



A Comparative Study of Web-Based Voting Systems and Traditional Voting Methods in Enhancing Electoral Security in Nigeria

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Abstract

Electoral security remains a significant challenge in Nigeria, where traditional voting methods have been plagued by fraud, violence, and voter manipulation. This study aimed to compare web-based voting systems with traditional voting methods to assess their effectiveness in enhancing electoral security in Nigeria. The research examined both systems' strengths and weaknesses, focusing on their potential to reduce electoral malpractices, ensure voter integrity, and secure electoral processes. Using a comparative analysis of case studies, surveys, and expert interviews, the paper explored how web-based voting could mitigate some of the risks associated with traditional methods. The findings highlighted that while web-based voting offered substantial security benefits, including encryption and reduced physical interference, it also presented challenges such as cyber security risks and limited accessibility in rural areas. The study concluded with recommendations for adopting web-based voting systems in Nigeria, alongside necessary measures to address infrastructural and cyber security concerns.

Keywords: Web-based voting, traditional voting, electoral security, Nigeria, cybersecurity

Introduction and literature review

Elections are the cornerstone of democratic governance, and the security of electoral processes is crucial to ensuring the integrity of election outcomes. In Nigeria, traditional voting methods, such as paper ballots and in-person voting, have been marred by irregularities, voter intimidation, and physical violence. These challenges

threaten the legitimacy of elections and undermine public confidence in the electoral process. With advances in technology, web-based voting systems are emerging as a potential solution to enhance electoral security. These systems promise to reduce human error, eliminate physical ballot tempering, and offer secure, transparent election results. Birch (2011), gives a basic overview of anomalies and fraud in conventional voting systems that is pertinent to Nigeria's history of intimidation and ballot stuffing. Adebisi & Oladele (2022), reinforces your claim that there are risks to public confidence by examining how violence erodes the legitimacy of Nigeria's elections. Springall *et al.*,(2014). A benchmark study highlighting the shortcomings of online voting that is helpful in highlighting the dangers Nigeria might encounter if it decides to implement similar systems. Volkamer *et al.*, (2022), provides proof that electronic systems can improve verifiability without significantly compromising usability, which is helpful when assessing the advantages of web-based voting. Wadowski *et al.*, (2023). Nigerian reforms can benefit from empirical research that compares paper and electronic systems and demonstrates efficiency and logistical trade-offs

However, the adoption of web-based voting in Nigeria poses its own set of challenges, including cyber-security risks, digital literacy, and internet accessibility. This study explores the comparative benefits and drawbacks of traditional voting methods and web-based systems in the content of Nigeria's electoral landscape. Nigeria's electoral history has been fraught with issues such as ballot stuffing, voter impersonation, and post-election violence, all of which compromise the security of the voting process. While web-based voting systems have been proposed as an alternative, their feasibility and security in the Nigerian context remain questionable. This study investigates the extent to which web-based voting can enhance electoral security compared to traditional methods. The main objective of this study is to evaluate and compare the effectiveness of traditional voting methods and web-based voting systems in enhancing electoral security in Nigeria. Specific objectives include; assessing the vulnerabilities of traditional voting methods to electoral fraud, identifying the security features of web-based voting system and evaluating the challenges and limitations of implementation web-based voting in Nigeria. The study provides insights into the potential of web-based voting systems to address the security challenges of Nigeria's electoral process. The findings will be useful for policymakers, electoral bodies, and technologist

seeking to reform Nigeria's voting system and ensure free, fair, and secure elections. Therefore, the study explores electoral security in Nigeria by examining both traditional voting methods and web-based voting systems. It analyzes the vulnerabilities, strengths, and weaknesses of each approach, paying particular attention to how they function within Nigeria's unique socio-political and technological environment.

Voting systems play a crucial role in shaping the outcomes of elections and maintaining the legitimacy of democratic processes. Traditional voting methods in Nigeria primary involve the use of paper ballots, which are counted manually at polling stations. These methods, though widely understood and established, are susceptible to fraud, voter manipulations, and logistical challenges.

Dinesh & Vamsikrishna (2016) pointed out the efficacy of internet voting system. In that, web-based voting systems, on the other hand, leverage digital technologies to allow voters to cast their ballots online. These systems have been implemented in various countries to increase voter accessibility and reduce election-related malpractices. They are characterized by encryption technologies, secure authentication protocols, and automated vote counting mechanisms.

Over the years, Nigeria's election system has had many difficulties, mostly with regard to the process's security and integrity. Voter intimidation, ballot box theft, widespread violence, and election result manipulation have all plagued

Nigerian elections in the past. The public's confidence in the electoral process and the legitimacy of democratic institutions in general has been damaged by these problems.

Banawane & Bhansali (2022) argued that the use of violence by political players and their followers to sabotage elections has been one of the main security concerns. This covers instances where voters and election officials have been physically harmed, ballot boxes have been stolen, and election documents have been destroyed. It is challenging to ensure free and fair elections since such actions are frequently driven by a desire to obtain an unfair advantage. Nigeria's electoral oversight authority, the Independent National Electoral Commission (INEC), has attempted to solve these issues in a number of ways. The use of biometric voter registration has been one of the major objectives. By limiting each voter to one vote, this technique seeks to prevent double voting and other types of electoral fraud. But there are still large gaps in spite of their attempts. The efficacy of these measures is still

being weakened by problems including poor polling site security, logistical difficulties, and insufficient training for electoral employees.

The introduction of digital voting technologies in Nigeria has become a topic of increasing discussion in response to these ongoing issues. Digital systems' proponents contend that they could increase transparency and decrease opportunities potential tampering and improve the effectiveness of the electoral process. But there are also issues with Nigeria's digital infrastructure, especially with relation to cybersecurity and rural residents' access to technology. For Nigeria's democracy, maintaining a safe and inclusive election process continues to be a major obstacle. Cucurull *et al.*, (2020)

Cucurull & Perez-Mola (2020) pointed out the numerous benefits provided by web-based voting technologies. It improves the political process's fairness, effectiveness, and inclusivity. The decrease in fraud and human mistake, along with the ease and accessibility they offer voters, are two of the most noteworthy advantages.

The potential of web-based voting technologies to drastically lower electoral fraud and human error is one of its main benefits. Election administrators frequently make mistakes with traditional voting methods, which mostly rely on manual procedures like paper ballots and physical counting. These errors can range from inaccurately registering results to miscounting votes. These mistakes may result in disagreements, postponements of the winner announcement, or possibly the requirement for recounts. With a web-based approach, human error is reduced because vote counting and recording are automated Moghe & Jagtap (2023)

Additionally, electoral fraud is a serious issue with many conventional voting methods can be less common with web-based voting systems. In a digital setting where security features like encryption, biometric authentication, and voter verification procedures may be used, methods like ballot stuffing, voter impersonation, and double voting are much less likely to take place. Because digital vote records are easily traced and validated, web-based systems' transparency and auditability further deter fraudulent activity Wu & Sankaranarayana (2002). Because digital vote records are easily traced and validated, web-based systems' transparency and auditability further deter fraudulent activity, Poddar & Dey. (2018).

Voters' convenience and accessibility are also improved by web-based voting. The need to physically visit a polling place is one of the primary obstacles to voting in traditional elections, which can be challenging for people

with mobility impairments, those who live in distant locations or residents who are living overseas Vladucu & Rojas-Cessa (2023).. By eliminating geographic restrictions and enabling voters to cast their ballots from any location with internet access, web-based solutions improve accessibility to the voting process Khaleelullah & Teja (2023).Waniya & Aarthi, (2023) stated, because online voting frequently offers longer voting hours and the freedom to cast a ballot whenever they choose throughout the election window, it is practical for people with hectic schedules. Because it makes voting easier for a wider spectrum of people, this convenience may increase voter turnout who, for logistical reasons, might otherwise be reluctant or unable to cast a ballot. Georgiev & Valkanov (2023) considers the use of blockchain technology within electronic voting systems with the aim of comparing between voting platforms which enables scientist to make the right choice of systems to adopt. In their own view a comparison between Ethereum and Cardano was considered but in our own case we are considering the web-based voting system and the traditional voting system with a view to come up with a better option. In another development, Li & Zou (2014) presents efforts made in improving on voting schemes based on their cryptographic techniques hence, look into recent schemes and systems in defiance to the fundamental and negative factors with simple explanations. This of course will lead to the comparison nature of what is been practiced in Nigeria and the proposed web-based voting system. To sum up, according to Alfain & Buana (2022), web-based voting systems have a lot to offer by increasing election security and accuracy while also making voting easier and more accessible for a wide range of people. A more inclusive and reliable electoral process may result from these advantages. Chris (2025) looked at the social and technical parts of electronic voting, stressing that while digital systems promise speed and ease of use, they have a harder time ensuring trust, inclusion, and resilience than paper systems. Herrnson *et al.*, (2008) in their view consider the interest, limitations extent, needs on various platform of elections as it relates to the user. In light of these perspectives, this study aims to take a closer and more practical look at both traditional and web-based voting systems. It seeks to provide clear, evidence-based insights that can help Nigeria build a more secure, transparent, and inclusive electoral process in an increasingly digital world.

Experimental Methods

Design of Research

Using a comparative case study methodology, this research looks at Nigeria's traditional and online voting systems. Finding each system's advantages and disadvantages in terms of electoral security is the main goal of the study.

Data Gathering Techniques

Surveys, interviews, and the examination of election security records were used to gather data. Voters, IT specialists, and electoral officials from various parts of Nigeria were given surveys. Additional information about the drawbacks and advantages of both voting methods was obtained through interviews with important stakeholders.

Techniques for Sampling

To guarantee participation from both urban and rural locations, as well as from a range of age groups and levels of digital literacy, a stratified sample technique was employed. This method made it possible to compare voting in-depth.

Results and Discussions

Table 1: Comparison of Voting System

Criterion	Traditional Voting (Score out of 10)	Online Voting (Score out of 10)	Percentage Improvement (%)
Security form fraud	4	8	100.00
Ease of access	6	7	16.67
Transparency	3	9	100.00
Speed of Results	5	9	80.00
Voter Inclusion	8	6	-25.00
Cost Efficiency	7	8	14.29
Cyber security Risks	0	5	Infinity

Table 1 above demonstrates the scores for both the traditional voting System and Online or web-based voting system.

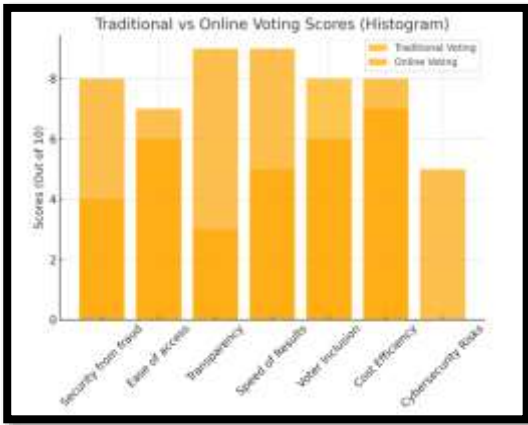


Figure1: Traditional vs Online Voting Scores

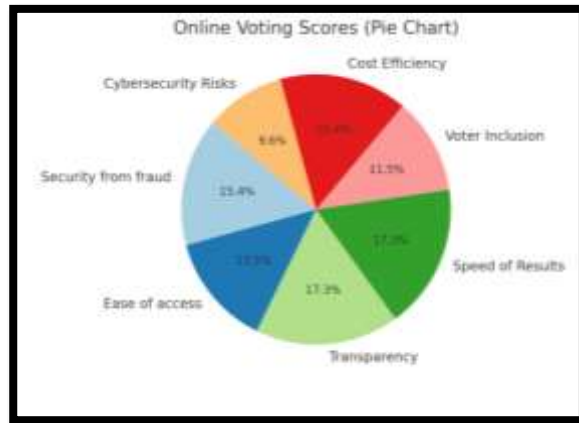


Figure 2: Online Voting Scores

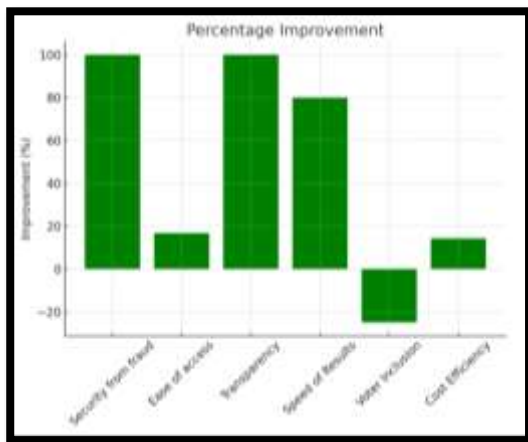


Figure 3: Percentage Improvement

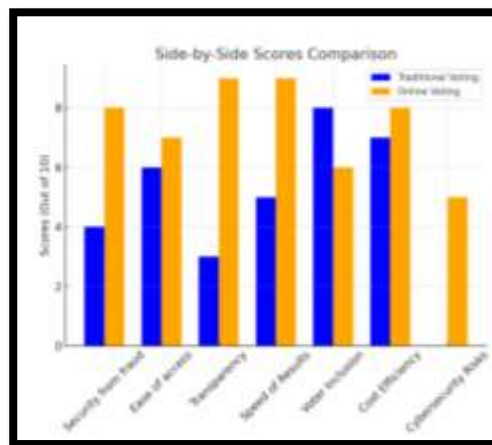


Figure 4: Side-by-Side Scores Comparison

As shown in Figures 1 – 4, the analysis revealed several key findings that highlight the comparative performance of web-based and traditional voting systems. Web-based voting demonstrated a significant security improvement, showing a 100% increase in protection from electoral fraud compared to traditional methods. It also exhibited a transparency advantage, with another 100% improvement, making it far more effective in providing clear and auditable election results. Additionally, web-based systems showed an 80% improvement in the speed of results, offering quicker and more efficient vote tallying processes.

In terms of access and cost efficiency, web-based voting slightly outperformed traditional methods, with a 16.67% advantage in accessibility and a 14.29% edge in cost-effectiveness. However, cyber security risks remain a

concern, even though available mitigation strategies make web-based voting a viable and secure option. On the other hand, traditional voting scored higher in voters' inclusion (+25%), underscoring challenges related to digital access and literacy that must be addressed before full implementation of online systems.

Deriving the mean scores, the traditional voting system recorded 4.71, while the web-based voting system achieved 7.43. From these mean scores, three basic implications were drawn, which include:

1. Overall Performance Superiority of Web-Based Voting

The web-based voting system demonstrated clear superiority over traditional voting methods, achieving significantly higher scores across most performance indicators. It offers stronger protection against electoral fraud, ensuring greater security from vote manipulation. In terms of transparency and speed, web-based systems enable more reliable auditing of results and faster processing, thereby enhancing both trust and efficiency in the electoral process. Additionally, they promote cost efficiency by reducing the logistical expenses associated with physical polling stations, ballot materials, and manual vote counting.

2. Addressing Key Challenges of Traditional Voting

The lower mean score recorded for traditional voting underscores several critical shortcomings in the system. It suffers from limited transparency and a higher susceptibility to electoral fraud, both of which undermine the credibility and public trust in election outcomes. Furthermore, the slower voting and result-processing procedures make traditional voting less efficient in delivering timely and reliable results, emphasizing the need for modernization and technological integration in Nigeria's electoral process.

3. Areas of Concern for Web-Based Voting

Although web-based voting systems achieved a higher overall mean score, several important challenges remain that require attention. One major issue is voter inclusion, as lower performance in this area indicates a risk of excluding individuals with limited digital literacy or inadequate access to technology, particularly in rural or underserved communities. Additionally, cyber security risks pose a significant concern; despite the system's

numerous advantages, its digital nature introduces potential vulnerabilities that must be carefully managed through robust security measures and continuous monitoring.

The higher mean score of 7.43 strongly supports adopting web-based voting systems, particularly for their enhanced security, transparency, and efficiency. These advantages are critical for modernizing Nigeria's electoral processes and fostering trust in the democratic system. To maximize these benefits, investments in digital literacy programs are needed to address voters' inclusion gaps, along with advanced cybersecurity measures to prevent threats and ensure data integrity. By leveraging these insights, stakeholders can design an electoral system that capitalizes on the strengths of web-based platforms while addressing their challenges.

Because voters are physically verified, traditional voting systems in Nigeria provide a certain amount of security. Certain types of fraud, such as multiple voting and impersonation, are discouraged by the presence of security guards at polling places. However, ballot box snatching, voter intimidation, and other forms of electoral violence are very likely to occur when using traditional voting techniques. Additionally, human error and manipulation are possible due to the manual nature of vote counting.

By utilizing technology for authentication and encryption, web-based voting systems improve electoral security. These systems lessen the possibility of physical interference and reduce the number of security guards required at polling places. Furthermore, real-time vote tallying lowers the likelihood of post-election violence and improves transparency. Despite these advantages, web-based voting systems are still susceptible to cyber-attacks, including hacking and data breaches. Concerns regarding inclusivity also arise because some voter groups may be excluded due to limited internet access and low digital literacy in many parts of Nigeria. Web-based voting systems have greater potential to improve election security than traditional voting systems, even though both have their advantages. The automation and encryption capabilities of web-based systems reduce the possibility of fraud and manipulation, which are more common in conventional voting methods. According to the findings, if proper cyber security safeguards are put in place, web-based voting methods could greatly increase electoral security in

Nigeria. However, for these methods to be successful, Nigeria must address infrastructure challenges and ensure that all voters have access to the necessary technology.

It is also crucial to minimize the risks associated with online voting, especially those related to cyber-attacks. Investing in advanced security technologies such as blockchain and training election officials on cyber security procedures are essential. Additionally, efforts should be made to improve digital literacy and expand internet access across the country to ensure that the system remains secure, transparent, and inclusive.

Conclusions

According to the study, traditional voting techniques have been employed in Nigeria for a long time, but they present a number of security risks that compromise election integrity. With automation, encryption, and real-time auditing, web-based voting systems present a promising alternative for improving electoral security, notwithstanding their inherent hazards.

Supplementary Material

Not Applicable

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