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Empowering Students through Hands-On Technological Education for Enhancing Practical Skills and Self-Reliance for Nation Building

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Abstract
The write-up explores empowering students through hands-on technological education for enhancing practical skills and self-reliance in Nigerian schools for development and nation building. It stresses that education in Nigeria is a corner stone of national development, with the power to determine the country's socioeconomic destiny. It put into consideration the role of education in economic productivity technical and vocational training, STEM Education and Innovation, Entrepreneurship and Self-Reliance, Integration of Emerging Technologies in Education, Artificial Intelligence (AI), Augmented and Virtual Reality (AR/VR), Robotics and Internet of Things (IoT), Shift Toward Competency-Based Learning, Focus on Lifelong Learning and Upskilling, STEM Education as a Foundation for Innovation, Emphasis on Entrepreneurship and Innovation, Digital Transformation in Education Delivery, Localizing Global Models for Contextual Relevance, the Role of STEM Education in Empowering Students, Fostering Problem-Solving and Critical Thinking Skills, Encouraging Innovation and Creativity, Developing 21st-Century Competencies, Driving Socio-Economic Development, Inspiring Lifelong Learning and Curiosity, Hands-on Learning and Its Impact on Skill Acquisition, Technological Education in Nigeria, as well as Current Challenges in the Nigerian Educational System and recommendations.

Keywords: empowering, hands-on technology, practical skills, self-reliance, nation building

Introduction

Education, in Nigeria, is a corner stone of national development - with the power to determine the country's socioeconomic destiny. With one of the world's largest young populations, Nigeria's education system prepares millions of learners to become skilled, knowledgeable, and productive citizens who can substantially contribute to the country's progress. However, the system has

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numerous obstacles that limit its ability to provide quality education to its varied population (Saha, 2016).

The Nigerian educational system comprises multiple tiers: early childhood education, primary school, secondary education, and university education. Each level is essential in providing students with fundamental knowledge, technical abilities, and advanced competencies. Notwithstanding significant advantages, including a comprehensive curriculum framework and an increasing focus on science and technology education, as well as systemic challenges endure (Moja 2020, Sooter, 2023).

Chronic underfunding, inadequate infrastructure, and differences in educational access between urban and rural communities are all important barriers Furthermore, teacher shortages, antiquated teaching approaches, and socioeconomic constraints, such as poverty and cultural hiases, impede inclusive and equal education provision(Ige, 2021, Imam, 2018)

The Nigerian education system is split into three main levels: (i) Basic Education. This comprises early childhood education, Primary School (Grades 1-6), and Junior Secondary School (Grades 7-9). Basic education is free and compulsory, as stipulated by the Universal Basic Education (UBE) programme. implemented in 1999; (ii) Senior Secondary Education comprises three years of education (Grades 10-12) and allows pupils an opportunity to focus on academic, technical, or vocational programmes. At the end of this level, learners take the Senior Secondary Certificate Examination (SSCE); (iii) Tertiary Education. This comprises Universities, Polytechnics, Colleges of Education, and Vocational Training Facilities. Nigeria has around 170 universities (Federal, State, and Private). The country also has polytechnics and mono-technics that focus on technical and vocational education.

Despite its challenges, the Nigerian education system possesses several strengths that underscore its potential as a critical driver of national development. These advantages reflect the system's resilience and the stakeholder's efforts which enhance its quality and accessibility.

Recognizing the global shift towards STEM (Science, Technology, Engineering, and Mathematics) fields, Nigeria has incorporated these areas into its educational priorities. Initiatives to promote science fairs, technical education, and research in higher institutions reflect a growing commitment to equipping students with skills for the modern workforce. Programs like Technical and Vocational Education and Training (TVET) aim to bridge the gap between education and industry, fostering technical expertise and entrepreneurship.

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Nigeria has a broad network of tertiary institutions, that keep providing opportunities for millions of students to pursue higher education in various fields, contributing to the development of skilled professionals and academics Nigerian universities have produced a wealth of notable alumni who have made significant contributions globally, showcasing the country's intellectual potential Policies such as the Universal Basic Education (UBE) program and the National Policy on Education demonstrate the government's intent to improve access to and the quality of education. These frameworks aim to address issues like illiteracy gender inequality, and regional disparities in education. International partnerships and donor support have further enhanced these efforts, helping to expand school infrastructure and train educators.

The Nigerian government has implemented several initiatives and reforms to address challenges in the education sector and improve its overall quality and accessibility One key program is the Universal Basic Education (UBE) Program, launched in 1999, which aims to provide free, compulsory, and universal basic education for children aged 6-15 years. While it has led to increased enrollment rates, significant challenges remain in ensuring equitable access and quality education for all Efforts to promote STEM education have included the establishment of specialized science schools and the integration of ICT into the curriculum. However, these initiatives face limitations in implementation, particularly in resource-constrained

Role of Education in Economic Productivity

Research efforts have affirmed clear correlation between technical education and labor preparedness, especially in emerging countries. Practical skills acquired via experiential learning empower learners to address deficiencies in sectors such as industry, agriculture, and technology. Germany's dual-system model of vocational training combines theoretical and practical education, resulting in a highly trained labour force.

STEM Education and Innovation

The focus on STEM (Science, Technology. Engineering. Mathematics) disciplines in education is meant to foster innovation and to enhance national competitiveness on a worldwide scale Research from nations like South Korea emphasizes how expenditures in technology education led to fast industrialization and economic progress

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Entrepreneurship and Self-Reliance

Practical education encourages entrepreneurship by educating students with the skills required to develop and run firms Nigerian youth, for instance, may benefit from technical education to generate breakthroughs in agriculture, renewable energy, and small-scale industry.

Integration of Emerging Technologies in Education

The introduction of sophisticated technology is transforming how students gain information and practical skills, making learning more interactive, individualized, and relevant to industry demands. Some of these include:

Artificial Intelligence (AI): Al-powered technologies tailor learning experiences, responding to individual students' strengths and shortcomings. Platforms like Khan Academy and Duolingo employ Al algorithms to deliver personalized learning routes in advanced technical education, Al provides real-time evaluation and feedback

Augmented and Virtual Reality (AR/VR): These technologies provide realistic simulations for learning complicated tasks, such as conducting operations, maintaining machines, or navigating dangerous locations AR/VR makes abstract ideas concrete, boosting understanding and recall

Robotics and Internet of Things (IoT): Robotics exposes students to automation and coding, while loT stimulates hands-on learning with smart devices. These technologies educate students for professions in automation smart manufacturing, and data-driven systems. Countries worldwide are utilizing technological breakthroughs to enhance education, with prominent instances exhibiting varied techniques.

Shift toward Competency-Based Learning

The transition toward competency-based education (CBE) is altering learning by prioritizing the acquisition of real-world skills over conventional time-bound curriculum, guaranteeing that students are more equipped for job needs. CBE is defined by an emphasis on quantifiable results, the incorporation of industry relevant credentials, and flexible timeframes that enable learners to develop at their own speed, responding to varied learning requirements Globally, Germany exhibits this method via its dual education system, which integrates classroom teaching with paid apprenticeships in diverse sectors, guaranteeing students obtain both theoretical knowledge and practical experience immediately transferable to the labor market. Similarly, in Canada, schools like the British Columbia Institute of Technology (BCIT) cooperate with companies to give competency-based technical education, giving students with skills linked with current job trends

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These approaches underline the worldwide focus on integrating education with industrial needs, developing a workforce able to address new problems and possibilities

Focus on Lifelong Learning and Upskilling

The fast speed of technological innovations has spurred a worldwide trend toward supporting lifelong learning and upskills to guarantee worker flexibility and competitiveness. Central to this movement are online and hybrid learning platforms such as Coursera, Udemy, and EdX, which give flexible options for professionals to reskill or gain new abilities Governments and companies are increasingly promoting workforce development via specialized initiatives aimed at meeting growing employment needs. In the European Union, programs like Erasmus+ and the Digital Education Action Plan concentrate on continual professional development, stressing digital literacy and skill upgrades to correspond with the needs of a knowledge-based economy. Similarly, India's Skill India Mission has made considerable gains in delivering technical and vocational training to millions of young people, integrating new technology into its programs to guarantee relevance to current and future industry demands. These initiatives underline a worldwide realization of the need for lifelong learning as a cornerstone for the economic resiliency and human empowerment.

STEM Education as a Foundation for Innovation

STEM (Science, Technology. Engineering, and Mathematics) education is generally acknowledged as a key foundation for promoting creativity, giving students with the analytical, technical, and problem-solving abilities essential to handle real-world difficulties and drive technological improvements. Globally. Many ways have been implemented to strengthen STEM education and relate it to practical applications. In the United Kingdom, the STEM Ambassadors initiative invites industry experts into classrooms, where they mentor students and give insight into real-world STEM vocations, thereby bridging the gap between theoretical understanding and practical applications.

Emphasis on Entrepreneurship and Innovation:

Education systems worldwide are putting a heightened focus on entrepreneurship as an important result of technology education, recognizing its ability to generate innovation, economic growth, and social advancement. By stimulating creativity and problem-solving, these systems attempt to enable students to utilize their abilities to confront current concerns and generate possibilities In Israel, frequently referred to as the "Startup Nation," entrepreneurship education is seamlessly

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incorporated into STEM courses, giving students with the capabilities to design and build technology-driven enterprises. This methodology has resulted in a robust ecosystem of young innovators contributing to the global digital industry Similarly, Kenya's Ajira Digital initiative focuses on teaching adolescents with digital literacy and entrepreneurial skills, allowing them to leverage on technology for self-employment. These worldwide examples underline the relevance of entrepreneurial education in producing a generation of innovators who are prepared to adapt to and impact the dynamic needs of the contemporary world.

Digital Transformation in Education Delivery

The digital transformation of education is revolutionizing how knowledge is delivered, making learning more scalable, flexible, and accessible to diverse audiences. This shift is characterized by the rapid growth of massive open online courses (MOOCs) on platforms like Coursera, edX, and Future Learn, which provide affordable access to high-quality education globally. Additionally, the rise of online certifications and Nan degrees targeting in-demand tech skills such as data science, cloud computing, and cyber security is equipping learners with industry-relevant expertise. In the United Kingdom, universities are collaborating with technology firms to offer remote certifications in advanced fields like artificial intelligence and block chain, aligning academic offerings with workforce demands. Similarly, in South

Africa, mobile learning platforms are playing a critical role in bridging the digital divide, particularly in rural areas where traditional educational infrastructure is limited. These global trends underscore the transformative potential of digital education to democratize learning and foster skill development across socioeconomic boundaries.

Localizing Global Models for Contextual Relevance

Localizing global educational paradigms is crucial to ensure that technology education is both successful and inclusive, especially in diverse and resource constrained situations. By adapting curriculum to meet local industry needs. Education institutions may boost the usefulness of skills being taught. For instance, low-cost technical tools and region-specific materials may bridge gaps in resource limited places, making cutting-edge education accessible to marginalized groups. Kenya illustrates this technique by modifying worldwide coding initiatives such as Code.org to fit rural schools, teaching programming via native content and methodology. Similarly, Brazil tailors its vocational training programs to serve developing industries like agri-tech and the bioeconomy, matching workforce development with national goals. These examples illustrate the necessity of

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contextualizing global best practices to enhance effect and support sustainable development in local contexts.

The Role of STEM Education in Empowering Students:

STEM (Science, Technology, Engineering, and Mathematics) education plays a transforming role in educating students about the challenges of the contemporary world. By encouraging critical thinking, inventiveness, and technical ability. STEM education equips students to flourish in an increasingly technology-driven and knowledge-based economy.

Fostering Problem-Solving and Critical Thinking Skills

Fostering problem-solving and critical thinking abilities is a fundamental objective of STEM education since it allows students to apply theoretical knowledge to practical, real-world circumstances. This approach stresses logical thinking. experimentation, and inquiry-based learning, enabling students to handle complicated hours creatively and systematically By participating in hands-on projects such as developing energy efficient systems or creating robotic prototypes, learners are exposed to problems that reflect real-world circumstances, strengthening their capacity to evaluate, hypothesize, and iterate solutions. For example, research has demonstrated that inquiry-driven activities boost students' capacity to integrate ideas across disciplines, creating a better knowledge of fundamental principles (Hmelo-Silver, 2024). Programs globally, such as FIRST Robotics and energy sustainability initiatives in schools, illustrate how practical problem-solving can foster critical abilities like adaptation and ingenuity, preparing children for future problems in a quickly expanding technology context

Encouraging Innovation and Creativity:

Encouraging innovation and creativity is a fundamental component of STEM education, establishing an atmosphere where students are motivated to think outside the box and find breakthrough solutions to modern difficulties, STEM subjects intrinsically stimulate creative creativity by mixing theoretical knowledge with practical application, which is particularly crucial in growing sectors such as artificial intelligence, biotechnology, and renewable energy. For instance, initiatives like FIRST Robotics competitions engage students in designing and programming robots, merging engineering principles with imaginative problem-solving, while Maker Fairs provide platforms for students to showcase inventive projects ranging from 3D-printed devices to sustainable energy prototypes. Studies have indicated that such practical learning activities dramatically boost student's capacity to create, giving them the abilities required

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to survive in fast-evolving technology environments (Lemelson-MIT Program, 2019), By incorporating these methods inside educational institutions, STEM education not only promotes technology, engineering, and mathematics By addressing gender disparities. STEM education ensures that diverse perspectives are included, thereby strengthening innovation and problem-solving by incorporating a wide range of experiences and viewpoints. Programs like Girls Who Code and Women in STEM are at the forefront of these efforts, providing mentorship, resources, and training opportunities for female students, empowering them to enter and thrive in male-dominated fields (National Girls Collaborative Project, 2021). These initiatives have been shown to increase participation and retention of women in STEM careers, leading to a more diverse workforce that drives creative solutions in technology, healthcare, and engineering (Bain & Company, 2020). By bridging the gender gap, these programs not only promote equality but also enhance the potential for innovation in the STEM sector, benefiting industries globally

Developing 21st-Century Competencies

Developing 21st-century competencies through STEM education is vital for preparing students for the modem workplace, were skills like teamwork. Adaptability, and effective communication are essential. As industries become more collaborative and dynamic, STEM education emphasizes the development of these competencies by integrating them into hands-on projects and interdisciplinary learning experiences. Collaborative STEM projects, for example, teach students how to work in teams, manage resources, and present their findings effectively. Skills that are highly valued by employers. Programs like NASA's Space Apps Challenge are a prime example, encouraging students to engage in cross-disciplinary problem-solving while working together as a team. These competitions allow students to tackle real-world issues, leveraging skills from various fields such as engineering, data science, and design, all while building critical soft skills like leadership and collaboration (NASA 2022). Through these initiatives, students not only gain technical knowledge but also develop the interpersonal and problem-solving abilities necessary for success in a rapidly evolving job market.

Driving Socio-Economic Development

STEM education plays a crucial role in driving socio-economic development by producing skilled professionals who are equipped to innovate and contribute to various industries, including healthcare, energy, and information technology. By focusing on hands-on learning and practical skill development, STEM programs cultivate a workforce capable of addressing complex societal

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challenges. Empowered students, through their expertise, often become entrepreneurs or researchers who not only contribute to innovation but also create opportunities for others in their communities. For example, India's STEM-focused policies have significantly supported the growth of its IT industry, fostered economic development, and enhanced global competitiveness. These policies, which include investments in higher education and research, have contributed to making India a hub for technology and innovation, boosting employment, and attracting international investment (World Bank, 2020). As more students in developing nations are empowered with STEM education, the long-term effects include improved living standards, increased productivity, and a more competitive global economy.

Inspiring Lifelong Learning and Curiosity

By encouraging students to pursue new scientific and technological frontiers and fostering their curiosity, STEM education cultivates an attitude of lifelong learning. In an age of rapid technological advancement, this method fosters a love of learning and motivates students to keep studying even after they have completed their official education Lifelong learners are better able to seek ongoing self-improvement, adjust to changing technology environments, and maintain their competitiveness in the job market. For instance, school-based STEM clubs and coding boot camps provide children with the chance to experiment with cutting-edge technology, keeping them interested and inspired to learn new things. These programs ensure that students stay on the leading edge of technological breakthroughs by igniting their interest and providing practical experiences that encourage them to pursue jobs in sectors like robotics, data science, and artificial intelligence (Koller, 2021). Students who participate in such programs are inspired to tackle problems creatively and curiously, which helps them become resilient and adaptive in a world that is always changing.

Hands-on Learning and Its Impact on Skill Acquisition

Hands-on learning, often known as experiential or active learning, engages students directly in practical tasks that simulate real-world circumstances. This method diverges from conventional lecture-based instruction and prioritizes active student engagement, promoting a more profound comprehension of ideas and abilities (Dutta et al., 2024, Sharma & Gupta, 2024, Singha, 2024).

Experiential learning cultivates critical thinking by involving students in active problem-solving, flexibility, and practical applications. Students evaluate circumstances, recognize obstacles, and formulate solutions, such as troubleshooting in STEM laboratories, therefore enhancing their

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analytical abilities, develops problem-solving ability by immersing students in practical applications, iterative processes, and collaborative assignments. Activities like making prototypes connect theory and practice, while repeatedly trying to develop persistence and technique refinement. Team-based assignments promote using multiple viewpoints to discover successful answers, encourages creativity by stimulating experimentation, design thinking, and visualization of abstract topics. Students explore multiple methods of problem-solving, construct prototypes via iterative procedures, and translate ideas into new solutions, empowers students by establishing a feeling of ownership and success via real work. Repeated practice helps kids learn skills, create self-reliance, and grow confidence to confront obstacles alone and encourages curiosity and active engagement, boosting information retention via engaging activities. It empowers students with transferable skills like critical thinking and cooperation, increasing mobility across fields and vocations.

Hands-on learning approaches are transformational in providing students with practical skills, boosting their cognitive capacities, and preparing them for real-world issues. These strategies engage learners actively, making the learning experience lively and effective. Below are some instances of how hands-on learning emerging in diverse circumstances and its advantages?

Technological Education in Nigeria

Technical and Vocational Education and Training (TVET) in Nigeria has experienced a revolutionary journey, distinguished by its vital role in training people with practical skills for economic growth, workforce development, and self-reliance. Rooted in the nation's colonial past, the growth of TVET reflects Nigeria's reactions to altering socio-economic and technical issues.

During the colonial period, technical education was largely implemented to provide trained personnel for administrative and infrastructure undertakings under British authority. Institutions like Yaba Higher College, founded in 1934. Functioned as pioneering institutions for technical instruction, concentrating on disciplines like engineering, agriculture, and secretarial skills.

Following independence in 1960, Nigeria realized the need to realign its educational structure to facilitate national growth. The Ashby Commission Report (1960) strongly affected this transition, urging the growth of technical education to boost industrialization. Subsequent programs, such as the National Policy on School (1977, updated in 1981 and 2004), formalized TVET as a key component of the school system, underlining its relevance in stimulating entrepreneurship and lowering unemployment.

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The construction of polytechnics, technical institutions, and vocational institutes signified a purposeful attempt to bridge the gap between education and the job market. Institutions like Kaduna Polytechnic and the Federal College of Technology in Akure were essential in offering specialized training in sectors including mechanical engineering, construction, and ICT. Additionally, the Federal Government's Universal Basic Education (UBE) initiative integrated pre-vocational topics to educate young learners to technical skills early on.

In recent decades, the Nigerian government has worked to integrate TVET with worldwide trends in technology and industry. Initiatives like the National Board for Technical Education (NBTE) and collaborations with foreign organizations have increased curriculum development and infrastructure for technical education. Moreover, the growth of digital technology has seen ICT incorporated into TVET programs, preparing learners for the needs of a quickly expanding global economy.

The historical evolution of TVET in Nigeria highlights its fundamental role in tackling important socio-economic concerns, from unemployment to industrial growth. While great progress has been achieved, continual changes are required to guarantee that TVET continues to fulfill the needs of contemporary business and technological innovation.

Current Challenges in the Nigerian Educational System in Technological and Practical Training

Nigeria's education system faces persistent challenges in delivering technological and practical training. These barriers hinder the ability of students to acquire essential hands-on skills needed for employment, entrepreneurship, and economic development. Some of these challenges are Outdated and Theoretical Curriculum, Insufficient Infrastructure and Resources, Insufficient Infrastructure and Resources, Inadequate Teacher Training, Underfunding of Education, Digital Divide and Technological Gaps, Government expenditure on education consistently falls below the UNESCO-recommended 15-20% of the national budget, Unequal access to technology and internet connectivity, especially in rural areas, limits students' exposure to digital tools and emerging technologies, Socio-Economic Barriers, Negative Perception of Vocational Education**,** Technical and vocational education is often viewed as inferior to academic education, leading to low enrollment in TVET programs, Poverty, gender inequality, and cultural norms restrict access to education for marginalized groups, particularly in rural areas, and Insecurity and Safety Concerns.

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Addressing these difficulties needs a holistic strategy comprising legislative changes, additional finance, infrastructure development, teacher training, and social mentality adjustments. By addressing these impediments, Nigeria can equip its young with the practical and technological skills required to prosper in a competitive global economics,

In conclusion, the chapter contribution highlights significant gaps in hands-on technology education within Nigerian schools. The lack of access to technology-based tools and insufficient teacher expertise are critical barriers that hinder effective learning. However, students demonstrate a strong awareness of the benefits of hands-on learning and express a desire for reforms that would enhance their educational experiences, therefore, there is need for strategic interventions to improve the availability of resources and training in technology education.

Recommendations

The following recommendations were giving based on the foregoing:

1. The government should prioritize investments in technology infrastructure in schools to provide students with access to modern tools and equipment necessary for hands-on learning
2. Implement comprehensive training programs for educators to equip them with the skills required to teach practical technology subjects effectively.
3. Explore and adapt successful international hands-on learning models to fit Nigeria's unique educational context, focusing on modern tools and collaborative project-based learning.
4. Advocate for policies that mandate the inclusion of hands-on technology education in the secondary school curriculum to ensure all students benefit from practical learning experiences.
5. Schools should establish partnerships with technology companies to facilitate internships and real-world applications, providing students with valuable experience and exposure to current industry practices.
6. Implement regular assessments of technology education programs to identify challenges and successes, allowing for ongoing improvements in the curriculum and teaching methods.

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