The Big Data Workshop in Africa

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ABSTRACT

Recent years have seen an increase in the amount of attention paid to the lack of diversity and shortage of data in the field of artificial intelligence and its influence on developing countries, particularly in Africa. This paper examines the burgeoning interest in big data within academic and business sectors, with a specific focus on Nigeria's standing in the African Big Data Readiness Index. Despite Nigeria's stature as a major African economy, it ranks 21st on the index, suggesting a notable discrepancy in big data adoption and proficiency. The study draws inspiration from a free, week-long course covering big data, design thinking, and women in technology, at University of Ibadan, Nigeria in July 2017. The paper provides an in-depth analysis of the event's organization, emphasizing the keen interest in big data and machine learning among Nigerian researchers. Methodologies for participant recruitment and event logistics are discussed, alongside the demographic analysis of attendees, which offers insight into gender and educational disparities in the field. The paper also highlights the event's diverse activities, from hands-on data analysis to discussions on women in technology. Results from participant surveys show unanimous satisfaction and a strong inclination towards big data tools and machine learning. The paper concludes by underscoring the vital role such educational initiatives play in enhancing big data understanding in Nigeria, while also calling attention to the need for increased female participation in AI sectors.

Keywords: AI training, Big Data Readiness, Educational Workshops in Africa, Big Data in Nigeria

1   Introduction

In the realm of modern technology, "big data" stands as a term that encapsulates the enormous volumes of digital information continuously generated, collected, and analyzed across various sectors. Defined by its immense volume, velocity, and variety, big data transcends traditional data-processing capabilities, demanding advanced tools and techniques for effective management and utilization (Mayer-Schönberger & Cukier, 2013). It is at the intersection of big data and artificial intelligence (AI) that the most groundbreaking advancements in technology are occurring. AI and machine learning algorithms thrive on the extensive datasets provided by big data, enabling unparalleled insights and predictive capabilities.

According to WordTracker, the phrase "big data" is searched approximately 153,000 times monthly on Google alone, indicating its growing relevance and interest among the general public (Wordtracker, nd). Despite this widespread interest, disparities in big data readiness and application exist across different regions, particularly in Africa. A report on Africa's Big Data Readiness Index (BDRI) reveals a varied landscape of big data adoption on the continent. Southern Africa leads the continent in big data readiness, while Nigeria, one of Africa's largest economies, is positioned at 21st in the BDRI (Joubert, Murawski, & Bick, 2019). This ranking highlights a notable gap between economic stature and technological advancement in the realm of big data within Nigeria.

This paper explores a unique case study that addresses this gap in AI knowledge: a comprehensive instructional workshop led by a Stanford Engineering Professor as part of an instructional odyssey at University of Ibadan, Nigeria, in July 2017. Supported by prominent organizations such as Google, the Association for Computing Machinery (ACM), the Very Large Data Bases (VLDB) Endowment fund, and Stanford University (Widom, 2017), the workshop focused on pivotal areas like big data, design thinking,

collaborative problem-solving, and the role of women in technology. It successfully attracted around 380 participants, primarily composed of graduate and undergraduate students from Nigeria and neighboring regions, offering them an unparalleled opportunity to delve deeply into big data topics without any cost. This initiative not only addressed a crucial educational gap but also highlighted the keen interest and potential within Nigeria for advancing knowledge and applications in big data.

The paper underscores the vital importance of educational workshops in nurturing skills and knowledge in AI. These workshops play a critical role in closing the skills gap and equipping a new generation of technologists and data scientists. They offer a dynamic platform for disseminating essential theoretical knowledge and providing practical, hands-on experience with real-world data and AI applications.

In Nigeria, the growing interest in big data is propelled by the nation's expanding digital economy and the global movement towards data-driven decision-making. Despite this interest, challenges like inadequate infrastructure, limited access to quality training, and a general lack of widespread awareness impede the full-scale adoption and utilization of these technologies. Hence, initiatives like this workshop are indispensable for preparing the upcoming generation with the skills needed to efficiently navigate and exploit these technologies. Understanding the intricacies of Big Data enables us to fully appreciate the context and significance of such educational efforts, as well as their potential impact on technological advancement and capacity building in Nigeria.

This paper delves into the specific methodologies and outcomes of the training. It examines the strategies for content delivery, participant engagement, and the overall impact of such educational initiatives in enhancing technological competencies in emerging fields.

Moreover, the paper discusses the approaches used in recruiting participants and executing the workshop. It explores the methods employed to attract a diverse group of participants and addresses the logistical challenges encountered during the planning and execution phases. Additionally, it provides insights and lessons learned from the Nigerian organizer's perspective throughout the event's implementation. This case study aims to highlight the enthusiasm and readiness of Nigerian students and researchers to deepen their understanding of big data, a critical driver of modern technological progress.

2   Background

The emergence and exponential growth of big data have revolutionized various sectors worldwide, from healthcare to finance, education to government policies. Big data refers to the massive volumes of structured and unstructured data generated every day, coupled with the technologies and analytical methods used to extract insights and make data-driven decisions (Mayer-Schönberger & Cukier, 2013). The increasing availability of data and advancements in computing power have made big data an invaluable asset for organizations seeking to improve efficiency, innovation, and customer engagement (Manyika *et al.*, 2011).

In the African context, the utilization of big data is still in its nascent stages compared to other continents. Despite the significant growth in digital data generation and mobile technology adoption, African countries face challenges in harnessing the full potential of big data. These challenges include limited infrastructure, skills shortage, and regulatory hurdles (Ndemo & Weiss, 2017). However, the potential for big data to drive economic growth and social development in Africa is immense, particularly in areas such as agriculture, healthcare, and urban planning (Kshetri, 2014).

Nigeria, as Africa's largest economy, presents a unique case. Despite its economic status, Nigeria's position in the Big Data Readiness Index is relatively low. This discrepancy highlights a gap in technological advancement and digital skills. However, the high search interest in big data within the country suggests a growing awareness and eagerness to bridge this gap (Wordtracker, 2020).

Educational initiatives play a crucial role in addressing this gap. The case of the Big Data Workshop exemplifies the impact of international collaboration in fostering big data knowledge and skills in Nigeria. Such initiatives are not only crucial for academic and professional development but also for positioning Nigeria as a future leader in big data in Africa.

Furthermore, the focus on inclusive and gender-balanced technology education, as seen in Professor Widom's emphasis on women in technology, aligns with global efforts to close the gender gap in STEM fields. This is especially pertinent in Nigeria, where gender disparities in technology and higher education are pronounced (Ojo & Fioramonti, 2018).

3 Methodology

This section of the paper delves into the methodology employed to orchestrate the big data workshop at the University of Ibadan, Nigeria. A comprehensive approach was adopted to ensure the effective delivery of content and maximize participant engagement and learning outcomes. The methodology encompassed several key components: participant recruitment, logistical planning, and pre- and post-workshop evaluation. Each of these components was carefully tailored to address the specific educational needs and context of Nigeria, particularly focusing on the practical aspects of big data, machine learning, and fostering inclusivity in technology education.

Significantly, the workshop was held at the University of Ibadan's Distance Learning Center, a state-of-the-art facility featuring a vast room equipped with 500 internet-enabled cubicles and four projection screens. This setup, while primarily designed for online classes, provided a unique environment for conventional teaching, facilitating a large-scale, interactive learning experience. The event's success was further amplified by the dedication and enthusiasm of local organizers and participants. Many attendees traveled long distances, enduring challenging conditions, to participate in this transformative educational experience. Their transportation and accommodation costs were subsidized, reflecting the significant investment in and commitment to enhancing AI and big data education in the region.

3.1 Publicity and Logistics

In implementing the Big Data Workshop, participant recruitment strategies were designed to attract a diverse group of learners, including undergraduate and graduate students, as well as professionals from various sectors. The content design was centered around the latest trends in big data and machine learning, ensuring relevance and applicability. Logistical planning encompassed all aspects of event management, from venue selection to technology setup, ensuring a conducive learning environment.

The promotional strategy for the event was multifaceted, leveraging both online and traditional outreach methods to maximize participation and engagement. Primarily, the event was advertised through the website and social media channels (Facebook and Twitter) of the Ibadan Association for Computing Machinery (ACM) chapter. This digital approach allowed for a broader reach, especially among the tech-savvy audience and academic community interested in big data and related fields.

In addition to digital marketing, a more personalized approach was employed. Customized letters were sent to various department heads and chairs in Nigeria's higher education institutions and organizations. This method ensured targeted outreach, especially towards professionals and students in relevant fields such as computer science, data science, and information technology. The involvement of ACM members in this process added credibility and a professional network effect, enhancing the event's visibility and perceived value.

The response to these promotional efforts was overwhelming. In total, over 600 applications were received from prospective participants. This high volume of interest necessitated a thorough review process to

ensure the quality and commitment of attendees. After a meticulous screening process to eliminate redundancies and inconsistencies in the applications, 555 authentic applications were retained. Of these, 420 participants confirmed their attendance, reflecting a substantial interest and commitment level among the applicants.

Table 1: *Summary of Applications and Confirmations*

Description	Number
Total Applications Received	600
Applications After Screening	555
Participants Confirmed Attendance	420

Table 2: *Screening Process Outcome*

Outcome	Number
Redundancies and Inconsistencies	45
Authentic Applications Retained	555

Tables 1 and 2 encapsulate the effective reach of the event's publicity and the subsequent participant screening process, highlighting the successful logistical management of the event. The high rate of confirmed attendance (75.68% of the authentic applications) is indicative of the keen interest in big data among the academic and professional communities in Nigeria.

3.2 Participants Demographics

Approximately 80% of the attendees were students at various levels of higher education, including undergraduates, master's, and doctoral candidates. This high proportion of student participation underscores the growing interest in big data among the younger academic community, aligning with global trends of increasing engagement in data science and related fields among university students (Berman & Cerf, 2017).

About 40% of these student participants received sponsorship, a testament to the efforts made to ensure inclusivity and accessibility, especially for those from out-of-town. This sponsorship, covering hotel accommodations, meals, and travel expenses, was instrumental in enabling broader participation and diversity among the attendees.

The employment status of the participants further reveals the varied backgrounds of those interested in big data. While 42% of the attendees were professionals from the academic sector, a significant portion, 34%, were unemployed. This highlights both the interest in big data as a viable career path and the current job market challenges in Nigeria. The remaining 24% were from various industries, businesses, or were independent developers, indicating the cross-sectoral appeal of big data (Hilbert, 2016).

Gender distribution among the participants was also noteworthy, with 31.6% females and 58.4% males. This disparity mirrors the global gender divide in technology and STEM fields. According to a study by Microsoft and KRC Research, efforts to increase female interest in STEM and computer science are not meeting expectations, a trend reflected in the workshop's demographics (Microsoft, 2018). This gender gap highlights the need for more targeted initiatives to encourage female participation in technology-related fields, particularly in regions like Nigeria where cultural and societal factors may further influence these disparities (UNESCO, 2017).

The workshop's participant demographics not only provide insights into who is currently engaging with big data in Nigeria but also underscore the necessity for more inclusive and diverse approaches in STEM education and technology training. Addressing these disparities is crucial for fostering a more balanced and representative tech community, which in turn can drive more innovative and comprehensive solutions in

the field of big data.

(a) Demographics by occupation

(b) Demographics by gender
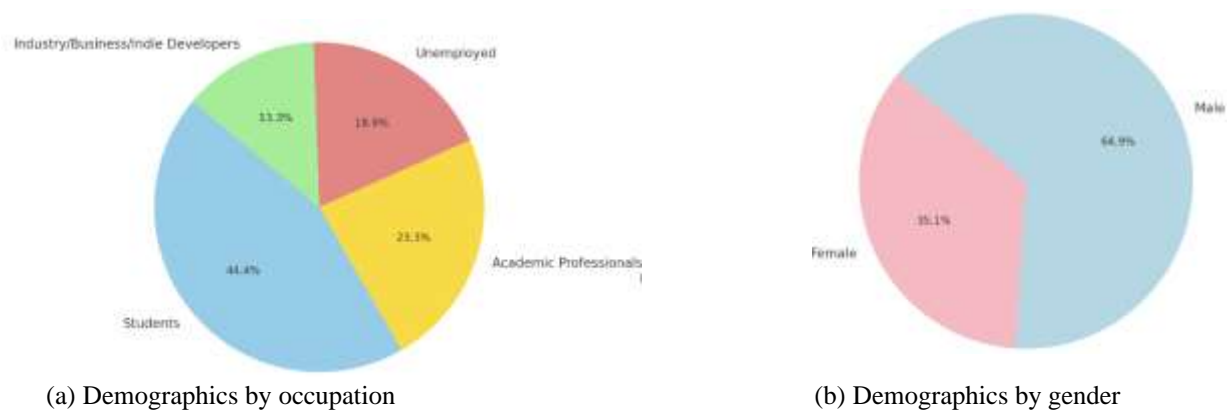
Figure 1: *The demographic composition of the Workshop participants*

3.3   Attendance and Networking

The significance of the workshop was reflected in its high attendance rates. Out of 420 individuals who confirmed their participation, an average of 380 participants were present each day, demonstrating a substantial commitment to the event. This level of engagement is particularly noteworthy, given the broad spectrum of topics and the intensive nature of the training sessions.

The workshop organizers implemented a thorough attendance tracking system, requiring participants to check in twice daily: once in the morning before the start of the day's activities and again in the afternoon following lunch. This system was designed not only to monitor the daily attendance figures but also to ensure that participants were genuinely engaged in the learning process and not merely attending to receive a certificate of participation.

The participant demographics, as shown in the table below, reveal a diverse educational background among the attendees. This diversity highlights the workshop's broad appeal, reaching individuals at various stages of their academic and professional journeys.

Table 3: *Participant Educational Background Distribution*

Education	Population	Percentage (%)
Undergraduate	118	34.2
Graduate students (Masters)	104	30.1
Grad students (PhD)	45	13.0
Others	78	22.6
Total	345	100

The 'Others' category included professionals, educators, and industry experts, further enriching the workshop's learning environment through their diverse perspectives and experiences. This mix of participants facilitated a dynamic exchange of ideas, enhancing the overall quality of discussions and networking opportunities.

To encourage consistent attendance and active participation, the organizers introduced incentives. Attendees who maintained at least 75% attendance were eligible for awards, fostering a competitive yet collaborative atmosphere. Moreover, the instructor personally incentivized engagement by rewarding participants who actively contributed to sessions, either through insightful questions or by demonstrating their skills in practical exercises.

Beyond the physical attendance and interaction, the workshop extended its impact through the establishment of a Slack group for participants. Slack, a communication platform favored in professional

and academic settings, was utilized to foster a community of continuous learning and collaboration (Slack Technologies, 2020). This platform supported organized discussions in chat rooms (channels) and provided opportunities for direct messaging, enabling about 300 registered participants to engage in meaningful dialogues on AI, Machine Learning, Big Data, and pertinent trends within African communities.

The Slack group functioned as a virtual extension of the workshop, allowing participants to maintain connections, share resources, and collaborate on projects even after the conclusion of the physical event. This ongoing interaction has been instrumental in sustaining the momentum generated by the workshop and in fostering a community of learners and practitioners dedicated to the advancement of big data knowledge in Nigeria and across Africa.

Furthermore, the workshop's structure promoted networking opportunities, with scheduled sessions dedicated to fostering connections among participants. These networking sessions were designed to not only facilitate professional connections but also to encourage collaborations that could lead to future projects and research endeavors. The diversity in the participants' backgrounds provided a rich tapestry of experiences and viewpoints, contributing to vibrant discussions and potential collaborations.

Figure 2 offer a glimpse into the vibrant and engaging environment of the workshop, capturing the essence of the learning experience, the enthusiastic involvement of participants, and the dynamic interactions that took place during this transformative educational event.

(a) Design Thinking Activities   (b) Participants applauding at the end of training.

Figure 2: *The Training Environment? (Widom, 2017)*

The success of these networking and community-building initiatives is evident in the continued activity and engagement within the Slack group. Participants have shared success stories of collaborations formed during the workshop, discussed ongoing projects, sought advice, and shared opportunities relevant to the fields of AI, Machine Learning, and Big Data.

Thus, the workshop's approach to attendance, networking, and community building played a crucial role in its success. The dual focus on physical attendance and virtual engagement ensured that the workshop's impact extended far beyond the event itself, laying the foundation for a sustained community of practice that continues to thrive and contribute to the advancement of big data in Nigeria and beyond.

3.4   Event Activities

The workshop commenced on July 11, 2017, with participants arriving from various locations to the University of Ibadan Distance Learning Centre. The event's itinerary was meticulously planned, spanning five days, and featuring a comprehensive curriculum designed to cater to both beginners and advanced learners in big data and related fields.

Day 1: Introduction to Data Analysis using Google Sheets

The opening day set the tone for the workshop, starting with welcoming remarks from professors at the University of Ibadan. The day's agenda included a hands-on introduction to data analysis using Google

Sheets. Participants were guided through the process of setting up databases, familiarizing themselves with the Google Sheets interface, and engaging in practical exercises. These activities were designed to provide foundational skills in data handling and analysis, essential for understanding more complex concepts in big data.

Day 2: Exploring Data Visualization and Database Management

The second day expanded into more sophisticated tools with overviews of Tableau and Instabase, along with an introduction to SQL. This session aimed to build participants' skills in data visualization and database management, vital components in the analysis and interpretation of big data. The interactive nature of this session allowed for a hands-on approach, enabling attendees to directly apply the concepts being taught.

Day 3: Hands-on Machine Learning with Python

Day three delved into the realm of machine learning, with Python as the primary programming language. This session covered basic machine learning concepts and algorithms, allowing participants to understand how to implement these using Python. The focus was on practical applications, providing attendees with the skills to develop machine learning models and understand their use in big data analytics.

Day 4: Advanced Machine Learning Techniques

Continuing the momentum, the fourth day centered on more advanced machine learning techniques, utilizing both Python and R programming languages. This session was aimed at providing a deeper understanding of machine learning and its applications. Participants worked on more complex datasets, learning how to interpret and derive meaningful insights from vast amounts of data.

Day 5: Design Thinking, Problem-Solving, and Women in Technology Roundtable

The final day was dedicated to a workshop on design thinking and collaborative problem-solving, along with a round-table discussion on women in technology. This day was crucial in integrating the technical skills learned in the previous sessions with creative and critical thinking approaches. The round-table discussion on women in technology provided a platform to address gender disparities in the field and explore strategies to encourage more female participation in STEM.

Each day's activities, running from 9 am to 6 pm, were structured to maximize learning and engagement, ensuring that participants left with a comprehensive understanding of big data, its tools, and its applications. The workshop's diverse range of topics, from basic data analysis to advanced machine learning and inclusive discussions, reflects the evolving nature of the big data field and its relevance in various sectors.

4   Results and Participants' Feedback

The outcomes of the workshop, as assessed through pre- and post-training surveys, provided crucial insights into participant satisfaction and areas of interest. Out of 345 participants, 274 completed the surveys, representing a substantial 79.4% response rate. Remarkably, the surveys revealed a unanimous satisfaction rate of 100%, with every respondent expressing their willingness to attend similar events in the future. This overwhelming positive response underscores the workshop's success in meeting the educational needs and expectations of the participants.

The analysis of the survey data provided valuable insights into the specific interests of the participants. As illustrated in figure 3, the most captivating aspect of the training was 'Big Data Tools and Techniques', capturing the interest of 41.8% of respondents. This finding highlights the growing relevance and appeal of practical big data applications in the Nigerian context.

Machine learning was the second most popular topic, with 30.4% of participants finding it most interesting. This reflects the global trend of increasing interest in machine learning as a pivotal component of data science. Relational databases were also well-received, garnering the interest of 17.2% of participants. This indicates a solid interest in the foundational aspects of data management and storage, which are critical for big data processing. Other areas such as 'Correlation and Causation' and 'Data Mining' drew the interest of 4.8% and 3.7% of the participants, respectively. While these topics attracted fewer participants, they are still significant for a comprehensive understanding of data analysis. A small percentage (2.2%) did not specify a particular interest, which could suggest a general appreciation for all aspects of the training or the need for more targeted content in future workshops. Participants also expressed significant interest in the design thinking workshop. This aspect was praised for its innovative approach to problem-solving, fostering creativity, engagement, and empathy, aligning with best practices in educational design (O'Callaghan & Connolly, 2020; Nguyen, Pham, & TU, 2021). This feedback underscores the effectiveness of incorporating design thinking into technology training, suggesting it as a valuable component in future workshops.

Thus, these results not only affirm the success of the workshop in terms of participant satisfaction but also provide valuable insights into the areas of big data and data science that are most appealing to Nigerian students and professionals. This information is crucial for shaping future educational initiatives to better align with the interests and needs of the Nigerian tech community. The overwhelmingly positive response and the specific areas of interest highlighted by the participants demonstrate the effectiveness of the workshop's content and delivery. The results not only validate the efforts of the organizers but also provide guidance for future events, emphasizing the need to focus on practical, hands-on skills in big data, machine learning, and relational databases.
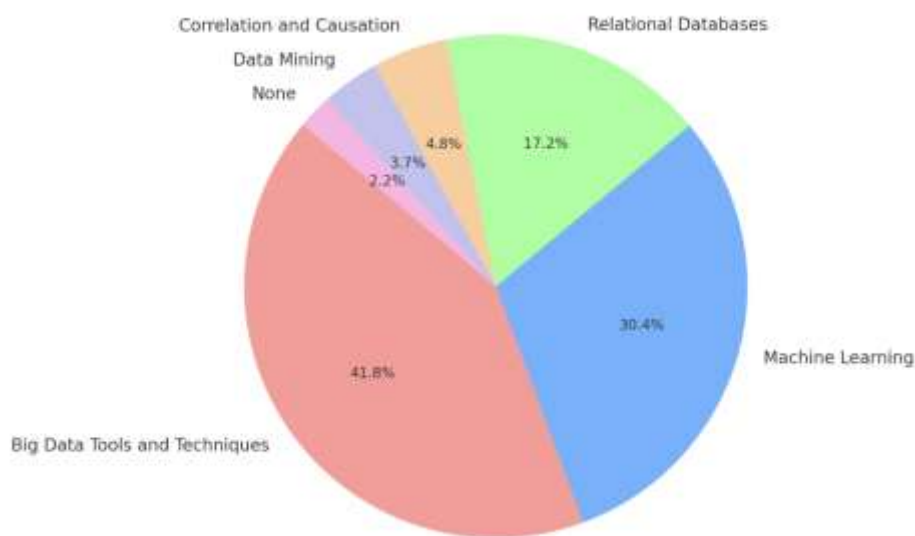
Figure 3: *Interests in different aspects of the training*

5   Discussion of Results

The results of the workshop surveys provide several noteworthy insights into the interests and preferences of participants in the field of big data and related technologies.

5.1   High Interest in Big Data Tools and Techniques

The predominant interest in Big Data Tools & Techniques (41.8%) echoes the global trend toward data-driven decision-making in various sectors, as discussed by Mayer-Schönberger and Cukier (2013) in their seminal work on big data. This trend is indicative of a growing demand for skills in data handling, analysis, and visualization across industries.

5.2   Machine Learning as a Key Area of Focus

The substantial interest in Machine Learning (30.4%) aligns with the perspectives of Jordan and Mitchell (2015), who emphasized its pivotal role in modern big data analytics. The transformative potential of machine learning in predictive analytics, AI, and automation makes it a highly sought-after skill set. This interest could be driven by the recognition of machine learning's transformative potential in areas like healthcare, finance, and urban planning, which are particularly relevant in the African context.

5.3   Emerging Trends and Future Directions:

The survey results indicating lower interest in areas such as Correlation & Causation and Data Mining suggest a potential gap in the understanding of these foundational concepts in big data analytics. It is essential for future workshops to address this by emphasizing these areas, perhaps by integrating them more clearly with practical applications. This aligns with the perspectives shared by Mayer-Schönberger and Cukier (2013) on the importance of understanding the nuances of data analysis in the context of big data. Additionally, the sustained interest in Relational Databases points to an ongoing need for skills in managing and querying structured data. As highlighted in their book, Mayer-Schönberger and Cukier (2013) discuss the foundational aspects of data science, including the significance of efficiently handling structured data, which is critical in various applications of big data. These insights indicate the importance of not only keeping pace with emerging trends in big data but also ensuring that the foundational aspects of data science are well understood. This balance is crucial for developing comprehensive skills in the field.

5.4   Design Thinking in Technology Education

The positive reception of the design thinking workshop aligns with contemporary educational approaches that emphasize creative problem-solving and user-centered design in technology (Brown, 2008). This approach in education, emphasizing creativity and innovation, is increasingly relevant in the rapidly evolving field of technology. This aspect of the program resonates with global trends in integrating design thinking into STEM education.

5.5   Implications for Future Educational Initiatives

The outcomes of the workshop underline the importance of focusing future educational initiatives in Nigeria, and similar contexts, on hands-on, practical training in big data tools and machine learning. This approach aligns with the global trend towards experiential learning in technology education, which emphasizes the practical application of skills in real-world scenarios (Mayer-Schönberger & Cukier, 2013). Additionally, there's a recognized need to balance technical skills with a robust conceptual understanding of foundational areas such as data mining and statistical reasoning. This dual focus is essential to develop well-rounded professionals who are not only technically proficient but also capable of critical thinking and problem-solving in the complex landscape of big data (Jordan & Mitchell, 2015).

5.6   Addressing the Gender Gap in Technology

While the survey results did not specifically highlight the gender dynamics of the workshop, the emphasis on women in technology addresses a critical global challenge. The gender gap in technology fields is a well-documented issue, and educational initiatives that promote the inclusion and participation of women in STEM are increasingly recognized as vital (Hill, Corbett, & St. Rose, 2010). Such initiatives are crucial for creating more diverse and inclusive tech environments, which have been shown to foster greater innovation and problem-solving capabilities.

6   Conclusion

This paper provided a comprehensive analysis of a unique educational initiative on big data in Nigeria, highlighting the significant interest and potential in this field among students and professionals in the region. The high level of participant satisfaction and the specific areas of interest identified in the workshop surveys reflect a growing demand for practical skills in big data analytics, machine learning, and related technologies. The overwhelmingly positive response to the workshop, including the keen interest in hands-on training in big data tools and machine learning, underscores the crucial role of such initiatives in bridging the skill gap in emerging technologies. This is particularly relevant in the context of Nigeria, a country with immense potential but currently lagging in the Big Data Readiness Index. Initiatives like these not only provide valuable skills and knowledge to the participants but also contribute to the broader goal of advancing the technological capacity of the country. Furthermore, the workshop's focus on inclusive education, particularly in encouraging female participation in STEM, aligns with global efforts to address gender disparities in technology. This aspect of the workshop is pivotal in fostering a more diverse and inclusive technological landscape, which is essential for driving innovation and comprehensive development.

In conclusion, the success of this workshop serves as a model for future educational programs in Nigeria and similar contexts. It highlights the importance of practical, hands-on training, balanced with a strong foundation in theoretical knowledge. Additionally, it emphasizes the need for inclusivity in technological education, ensuring diverse perspectives and talents are nurtured for the advancement of the field. As Nigeria, and Africa at large, continue to evolve in the digital era, such educational initiatives will be instrumental in shaping a skilled and diverse workforce, ready to leverage the vast opportunities presented by big data and related technologies.

7   Declarations

7.1   Acknowledgements

7.2   Publisher's Note

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