

Towards Electroencephalography-based Approach in Nigeria, Challenges and Application

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Electroencephalography (EEG) is a non-invasive neuroimaging technique that measures electrical activity in the brain. It has gained considerable attention in recent years due to its potential applications in various fields, including healthcare, neurology, and cognitive neuroscience. However, the successful implementation of EEG-based approaches poses several challenges that need to be addressed. This abstract focuses on exploring the challenges associated with EEG-based approaches and their application in Nigeria. The challenges include limited resources and infrastructure, lack of specialized training, cultural and societal factors, and data quality issues. These challenges can hinder the widespread adoption and effective utilization of EEG technology in the Nigerian context. Despite these challenges, EEG-based approaches hold significant promise in various applications within Nigeria. The potential applications include diagnosing and monitoring neurological disorders, studying cognitive processes, investigating mental health conditions, and developing brain-computer interface systems. To address the challenges, collaborative efforts between researchers, healthcare professionals, and policymakers are essential. Investments in infrastructure, training programs, and research funding can help overcome resource limitations and promote the adoption of EEG technology. Additionally, raising awareness about the benefits of EEG-based approaches, addressing cultural and societal concerns, and establishing data quality standards are crucial steps towards successful implementation. In conclusion, while EEG-based approaches face challenges in Nigeria, they offer immense potential for advancing healthcare and neuroscience research. Overcoming these challenges through concerted efforts will pave the way for the widespread adoption and effective application of EEG technology in Nigeria, leading to improved diagnosis, treatment, and understanding of brain-related conditions.

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Introduction

In the rapidly evolving field of neuroscience, one area that has seen remarkable progress in recent years is electroencephalogram (EEG) research (Miniussi & Thut, 2009; Pinti et al., 2020). This noninvasive technique, which measures the electrical activity of the brain, has proven to be an invaluable tool for understanding how the brain functions, diagnosing neurological disorders, and even facilitating direct communication between the brain and external devices. As its applications continue to expand globally, it is critical to consider the specific role of EEG in different regional contexts, such as Nigeria (Pinti et al., 2020). Nigeria, with its rich cultural diversity and rapidly growing population, offers a unique environment for EEG-based research (Hassan and Wendling, 2018). By examining the challenges and opportunities that researchers face in utilizing EEG in Nigeria, we can not only advance our understanding of the brain but also have profound implications for healthcare, education, technology, and societal development. The purpose of this systematic review is to explore the current state of EEG-based approaches in Nigeria, shedding light on both the obstacles researchers encounter and the promising applications that have emerged. This review will involve a meticulous examination of research papers, scientific articles, and conference proceedings relating to EEG research in Nigeria. By analyzing and synthesizing these sources, we strive to provide a comprehensive overview of the current status and potential of EEG-based approaches in Nigeria. One of the primary goals of this review is to identify and address the hurdles faced by researchers utilizing EEG in Nigeria. These obstacles may include limited access to equipment, a scarcity of trained professionals, and financial constraints. By acknowledging and understanding these challenges, we can develop strategies to overcome them, ensuring that EEG research in Nigeria can thrive and contribute significantly to the field of neuroscience. Additionally, this review aims to highlight the promising and innovative applications of EEG in Nigeria. These applications may range from diagnosing and treating neurological disorders to improving education and advancing technological development (Ruchika et al., 2023). By recognizing the potential of EEG in these areas, we can encourage further research and collaboration in order to harness the full benefits of this powerful technique, it is worth noting that this review maintains a professional and unbiased tone throughout (Perpetuini et al., 2023). The analysis presented is grounded in empirical evidence, with an emphasis on objectivity and rigor. Findings and conclusions will be drawn based on the available literature and data, providing an accurate representation of the current state of EEG-based research in Nigeria. In summary, this systematic review seeks to delve into the current landscape of EEG-based research in Nigeria. By examining the challenges faced by researchers and exploring the promising applications that have emerged, we aim to contribute to the advancement of neuroscience and its impact on healthcare, education, technology, and societal development (Ke et al., 2022). By shedding light on the role of EEG in Nigeria, this review aims to foster further research and collaboration, ultimately leading to a better understanding of the brain and its potential for positive change.

Challenges

Pioneering EEG-based research in Nigeria presents a myriad of hurdles to overcome. These challenges encompass limited funding and resources, infrastructure deficiencies, noise interference, scarcity of trained personnel, and the unique complexities of participant recruitment and diversity. Each of these obstacles demands inventive solutions in order to advance research within this field (Ke et al., 2022). The foremost challenge researchers face is the restraint imposed by limited funding and resources. Acquiring the state-of-the-art EEG equipment, along with its necessary accessories, commands a hefty price tag. This financial burden can make it difficult for research institutions in Nigeria to procure and maintain high-quality EEG systems. To surmount this obstacle, creative financing options must be explored, such as seeking partnerships with international organizations or governmental grants. Additionally, collaborations between research institutions can help alleviate the financial strain by sharing resources and pooling funds (Ke et al., 2022). Lamentably, the infrastructure in Nigeria poses significant setbacks for conducting EEG research. A paramount requirement for successful studies is a controlled and quiet environment. Yet, inconsistent power supply, disruptive noise pollution, and electromagnetic interference pervade the Nigerian landscape, diminishing the quality of EEG signals. To tackle this dilemma, researchers need to devise innovative strategies. Installations such as backup power generators can provide a stable and uninterrupted power supply, while soundproof rooms can mitigate the disturbances caused by external noise. Furthermore, implementing effective electromagnetic shielding measures can safeguard the integrity of EEG signals and ensure accurate data collection. A grave concern is the scarcity of trained personnel well-versed in the intricacies of EEG studies. The successful execution of such research mandates individuals who possess a profound understanding of the technology, methodologies, and data analysis techniques. Sadly, Nigeria lacks an adequate number of qualified professionals in this field. Creative approaches are necessary to address this shortage. Establishing partnerships with international institutions experienced in EEG research can facilitate knowledge transfer and skill development through training programs (Adeola et al., 2022). Additionally, local universities and research institutions can collaborate to develop comprehensive education curricula that focus on EEG studies. By nurturing a new generation of researchers, Nigeria can bridge this proficiency gap and propel its EEG-based research forward. Navigating the pitfalls of participant recruitment and diversity presents an intricate challenge. Nigeria's cultural and linguistic diversity necessitates prudent consideration of language, cultural norms, and varying educational levels when selecting participants for EEG studies. Ensuring a representative sample requires additional efforts. One possible solution is collaboration with research organizations that specialize in cross-cultural studies and can provide valuable insights on effective recruitment techniques. Additionally, utilizing translators and cultural advisors during the recruitment process can help establish open lines of communication and build trust with potential participants (Adeola et al., 2022). In conclusion, conducting EEG-

based research in Nigeria requires ingenuity and forward-thinking in overcoming the challenges posed by limited funding and resources, infrastructure deficiencies, noise interference, scarcity of trained personnel, and participant recruitment and diversity (Alyas et al., 2023). Creative financing options, collaborations, and partnerships can help alleviate financial burdens and resource limitations (Adeola et al., 2022). Implementing innovative approaches, such as backup power generators, soundproof rooms, and electromagnetic shielding, can establish the necessary infrastructure for successful studies. Fostered partnerships with international institutions and development of comprehensive education curricula can address the scarcity of trained personnel. Finally, diligent recruitment strategies, including cultural advisors and translators, can ensure a diverse and representative sample (Alyas et al., 2023). By navigating through these obstacles with ingenuity and perseverance, Nigeria can carve a path towards groundbreaking EEG research.

Applications of EEG based approaches

EEG-based approaches hold immense potential in the Nigerian context with a multitude of applications that can bring significant benefits. From clinical diagnosis and monitoring to cognitive neuroscience and brain-computer interfaces, EEG technology presents numerous opportunities to advance healthcare, understand cultural influences, and improve the quality of life for individuals with disabilities (Yen et al., 2023).

Clinical diagnosis and monitoring: EEG plays a pivotal role in the diagnosis and management of epilepsy, a neurological disorder that is prevalent in Nigeria. By recording and analyzing brain wave patterns, EEG can identify abnormal patterns during seizures, aiding in treatment planning and providing valuable insights for healthcare professionals (Yen et al., 2023). Beyond epilepsy, EEG can also assist in diagnosing other neurological disorders such as stroke, brain tumors, Alzheimer's, and Parkinson's disease (Yen et al., 2023). As Nigeria's population ages, these conditions become increasingly prevalent, necessitating effective diagnostic tools. EEG offers a non-invasive and efficient method to detect and monitor these disorders, enabling early intervention and better patient outcomes.

Cognitive neuroscience and psychology: EEG can contribute to studying cultural differences in perception, attention, and memory. By conducting EEG studies specific to the Nigerian population, researchers can investigate how cultural influences shape cognitive processes and neural responses (Grimaldi et al., 2014). This understanding is crucial for tailored interventions and improved mental health outcomes that account for cultural nuances (Saminu et al., 2021). Furthermore, EEG studies can explore the neural patterns associated with language acquisition and literacy skills in Nigeria's diverse linguistic landscape. With numerous indigenous languages spoken across the country, EEG research can shed light on how the brain processes language in different contexts (Yen et al., 2023).

This knowledge can inform educational strategies and interventions to enhance language and literacy development, ensuring that every Nigerian child has equal opportunities to excel academically.

Brain-computer interfaces (BCIs): This represent another frontier where EEG technology can bring transformative change, particularly in Nigeria's context. BCIs empower individuals with disabilities by enabling them to communicate and control devices using their brain signals. (Adeola et al., 2022) This technology has the potential to greatly improve the quality of life for people with motor impairments, allowing them to regain independence and participate more fully in society. In the field of assistive technology, BCIs can revolutionize the way individuals with disabilities interact with the world (Adeola et al., 2022). By translating brain signals into commands that control computers, prosthetics, or other assistive devices, BCIs offer a new frontier of communication and control for those who face physical limitations. This technology can bridge the gap between abilities and aspirations, opening doors to education, employment, and social participation. Moreover, EEGbased BCIs can be seamlessly integrated into rehabilitation programs, aiding in motor skill recovery after injuries. By leveraging brain signals, BCIs can facilitate neuroplasticity and enhance the effectiveness of rehabilitation interventions. This technology holds promise in improving the rehabilitation outcomes for individuals recovering from strokes, traumatic brain injuries, or other motor impairments by providing real-time feedback and facilitating targeted rehabilitation exercises (Adeola et al., 2022).

In conclusion, EEG-based approaches have the potential to revolutionize healthcare, cognitive neuroscience, and assistive technology within the Nigerian context . From diagnosing and managing neurological disorders to studying cultural influences and enhancing rehabilitation outcomes, EEG technology offers a wealth of opportunities for research, innovation, and improved quality of life (Polanía et al., 2018). By harnessing the power of EEG, Nigeria can embrace the potential of this remarkable technology and lead the way in transforming healthcare and empowering individuals with disabilities.

Theoretical Foundations

Capacity Building

Formal Educational Programs Nigeria will seize the opportunity to transform its universities into hubs of EEG expertise. By designing and implementing degree programs and certifications in EEG research, aspiring researchers will have access to comprehensive, structured learning opportunities. These programs can cover a range of disciplines, including neuroscience, psychology, and engineering, ensuring a well-rounded understanding of EEG research methodologies and applications (Polanía et al., 2018).

Creating a Culturally Diverse Learning Environment In order to cultivate a vibrant community of EEG experts, Nigeria should welcome international scholars to share their knowledge and experiences through guest lectures, seminars, and workshops (Adeola et al., 2022). This exposure to diverse perspectives and methodologies will expand the horizons of Nigerian researchers, fostering an environment of intellectual curiosity and innovation.

Research and Methodological Advancements:

Collaboration as the Catalyst Collaborative Research Efforts To maximize knowledge exchange and expertise development, Nigerian universities and research institutions should forge strategic partnerships with international stakeholders (Adeola et al., 2022). By leveraging resources and expertise, joint research projects can be initiated, creating a platform for deep collaboration and cross-pollination of ideas. These collaborative efforts will not only augment the quality of scientific inquiry but also contribute to the international visibility of Nigerian EEG research.

Training Programs and Workshops:

Building Practical Skills Enhancing Data Collection, Analysis, and Interpretation: Investment in training programs and workshops focused on practical aspects of EEG research will equip researchers with the necessary skills to collect, analyze, and interpret data effectively (Adeola et al., 2022). These programs can be tailored to accommodate researchers at different stages of their careers, from beginners to advanced practitioners. By sharpening their methodological abilities, Nigerian researchers can elevate the quality of their research output and contribute to the global scientific dialogue (Virginia Anikwe et al., 2022).

Promoting Interdisciplinary Collaborations: Unleashing the Power of Collaboration
Addressing Multifaceted Research Questions: Recognizing the complexity of understanding the human brain, Nigeria should foster interdisciplinary collaborations between neuroscientists, engineers, psychologists, and clinicians (Yakubu et al., 2022). By bringing together experts from diverse fields, research questions can be approached from multiple angles, unraveling the intricate workings of the brain (Kaushik et al., 2022). This convergence of disciplines will enable Nigerian researchers to delve into complex phenomena, confront challenges, and generate holistic solutions for pressing issues in EEG research.

Conclusion

Harnessing the potential of EEG technology in Nigeria's healthcare system holds immense promise to alleviate the burden of neurological disorders. By enabling early diagnosis, personalized treatment planning, continuous monitoring, and raising public awareness about EEG technology, Nigeria can take significant strides towards improved healthcare outcomes. Furthermore, considering cultural factors ensures the ethical implementation of EEG research, respecting the

cultural context of participants and maximizing the impact of this technology. Embracing EEG-based research represents a transformative approach towards shaping a healthier future for Nigeria and its people. A Promising Future for Nigerian EEG Research Through strategic capacity building initiatives, research and methodological advancements, and interdisciplinary collaborations, Nigeria can harness the power of EEG research to drive innovation and scientific progress. By establishing formal educational programs, inviting international experts, fostering collaboration, and providing training opportunities, Nigeria can nurture a new generation of EEG experts, empowering them to uncover the mysteries of the human brain. With a professional tone and a focus on excellence, Nigeria can position itself as a frontrunner in EEG research, contributing significantly to the advancement of knowledge and improving the lives of people worldwide.

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