British Journal of Research
ISSN: 2394-3718

Open Access Research Article

Assessing the Implementation Challenges of E-Voting on the Electoral Integrity of Asian Democracies: A Systematic Review of Literature

Aurora de Vega Alforte*

Department of Political Science, University of the Philippines, Quezon City, Philippines

ABSTRACT

This study systematically reviews 25 research articles on e-voting implementation across five Asian countries: Bangladesh, India, Indonesia, Pakistan, and The Philippines. The review explores the challenges faced in e-voting implementation by these countries. It conducts a thematic analysis of the reviewed studies to identify the themes.

The review reveals that e-voting in the five Asian countries confronts significant implementation challenges. These are challenges in system security, electoral integrity, and public trust. The study identifies a critical need for advanced technological solutions such as blockchain and biometric verification to enhance e-voting system reliability. However, such reliability requires building public trust, ensuring secure technology, and establishing clear rules and guidelines by policymakers to address the challenges and establish a trustworthy electoral system.

Keywords: E-Voting; Implementation challenges; Electoral integrity; Public trust; System security

INTRODUCTION

The conduct of a nation's general election is inseparable from its commitment to democratic principles. With technological and informational advancements, a new form of democracy has emerged-digital democracy–utilizing communication technology to promote democratic participation in the public sphere. Electronic voting (e-voting) is one of the many emerging innovations in the 21st century, reflecting the height of government solutions for a more convenient exercise of the right to suffrage. It is conducted in person at polling sites or remotely via the Internet. Elections become modernized through these electronic systems, bringing many advantages over paper-based voting methods, including efficiency, cost-effectiveness, and quick result dissemination. Whether e-voting is a test bed for e-democracy is explored by several authors.

The United States pioneered e-voting. Countries in Latin America and Asia later adopted it. Traditional ballot casting is laborious, time-consuming, and prone to errors, making it inefficient. In contrast, numerous countries have employed e-voting systems such as Direct Recording Electronic (DRE) voting machines, remote internet voting, or a combination of both. Countries using Electronic Voting Machines (EVMs) include the United States, United Kingdom, Scotland, Germany, The Netherlands, Italy, Brazil, Kazakhstan, Namibia, The Philippines, South Korea, Bhutan, and Belgium. On the other hand, countries utilizing remote internet voting include Canada, Estonia, Finland, France, Norway, Spain, and

Received:	13-August-2024	**Manuscript No:**	IPBJR-24-21151
Editor assigned:	15-August-2024	**PreQC No:**	IPBJR-24-21151 (PQ)
Reviewed:	29-August-2024	**QC No:**	IPBJR-24-21151
Revised:	14-Jan-2025	**Manuscript No:**	IPBJR-24-21151 (R)
Published:	24-Jan-2025	**DOI:**	10.35841/2394-3718-12.01.125

Corresponding author: Aurora de Vega Alforte, Department of Political Science, University of the Philippines, Quezon City, Philippines; E-mail: aalforte@yahoo.com

Citation: Alforte AV (2025) Assessing the Implementation Challenges of E-Voting on the Electoral Integrity of Asian Democracies: A Systematic Review of Literature. Br J Res. 12:125.

Copyright: © 2025 Alforte AV. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

© Under License of Creative Commons Attribution 4.0 License
This article is available in: https://www.primescholars.com/british-journal-of-research.html

Switzerland. Australia and India are examples of countries utilizing EVMs and remote internet voting.

Embracing new voting technologies has streamlined the voting process, reducing reliance on human assistance and enhancing efficiency. The increasing popularity of e-voting is due to its potential benefits of speed, anonymity, and scalability. An e-voting system may assure the public of the trustworthiness of the election through independent testing and certification of qualified testing centers. However, while vote counting is quick and accurate, detecting tampering is difficult due to the tangible nature of digital processes. Experiences with e-voting in the United States, Europe, and Asia have raised concerns about its reliability and led most European countries to stick to the tried and tested paper ballots. Even the number of countries using e-voting has decreased lately. Moreover, there is a noticeable trend in Europe, where some countries like the United Kingdom, the Netherlands, and Norway have ceased using e-voting. Overall, the adoption of e-voting has declined globally, with the number of countries using e-voting systems dropping from 43 in 2010 to 33 in 2019. Despite the downward trend, academic interest in the subject has surged. The number of scholarly articles on e-voting adoption increased significantly, from one publication in 2019 to 14 in 2020. This growing academic focus underscores the importance of providing comprehensive insights and further research on e-voting implementation [1-5].

Further, the table below shows countries on different levels of e-voting implementation (**Table 1**).

Table 1: E-voting implementation.

No.	Status	Country
1	Countries that completed the implementation of e-voting	Brazil, Estonia, India, Philippines
2	Countries that partially implement e- voting	Argentina, Belgium, Canada, France, Japan, Mexico, United States, Peru
3	Countries that cancelled e-voting implementation after conducting try- outs	Australia, Costa Rica, Finland, Guatemala, Ireland, Italy, Kazakhstan, Norway, United Kingdom
4	Countries that discontinued e-voting implementation	Germany, Netherlands, Paraguay
5	Countries in the process of e-voting testing	Bangladesh, Bhutan, Ecuador, Indonesia, Mongolia, Nepal, Switzerland

Of important note, a challenge confronting e-voting is the susceptibility of voting machines to untraceable changes, either by hackers or non-hackers. Nearly every e-voting system thoroughly examined by independent security experts has been found to have critical vulnerabilities. Verifiability is another major issue, as fraud and machine malfunctions occur periodically, which could potentially disrupt the electoral process, compromise the integrity of the results, and violate voter confidentiality. If implemented efficiently, e-voting can enable timely results transmission and accurate ballot counting. E-voting systems must be legitimate and safe; otherwise, associated potential problems may limit their adoption.

It is also important to note that since economic crises and political conflicts confront people in securing their right to suffrage and participating in democratic processes, the question remains whether digital election access is enough to steer people to trust e-voting systems, specifically in areas with volatile political climate. The challenge lies in balancing the importance of maintaining secrecy with ensuring system verifiability, as these aspects often conflict [6-8].

Aim of the Study

This systematic review contributes to the existing literature exploring the progress of research on the implementation of e-voting in Asia. In particular, it focuses on Bangladesh, India, Indonesia, Pakistan, and The Philippines. It aims to systematically explore and synthesize the existing body of research on e-voting in these countries and identify how the implementation patterns and trends influence their democratization practices. The study focuses on answering this research question: What challenges confront e-voting implementation in Asian democracies?

The Implications of E-voting Systems for Electoral Integrity

E-voting systems offer potential cost and time efficiencies, yet recent research highlights significant concerns regarding technical reliability and privacy compromises within the systems used. Lubis et al. report that the legal framework often lacks effective regulations to govern voting machine use, particularly concerning security, certification, and tabulation. Instances of exploiting e-voting vulnerabilities for personal gain in elections highlight the critical need for compliance with established guidelines to safeguard personal data in e-voting systems. Building on these concerns, Ahmad et al. argue that a robust e-voting system must prioritize electoral transparency, cybersecurity, accuracy, speed, privacy, accessibility, impartiality, cost-effectiveness, and sustainable implementation in its design. They suggest that e-voting

systems offer voters conveniences such as saving time, money, and effort while reducing the overall expenses of elections. Online voting, in particular, benefits citizens who face challenges of physically reaching polling stations. However, e-voting remains highly debated within information technology applications in elections, underscoring the critical need to establish public confidence in this evolving technology. The diffusion of innovations theory focuses on how and at what rate new technology spreads through culture, which may examine the social, cultural, and political factors influencing e-voting adoption to shed light on the dynamics that support or hinder e-voting in Asian democratic practices. Ultimately, e-voting represents a significant advancement in democracy, promising to enhance the accessibility, efficiency, and transparency of the electoral process.

Alternatively, Zhang et al. explore the potential of blockchain technology in e-voting, highlighting its decentralization, transparency, and tamper-resistance, which can ensure fair and secure elections. They proposed using Ethereum smart contracts as an efficient and cost-effective e-voting system that enhances voter privacy. Sarker et al. and Jafar et al. similarly affirm the relevance of blockchain in addressing issues of legitimacy and accuracy in e-voting systems. Further, Jafar et al. examine blockchain's end-to-end verification capabilities and propose strategies to enhance privacy protection and transaction speed in e-voting. Together, these studies underline the comprehensive benefits of blockchain technology in strengthening the integrity and efficiency of e-voting.

Conversely, Hapsara et al. note that the degree of e-voting adoption in developing countries is too significant to ignore; however, the lack of a theoretical groundwork has led to scattered means of perceiving technology. Systematically examining 67 articles, Hapsara and colleagues found that the issue considers how e-voting concepts and theoretical constructs can fit various contexts of democracy development. Based on the results of Lubis et al. the legal framework is inadequate to effectively regulate the use of voting machines, especially concerning security safeguards, the certification process, and tabulation. The current e-voting regulation is complicated to understand due to inaccessibility and lack of education and awareness, which creates a misconception of e-voting intentions. While it is necessary to recognize the rights of individuals to personal data protection, the election commission must also collect, use, and disclose personal data essential for e-voting. The technology acceptance model explains the influence of perceived usefulness and ease of use on accepting new technology and provides insights into voter perceptions of data security and usability on acceptance of these systems.

Furthermore, Sarker et al. point out that e-voting will not erode democracy nor enable vote buying and election fraud, which can happen under the pen and paper voting method. On the other hand, Parizad and Agortimevor argue that e-voting and e-democracy are changing the interaction between governments and citizens, owing to the emergence of new information technologies that allow transparency and accountability. However, the Council of Europe (CoE) guidelines indicate that member states should implement e-voting only if citizens have public trust in the electoral system. Public trust is essential in the perception of e-voting efficiency and trustworthiness. Considering the socio-political context of e-voting, Oostveen and van den Besselaar examine whether there is a growing scientific interest in e-voting in emerging democracies and whether e-voting approaches in developed democracies are not the same as those in emerging democracies. They reveal that developed democracies approach e-voting evaluation more evenly than emerging democracies. It underscores the need for tailored e-voting strategies that address specific challenges in building an efficient and trustworthy electoral system.

E-Voting Implementation in Asian Democracies

The article of Darmawan explores why The Philippines adopted e-voting, with election fraud and political elite agreement as primary factors for improving election quality. Since 2010, the country has adopted e-voting in national elections, starting with one area and expanding nationwide in 2013 and 2016. While many commend e-voting adoption, it has sparked debates among stakeholders like NGOs. Conversely, in their analysis of e-voting readiness, Risnanto et al. identify The Philippines as one of the countries with successful implementation of e-voting, along with Brazil, Estonia, and India. Ahmad et al. stress that The Philippines began its journey in the 1990's, with the first nationwide implementation occurring on May 10, 2010. Facing the challenge of registering 50 million voters across thousands of islands, the Commission on Elections (COMELEC) adopted e-voting to streamline the counting, which previously took up to 18 hours, and tabulation processes, which took up to 40 days. Despite delays and funding issues, the country used automated systems for regional elections in 2008. By 2010, it utilized five technologies, including Direct Recording Electronic (DRE), Optical Mark Recognition (OMR), and Precinct Count Optical Scan (PCOS), among others, to enhance election efficiency and reduce fraud. Timonera et al. offer insights for tailored strategies for political engagement in their investigation of the link between demographic profiles and perceptions of e-democracy in the Visayas and Mindanao regions of The Philippines. These studies demonstrate attempts to look deeply into the Philippine conduct of e-voting to strengthen the democratic processes. The country's adoption of multiple voting technologies by 2010 illustrates the early stages of innovation diffusion indicated by the diffusion of innovations theory. Timonera et al.'s investigation highlights the social, cultural, and political factors that influence the adoption and perception of e-voting technologies. These factors are crucial in understanding how innovations in e-voting can be effectively disseminated and accepted across different regions, thereby enhancing democratic practices [9-11].

The studies of Sayem, Ahmed et al., and Sarker et al. paint a comprehensive picture of the opportunities and challenges associated with EVM adoption in Bangladesh, emphasizing

the need for a balanced approach to address technological and social factors. Sayem examines the factors influencing citizens' behavioral intentions to use EVMs in Bangladesh, focusing on e-voters in Dhaka. His study reveals that performance expectancy, trust in institutions, and effort expectancy positively influence the intention to use EVMs, indicating a favorable attitude toward this technology among the urban electorate. This study complements the technology acceptance model, which focuses on the technology's perceived usefulness and ease of use. Ahmed et al. further explore the challenges associated with the widespread adoption of EVMs in Bangladesh, concluding that security vulnerabilities and accessibility issues have hindered the broader acceptance and use of EVMs. These findings suggest that despite the potential benefits identified by Sayem, significant barriers remain that need to be addressed to realize the full potential of EVMs in enhancing electoral processes. Sarker et al. highlight the importance of practical testing and pilot projects to determine the efficacy of e-voting solutions. They emphasize that while e-voting can address some technical issues, it is not a panacea for all social causes of electoral disengagement. This perspective highlights the need for comprehensive strategies beyond technological implementation to engage voters effectively.

Conversely, Narzary commends the simplicity and reliability of EVMs in Indian elections but also pinpoints criticisms of vulnerabilities. These vulnerabilities include attacks that could manipulate election results and compromise voter secrecy. Despite ongoing concerns and reported violations, certain aspects of EVM design remain undisclosed and have not undergone comprehensive security reviews. Narzary emphasizes the seriousness these vulnerabilities pose to democratic integrity in electoral processes in India. Similarly, Likitha et al. point out that adopting online voting introduces addressing cybersecurity challenges to ensure the system's integrity and trustworthiness-concerns highlighted in many studies, including those by Narzary. Despite this, Likitha et al. emphasize that implementing an online voting system modernizes the electoral process in India, enhancing accessibility for voters with physical or logistical barriers and allowing citizens to vote from home. It can also expedite vote counting and result announcements.

Moreover, the article of Haq and Ali outlines the context of electoral issues in Pakistan and that any shift towards EVMs should uphold the principles of ballot secrecy, electoral integrity, transparency, accessibility, usability, and sustainability. It details EVM strengths such as faster tabulation, fraud reduction, and increased turnout while addressing weaknesses like transparency, security, malfunctions, and high costs. The article provides comparative summaries of EVM models and case studies from various countries, highlighting lessons and common pitfalls, such as the "Fetishization of technology." Concepts like public verifiability and risk-limiting audits enhance trust in EVMs. Haq and Ali present a holistic framework addressing technical, human, and infrastructural challenges, stressing the importance of building a supporting ecosystem. They conclude that one should be cautious of relying solely on technology to solve political problems, emphasizing the importance of human integrity in managing election technology. The Institutional Theory aligns with this insight as it delves deeply into how institutional structures, norms, and rules shape technology adoption. The theory focuses on the interplay between technology, actors, and organizational contexts, which can help understand the holistic framework proposed by Haq and Ali.

Building upon this, the research of Ali et al. highlights the benefits of EVMs in improving electoral efficiency and ensuring fast and error-free polling. While recognizing security concerns such as hacking and manipulation, they suggest measures to address these challenges, including public awareness, capacity building, robust security protocols, user-friendly interfaces, and regular audits. These recommendations align closely with those proposed by Haq and Ali, advocating for phased implementation, regulatory support, capacity building, and rigorous voter education to improve e-voting in Pakistan. By focusing on both technological and human elements, these studies collectively offer a comprehensive approach to enhancing the reliability and efficiency of EVMs, thereby strengthening democracy in Pakistan.

Similarly, Karolan notes that the successful adoption of e-voting in Indonesia hinges on technological readiness, community preparedness, and government efforts to educate and engage the public. It aligns with the technology acceptance model since it maintains that perceived ease of use and usefulness shape the attitudes toward adopting new technologies. Indonesia has begun adopting e-voting for local elections, such as village head elections in regions like Pemalang Regency and Jembrana Regency. Its e-voting adoption involves touchscreen interaction and e-verification using voters' national identity cards (E-KTP). The implementation of e-voting aims to uphold the principles of direct elections, ensuring that the process is direct, general, free, secret, and fair. It highlights the need for transparency, security, accountability, and accuracy within the e-voting systems, which many authors have also emphasized.

Relating to this context, the study by Elven and Al-Muqorrobin advocates for the broader implementation of e-voting in Indonesia, especially following the 2019 simultaneous elections, which resulted in the tragic death of 527 election officials from extreme fatigue. Known as the most complex election in the world, it involved five paper-based elections conducted simultaneously, highlighting the urgent need for change. The lengthy period between voting and result announcement increases the risk of fraud, as evidenced by numerous lawsuits. Despite controversies and debates regarding the readiness of Indonesia for e-voting, Elven and Al-Muqorrobin propose it as a long-term solution to speed up ballot counting, reduce costs, enhance accessibility for disabled voters, and increase voter turnout. Their study underscores the potential benefits of e-voting while acknowledging the challenges to ensure its successful implementation.

In Mongolia, the e-voting system was initially implemented in 2012, marking a significant electoral reform to restore public trust following violent protests over the 2008 parliamentary election results. The introduction of e-voting aimed to simplify the voting process, enhance accessibility for various groups of citizens, and ensure a more transparent and fair electoral system. This reform was part of broader efforts by the parliament to address the fraud issues that plagued the previous electoral system. Key aspects evaluated include the effectiveness of the mixed electoral system in Mongolia, the impact of e-voting, and constitutional considerations in electoral reforms, as highlighted by Gangabaatar. E-voting in Mongolia represents an innovation intended to simplify the voting process and ensure a more transparent and fair electoral system. Continuing its efforts to integrate technology into the democratic process, it held a referendum on mining contracts involving pastoral-nomadic citizens in national decisions using public screens. Although the referendum did not yield a definitive policy mandate, it showcased the innovative use of text messaging to conduct the national vote. This method demonstrates the potential for reaching remote and mobile citizens, underscoring technology leverage to enhance democratic participation. This evolving narrative in Mongolia resonates with the broader global context of adopting e-voting technologies to improve the electoral processes.

Overall, the literature review highlights that while several factors drive e-voting adoption across several countries such as to reduce election fraud, increase efficiency, and improve accessibility the challenges related to security, public trust, and technological readiness remain significant. It also notes the need for increased research on e-voting in The Philippines since there was limited research in this area in the last five years, based on the literature search.

MATERIALS AND METHODS

This study employs a systematic review method, examining published articles to remove biased assumptions and deliver informed knowledge about the research area. It uses structured approaches to address the formulated questions, identify and critically evaluate related studies, and gather and analyze data from the selected studies. Inclusion and exclusion criteria helped select the studies for the review. The table below presents this information (**Table 2**).

Table 2: Inclusion and exclusion criteria.

Inclusion	Exclusion
Articles about e-voting in Bangladesh, India, Indonesia, Pakistan and The Philippines	Articles about election but not e-voting in Bangladesh, India, Indonesia, Pakistan and The Philippines
Peer-reviewed journal articles and conference articles only	Books/textbooks, unpublished theses/dissertations, government reports, country reports, blogs, newspapers, and notes
Only articles published within five years	Articles older than five years
Only English-language-published articles or their English translations	Articles not published in English or without an English translation

The search for articles employed Boolean operators such as "and" and "or" to refine or expand the search results. The keywords entered in the search are listed below:

- E-voting and Asian countries and democracy.
- E-voting or electronic voting and Asian countries and democracy.
- E-voting and Bangladesh.
- E-voting and India.
- E-voting and Indonesia.
- E-voting and Pakistan.
- E-voting and Philippines.

Twenty-five articles were selected for the review using the specified keywords. The academic databases searched include Springer Link, IEEE Xplore, Wiley Online Library, and Google Scholar (**Table 3**).

Table 3: Asian countries and their forms of democracy.

Country	Form of democracy
Bangladesh	Parliamentary democracy
India	Federal parliamentary democratic republic
Indonesia	Unitary presidential constitutional republic
Pakistan	Federal parliamentary republic
Philippines	Democratic republic with presidential system

The study also employs thematic analysis of the themes generated by the reviewed studies to identify the implementation challenges of e-voting confronting the five Asian countries. The steps taken for the thematic analysis are consistent with Braun and Clarke.

Data Collection

The e-voting adoption in each article is documented, excluding studies that do not directly deal with the topic. The initial screening involves reviewing titles and abstracts to ensure relevance to e-voting in the five selected Asian countries, eliminating duplicates and ineligible studies. Selected articles undergo a detailed review to assess their quality using a standardized checklist, adapted from Al Ghanem et al., to ensure strong evidence quality, as detailed in **Table 4**.

Table 4. Quality assessment checklist.

Questions	Partially Yes (0.5)	Yes (1)	No (0)
1. Are the research aims clearly defined?			
2. Does the article deal with e-voting in Bangladesh, India, Indonesia, Pakistan, or The Philippines?			
3. Were the conclusions supported by the results and data presented?			
4. Do the results contribute to the literature?			

All 25 articles underwent thorough evaluation using the checklist criteria, retaining only articles receiving a Yes for each question. Hence, all 25 articles have clearly articulated objectives focusing on e-voting in a specific Asian country. The results and data presented support their conclusions. Furthermore, all studies provide findings that enrich the existing literature.

RESULTS

This study reviews 25 articles published within five years (2019-2024). These articles investigate e-voting in five democratic Asian countries. The table below shows the number of articles reviewed per country (**Table 5**).

Table 5: Number of included studies per country.

Country	Number of included studies
Bangladesh	5
India	7
Indonesia	5
Pakistan	5
Philippines	3
Total	25

The limited number of included studies on e-voting in The Philippines, with only three studies, is due to the scarcity of research on e-voting published in the last five years. In contrast, India has seven included studies, reflecting the higher volume of e-voting research published in the country during the same period. **Table 6** shows the included studies.

Table 6: Included studies.

Author(s)	Method	Country	Research focus
Ali and Widjaja (2020)	Descriptive qualitative	Indonesia	Assessing e-voting's alignment with democratic election principles and evaluating implementation challenges

Arif et al. (2024)	Experimental	Bangladesh	Integrating e-voting with mobile technology to improve citizen engagement and secure voting
Arnob et al. (2020)	Experimental	Bangladesh	Proposing a blockchain-based voting system to improve security and transparency in elections
Avgerou et al. (2019)	Case study	India	Addressing trust in e-voting
Desai and Lee (2021)	Difference-in-differences methodology	India	EVMs' impact on voting behavior, invalid votes, minor candidate support, and factors like voter turnout, error, and fraud
Farmanullah et al. (2022)	Qualitative	Pakistan	Assessing Peshawar voters' views on e-voting to improve trust and reduce malpractices
Fauzi and Habibi (2023)	Document analysis and literature review	Indonesia	E-voting challenges and implementation requirements
Gushardana et al. (2020)	Qualitative	Philippines	Assessing how The Philippines is enhancing democracy with e-voting
Hassan et al. (2022)	Experimental	Pakistan	Evaluating blockchain to enhance e-voting's security, cost, and effectiveness
Haq et al. (2019)	Quantitative	Pakistan	Reviewing Pakistan's remote Internet voting trial for overseas citizens and its challenges
Karolan (2020)	Descriptive qualitative	Indonesia	Reviewing Pakistan's remote Internet voting trial for overseas citizens and its challenges
Kumar and Sharma (2019)	Theoretical modeling	India	Exploring blockchain for e-voting to boost efficiency and accuracy, and proposing a verification model
Mohanty et al. (2019)	Quantitative using Ballot- Level Comparison (BLC) and Cast Vote Record (CVR)	India	How RLAs with VVPATs can ensure confidence in Indian elections
Muñoz AV (2021)	Quantitative-online survey questionnaire	Philippines	Modernizing elections for digital age and ensuring voter safety during COVID-19
Narzary (2021)	Descriptive qualitative	India	EVM security vulnerabilities, threats to election results and secrecy, and the need for thorough reviews
Nigar et al. (2020)	Systematic, theoretical analysis	Bangladesh	Enhancing voting with biometric fingerprint scanning for accuracy, transparency, and cost reduction
Priyanka and Gopalan (2024)	Quantitative-survey questionnaire	India	Understanding EVMs' impact on India's election efficiency, transparency, and credibility, while noting debates and challenges

Rahman et al. (2021)	Literature review	Pakistan	The feasibility of an Electronic Voting System (EVS) in Pakistan, focusing on readiness, opportunities, and challenges
Risnanto et al. (2020b)	Literature review	Philippines (one of the countries in the study)	Mapping e-voting elements and developing an e-voting framework
Samihardjo and Murnawan (2021)	Literature review	Indonesia	Challenges and benefits of e-voting implementation
Sayem A (2023)	Quantitative	Bangladesh	Exploring factors influencing EVM use in Bangladesh, focusing on performance, trust, and effort expectancy
Sensuse and Aris (2020)	Quantitative–survey questionnaire	Indonesia	E-voting readiness and a proposed e-voting system architecture
Shahzad and Crowcroft (2019)	System modeling	Pakistan	Enhancing e-voting and addressing blockchain challenges
Uddin-Ahmed et al. (2021)	Quantitative-applied research	Bangladesh	Creating a cost-effective, secure EVM for Bangladesh with biometric verification
Venugopal and Rayan (2020)	Experimental	India	Voting security and reduced malpractices with IoT and fingerprint verification

Thematic Analysis of Reviewed Studies

The thematic analysis began with the author familiarizing herself with the data. She read and re-read the studies multiple times to ensure a thorough understanding. She then highlighted key points related to the research question and assigned codes to different data representing concepts. Subsequently, related codes were combined to generate initial themes, which are shown below (**Table 7**).

Table 7: Codes and initial themes.

Codes	Description	Initial themes
System failures, reliability issues, technical glitches	Examines the dependability of e-voting systems, focusing on hardware/software reliability	Technological reliability
Security vulnerabilities, hacking, tampering, unauthorized access	Investigates the measures in place to protect e-voting systems from attacks and unauthorized access	System security
Public skepticism, trust-building, voter education, acceptance	Addresses the level of public confidence in e-voting systems and the efforts to enhance trust through transparency and education	Public trust
Election fraud, vote rigging, multiple voting, voter secrecy	Focuses on how e-voting impacts the fairness and integrity of the democratic process	Electoral integrity
Infrastructural limitations, investment needs, logistical issues	Covers practical difficulties in implementing e-voting systems, such as infrastructure and resource requirements	Implementation challenges
Blockchain technology, biometric verification, cybersecurity measures	Discusses potential technological innovations to improve e-voting security and reliability	Innovative solutions

DISCUSSION

The identified themes from the review sum up the challenges confronting e-voting implementation in the five countries. These challenges are the following:

Challenges in System Security

E-voting has emerged as a potential solution to various electoral issues, including voter fraud, inefficiencies, and accessibility problems. However, its implementation in Bangladesh, India, Indonesia, Pakistan, and The Philippines faces numerous challenges. The selected studies focus on EVMs' susceptibility to attacks that can affect election outcomes and voter secrecy. They also tackle issues of multiple voting, unauthorized access, and vote rigging. Some studies further emphasize concerns about maintaining the integrity and confidentiality of voter data. Moreover, they show concerns about the need to overcome skepticism and ensure the reliability of e-voting systems.

Further, Farmanullah et al. and Hassan et al. emphasize the potential of blockchain to enhance e-voting security and cost-effectiveness in Pakistan. However, issues of lack of trust and reliability remain critical, as Haq et al. indicate. Similarly, the studies by Arif et al. and Arnob et al. utilize experimental approaches using mobile technology and blockchain to secure and engage citizens, highlighting the gradual integration of e-voting into the electoral practices in Bangladesh. Nigar et al. Also emphasize the need for biometric verification to enhance transparency and accuracy, underscoring the challenge of achieving consistent system reliability. Nevertheless, the reliability of these systems hinges on addressing technical vulnerabilities and ensuring tamper-proof operations. While many authors recommend blockchain technology and other forms of technology for fair and secure elections and address issues of privacy, legitimacy, and accuracy in e-voting, challenges like ensuring secure, transparent, and tamper-proof elections persist. The public's skepticism towards new voting technologies, coupled with the existing political climate, complicates the implementation process. Despite these, e-voting implementation in Bangladesh and Pakistan can enhance the integrity of democratization practices by improving election security and reducing malpractices, which Elven and Al-Muqorrobin and Gangabaatar also highlight in their studies. Shahzad and Crowcroft and Rahman et al. further highlight the need for robust system modeling and feasibility studies to address these concerns.

Electoral Integrity Issues

Despite e-voting promising to enhance efficiency, accessibility, and transparency, its implementation in Bangladesh, India, Indonesia, Pakistan, and The Philippines raises critical questions about its reliability and impact on the integrity of democratization practices, based on the included studies. India's use of EVMs has significantly impacted the integrity of its democratization practices. With its vast and diverse electorate, India faces unique challenges in e-voting implementation. Its extensive use of EVMs has been commended and scrutinized. Desai and Lee and Priyanka and Gopalan note that EVMs have reduced election errors and fraud in India. However, concerns about security vulnerabilities, as discussed by Narzary, indicate that maintaining the integrity of democratic practices requires continuous oversight and technological improvements. Ensuring the reliability of EVMs involves addressing security gaps and enhancing voter confidence in the system, as highlighted by many authors, including Ahmad et al. and Lubis et al.

Similar to India, both enthusiasm and caution mark Indonesia's journey towards e-voting. Ali and Widjaja and Fauzi and Habibi assess the alignment of e-voting with democratic principles and implementation challenges in the country. Its e-voting implementation concerns infrastructure-related limitations, building secure systems, and creating a reliable e-voting framework, as Darmawan points out. The primary challenges include ensuring reliable and secure voting systems amidst a dispersed population. The practical implementation of such systems requires substantial infrastructural investment and public trust. The literature review similarly noted reliability and security as critical challenges in e-voting implementation.

In Pakistan, e-voting implementation can enhance the integrity of democratization practices by improving election security and reducing malpractices, which Elven and Al-Muqorrobin and Gangabaatar also highlight in their studies. The study of Kumar and Sharma identify theoretical models to enhance e-voting efficiency, but logistical issues and the need to educate voters comprehensively hinder practical applications. Other included studies highlight the challenges in e-voting, including government preparedness and resource allocation. It is also necessary to maintain transparency in design elements and thorough security reviews to ensure system integrity.

Conversely, Gushardana et al. and Muñoz emphasize the positive impact of enhancing electoral integrity through e-voting systems. The Philippines' efforts to modernize its electoral process through these systems can enhance democratic integrity by ensuring voter safety and reducing election-related malpractices. However, establishing the integrity of democratization practices requires addressing system security challenges and building public trust.

Public Trust Issues

Across the five countries, several common challenges emerge. Ensuring the security and integrity of e-voting systems is a paramount concern. The threat of hacking and tampering necessitates robust cybersecurity measures, as Ali et al. emphasize. Public trust and acceptance of e-voting are critical, with many citizens skeptical about the reliability and transparency of electronic systems. The authors highlight its importance in the electoral process and technology. They also underscore the need for transparent processes and verifiable audit trails and address issues with the acceptance of EVMs and public attitudes towards IT. Further, they point out the need to address inefficiencies and ensure accurate vote

counting to establish trust in e-voting systems. Many studies, including those by Priyanka and Gopalan and Narzary, emphasize the importance of informing the electorate about the benefits and functioning of e-voting systems to build trust and encourage participation.

Studies by Karolan and Samihardjo and Murnawan highlight the significant challenges in public trust and the technological infrastructure required to support e-voting on a large scale in Indonesia. While the adoption of e-voting can potentially enhance the integrity of electoral processes by reducing fraud and increasing transparency, ensuring the integrity of democratization practices requires addressing technical challenges and fostering public trust. The literature review acknowledges these for an effective e-voting implementation. Also, while technical and socio-political factors confront the reliability of e-voting systems in Pakistan, Haq et al. note that public skepticism and political resistance undermine the perceived reliability of these systems. Effective implementation requires overcoming these barriers and establishing a trustworthy electoral framework, as Oostveen and van den Besselaar and Narzary point out. The technology acceptance model can help rationalize the citizens' perception of the use and usefulness of the new technology, denoting that they can trust the electoral system if they perceive that the election is fair, secure, and honest. The model helps explain such skepticism and resistance, as the public may have a low perception of ease of use and usefulness of the e-voting system.

On the same note, The Philippines has made strides in modernizing its electoral system, but challenges remain. Gushardana et al. and Muñoz examine efforts to enhance democracy and voter safety through e-voting. However, practical issues such as ensuring system security, public trust, and accessibility in a geographically fragmented country are significant challenges. The literature review likewise emphasizes this. Studies by Risnanto et al. and Sensuse and Aris indicate the need for a comprehensive e-voting framework and system architecture in the country to address these challenges effectively. Addressing these challenges can improve the perceived ease of use and usefulness of e-voting systems, as Aljarrah et al. and Mannonov and Myeong conclude in their respective studies. the technology acceptance model clarifies how technological infrastructure and issues of public trust influence e-voting adoption. The model can also help analyze whether citizens perceive e-voting as user-friendly and viable to address fraud and lack of transparency.

CONCLUSION

This systematic review has focused on exploring and synthesizing the current research on e-voting implementation in five Asian countries and identifying the implementation patterns and trends influencing their democratic processes. The research question highlights the challenges confronting e-voting implementation in Bangladesh, India, Indonesia, Pakistan, and the Philippines.

The review of 25 studies provides a comprehensive overview of the implementation of electronic e-voting in five Asian countries, emphasizing the complex interplay between system security, electoral integrity, and public trust. E-voting in countries like Bangladesh, India, Indonesia, Pakistan, and The Philippines faces significant challenges related to system security, including susceptibility to attacks, vote rigging, and maintaining voter data integrity. Studies emphasize the potential of blockchain and biometric verification to enhance security and transparency, but trust and reliability remain critical issues. While technological innovations are recommended for fair elections, achieving secure and tamper-proof operations is essential, with public skepticism and political climates complicating implementation.

Further, e-voting in the five countries presents challenges related to electoral integrity, despite its potential to enhance efficiency and transparency. India's extensive use of EVMs has both reduced errors and raised security concerns, while Indonesia faces infrastructure and trust issues, and Pakistan encounters logistical and educational barriers. The Philippines' e-voting efforts aim to improve electoral integrity but must address system security and public trust to be effective.

Furthermore, studies highlight the need for robust cybersecurity measures, transparent processes, and effective public communication to build trust and acceptance. Ensuring the security and integrity of e-voting systems is crucial, with public trust being a significant challenge due to skepticism about reliability and transparency.

The findings of the systematic review have several important implications. One of these is creating clear rules and guidelines by policymakers to address the challenges, including security, transparency, and access to e-voting systems. Another is the need for better and more secure technology, requiring ongoing studies in blockchain and biometric verification to make e-voting systems safer and more reliable. However, the impact on democratic integrity depends on establishing a trustworthy electoral system. Addressing socio-political and infrastructural issues, along with applying the Technology acceptance model, can help improve the perceived effectiveness and adoption of e-voting systems.

REFERENCES

1. Ahmad AH, Tabassum N, Ali S, Ayaz M, Bashir N, et al. (2021) Electronic voting system: Nature, origin and its global application. Int J Innov Creat Change. 15(2): 1333-1348.
2. Ahmed SU, Roouf NT, Hasan ANMS, Rozano OE, Rahman AF, et al. (2021) Development of a secured and low-budget biometric electronic voting machine for Bangladesh.
3. Akram, J (2018) Electronic voting keeping in view the democratic principles. 3(3):51-78.

4. Al-Emran M, Shaalan K (2021) Recent advances in technology acceptance models and theories. SN Switzerland.
5. AlGhanem H, Shanaa M, Salloum S, Shaalan K (2020) The role of KM in enhancing AI algorithms and systems. Adv Sci Technol Eng Syst. 5(4):388-396.
6. Ali B, Ali H, Rehman KU, Ishaq MM, Ali W (2024) Technology in elections: Unveiling the potential and challenges of elections with EVMs in Pakistan. J Namib Stud. 40:340-358.
7. Aljarrah E, Elrehail H, Aababneh B (2016) E-voting in Jordan: Assessing readiness and developing a system. Comput Hum Behav. 63:860-867
8. Anik AA, Jameel R, Anik AF, Akter N (2017) Design of a solar power electronic voting machine.
9. Arif A, Kaderye G, Kundu R (2024) A proposed design of e-voting system with consuming of existing GSM infrastructure in the aspects of Bangladesh. Int J Sci Eng Res. 15(3):1-5.
10. Avgerou C, Masiero S, Poulymenakou A (2019) Trusting e-voting amid experiences of electoral malpractice: The case of Indian elections. J Inf Technol. 34(3).
11. Braun V, Clarke V (2021) Thematic analysis: A practical guide.