sustainable pathway for technology adoption in Nigerian schools.

The alignment of digital education initiatives with national policies in DiFTIE framework provides roadmap to address the digital divide among the urban and rural residents in technology adoption. The comparative analysis between TPACK, SAMR, TIM) and DiFTIE exemplified that traditional frameworks assume universal applicability and resource adequacy, however, DiFTIE placed high priority on scalability, implementation, and adaptability to resource-limited environments in the developing countries like Nigeria, thereby making model suitable for Nigeria's educational system.

The DiFTIE Framework will provide a firm foundation for solving systemic related challenges that have been grappling with effective adoption of technology in Nigerian basic schools, thereby empowering key stakeholders like teachers and students to thrive well in the digital age.

5.1 Recommendations

The following suggestions are recommended:

1. The Nigerian government and education stakeholders should adopt the DiFTIE Framework as a guiding model for technology integration in schools, based on the premise that it aligns with national education policies and offers practical solutions for resource-limited contexts.
2. Capacity-building initiatives should focus on training teachers on using culturally relevant, localized content that accommodates offline teaching methods and promotes practical digital skills.
3. Educational stakeholders should intensify efforts to improve the digital infrastructural facilities such as reliable internet connectivity, access to electricity, affordable digital devices and readiness of schools to embrace technology integration and adoption. These infrastructural investments are crucial to the success of the DiFTIE Framework.
4. Government should establish robust monitoring and evaluation systems to assess the effectiveness of technology integration efforts by using metrics that are aligned with the goals of the DiFTIE Framework.
5. Education stakeholders (teachers, students, school administrators and members of community) should harness the inherent potential of the DiFTIE Framework to transform Nigeria's educational system by fostering more on equitable, inclusive and sustainable approach to technology integration.

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