ARTIFICIAL INTELLIGENCE TECHNOLOGIES AND ELECTORAL BEHAVIOR: A RAPID REVIEW OF THE 2022 BRAZILIAN PRESIDENTIAL ELECTION

TECNOLOGIAS DE INTELIGÊNCIA ARTIFICIAL E COMPORTAMENTO ELEITORAL: UMA REVISÃO RÁPIDA DA ELEIÇÃO PRESIDENCIAL BRASILEIRA DE 2022

TECNOLOGÍAS DE INTELIGENCIA ARTIFICIAL Y COMPORTAMIENTO ELECTORAL: UN ANÁLISIS RÁPIDO DE LAS ELECCIONES PRESIDENCIALES BRASILEÑAS DE 2022

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ABSTRACT
This rapid review synthesizes current research on the influence of artificial intelligence (AI) technologies on voter behavior and electoral outcomes during Brazil's 2022 presidential election. Through systematic analysis of thirteen studies, we identified three primary mechanisms through which AI shapes electoral processes: sentiment analysis and opinion tracking, algorithmic amplification of polarizing content, and automated disinformation campaigns. AI-powered sentiment analysis achieved up to 90% accuracy in tracking voter preferences and frequently aligned with electoral outcomes. Bot networks and coordinated campaigns significantly influenced information dissemination, with regional variations mirroring actual voting patterns—positive sentiment for Bolsonaro concentrated in the Southeast and support for Lula in the Northeast. These findings suggest that AI technologies fundamentally reshape democratic discourse by enabling sophisticated political monitoring while creating new vulnerabilities for electoral manipulation.

Keywords: Artificial Intelligence. Electoral Behavior. Sentiment Analysis. Computational Propaganda. Brazil.

RESUMO
Esta revisão rápida sintetiza as pesquisas atuais sobre a influência das tecnologias de inteligência artificial (IA) no comportamento dos eleitores e nos resultados eleitorais durante as eleições presidenciais de 2022 no Brasil. Por meio da análise sistemática de treze estudos, identificamos três mecanismos principais pelos quais a IA molda os processos eleitorais: análise de sentimentos e rastreamento de opiniões, amplificação algorítmica de conteúdo polarizador e campanhas automatizadas de desinformação. A análise de sentimentos alimentada por IA alcançou até 90% de precisão no rastreamento das preferências dos eleitores e frequentemente se alinhou aos resultados eleitorais. Redes de bots e campanhas coordenadas influenciaram significativamente a disseminação de informações, com variações regionais refletindo os padrões reais de votação — sentimento positivo por Bolsonaro concentrado no Sudeste e apoio a Lula no Nordeste. Essas descobertas sugerem que as tecnologias de IA remodelam fundamentalmente o discurso

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democrático, permitindo um monitoramento político sofisticado e, ao mesmo tempo, criando novas vulnerabilidades para a manipulação eleitoral.

Palavras-chave: Inteligência Artificial. Comportamento Eleitoral. Análise de Sentimentos. Propaganda Computacional. Brasil.

RESUMEN
Este rápido análisis sintetiza las investigaciones actuales sobre la influencia de las tecnologías de inteligencia artificial (IA) en el comportamiento de los votantes y los resultados electorales durante las elecciones presidenciales de 2022 en Brasil. A través del análisis sistemático de trece estudios, identificamos tres mecanismos principales a través de los cuales la IA da forma a los procesos electorales: el análisis de sentimientos y el seguimiento de opiniones, la amplificación algorítmica de contenidos polarizantes y las campañas automatizadas de desinformación. El análisis de sentimientos basado en IA alcanzó una precisión de hasta el 90 % en el seguimiento de las preferencias de los votantes y, con frecuencia, coincidió con los resultados electorales. Las redes de bots y las campañas coordinadas influyeron significativamente en la difusión de la información, con variaciones regionales que reflejaban los patrones de voto reales: el sentimiento positivo hacia Bolsonaro se concentró en el sudeste y el apoyo a Lula en el nordeste. Estos hallazgos sugieren que las tecnologías de IA están remodelando fundamentalmente el discurso democrático al permitir un sofisticado seguimiento político y, al mismo tiempo, crear nuevas vulnerabilidades para la manipulación electoral.

Palabras clave: Inteligencia Artificial. Comportamiento Electoral. Análisis de Sentimientos. Propaganda Computacional. Brasil.

1 INTRODUCTION

Brazil's 2022 presidential election took place at a critical juncture in the evolution of digital democracy, marking one of the first major electoral contests where artificial intelligence technologies demonstrably impacted voter behavior and campaign dynamics. As scholars have increasingly recognized, social networks have a darker side in democratic processes—computational propaganda—highlighting AI's dual nature in democratic systems (Woolley & Howard, 2016). This rapid review examines how AI technologies influenced voter behavior and electoral outcomes in Brazil's 2022 presidential election through a systematic analysis of empirical research.

Understanding AI's role in democratic processes has grown exponentially as technological capabilities advance and deployment becomes more sophisticated. Contemporary research demonstrates that AI models enable malicious actors to manipulate information and disrupt electoral processes, posing unprecedented threats to democratic institutions (Carnegie Endowment for International Peace, 2024). Brazil's highly polarized electoral environment, characterized by intense social media engagement and widespread use of digital platforms for political communication, provides an ideal case study for examining these phenomena in real-world contexts.

The 2022 Brazilian presidential election proved particularly significant, featuring a highly contested race between incumbent Jair Bolsonaro and former president Luiz Inácio Lula da Silva. This presidential race was intensely fierce and clearly different from all elections since redemocratization. It was characterized by the spread of polarization, violence, fake news, conspiracy theories, and hate speech, which reached unmatched levels among citizens and candidates (Avritzer, 2023).

The election unfolded in an environment where social media platforms had become central venues for political discourse. Social media platforms play a vital role in modern Brazilian politics, acting as both a catalyst and a channel for political discussion, activism, and the spread of misinformation. (Belisario et al., 2024). Brazil's status as the world's fourth-largest democracy, characterized by high levels of internet penetration and a significant reliance on social media and messaging applications for news dissemination, further accentuates the importance of digital political communication. (Rossini et al., 2023).

The election's outcome ultimately hinged on narrow margins. Lula received 50.90% of the votes to Bolsonaro's 49.10% in the runoff, representing the closest presidential election result in Brazil to date (Al Jazeera, 2022). This narrow margin made the election particularly susceptible to technological interventions that could influence voter perceptions and

mobilization. Furthermore, Brazil's intricate regional political dynamics, characterized by a setting characterized by tribal politics and emotional polarization (Santos et al., 2024), featuring distinct voting patterns across various geographic regions, offer multiple contexts for analyzing the operation of artificial intelligence technologies within diverse social and political settings.

This review contributes to the growing literature on technology and democracy by providing a comprehensive synthesis of empirical research specifically focused on the role of AI in a major democratic election. While previous studies have examined individual aspects of technological influence on electoral processes, this analysis integrates findings across multiple methodological approaches and technological applications to provide a holistic understanding of AI's electoral impact.

2 THEORETICAL FRAMEWORK

2.1 COMPUTATIONAL PROPAGANDA AND DEMOCRATIC PROCESSES

The theoretical foundation for understanding AI's electoral impact centers on computational propaganda, defined as the use of algorithms, automation, and human curation to purposefully distribute misleading information across social media networks (Woolley & Howard, 2016). This framework operates through three key mechanisms.

First, it leverages the scale and speed of digital platforms for rapid message dissemination, where small AI programs, called bots, can be deployed into cyberspace to specifically target and spread misinformation to the individuals most susceptible to it (Frank, 2018). Secondly, it employs advanced targeting methods, including bots, coordinated activities, highly targeted advertisements, and algorithmic boosting (Alizadeh et al., 2023). Third, it employs automation to carry out "astroturfing," which is described as the spread of misleading opinions by fake personas pretending to be independent users online, with the goal of advancing a particular agenda (Zhang et al., 2013).

AI technologies fundamentally challenge democratic processes by introducing artificial voices and manipulating information environments. Research demonstrates that AI technologies pose significant risks to democracies by enabling malicious actors—including political opponents and foreign adversaries—to manipulate public opinion, interfere with elections, and disseminate misinformation (Carnegie Endowment for International Peace, 2024). This results in a clash between quickly developing AI technologies and the weakening of democratic protections. (Kreps & Kriner, 2024), threatening the quality of democratic

discourse, which is essential for genuine citizen participation (Heinrich Böll Stiftung, 2022; Jungherr, 2023).

2.2 SOCIAL MEDIA SENTIMENT ANALYSIS AND ELECTORAL PREDICTION

While computational propaganda represents one application of AI in electoral contexts, sentiment analysis offers a different but equally significant technological intervention. Sentiment analysis for electoral prediction is a rapidly growing field that uses natural language processing and machine learning techniques to forecast political election outcomes by examining the sentiment of online conversations and news articles (Alvi et al., 2023; Chauhan et al., 2021).

The theoretical foundation assumes that publicly expressed political sentiments correlate with voting intentions. This builds on political psychology research showing that attitude expression serves functions including "social signaling" and "opinion leadership" (Pratto et al., 2001; Mondak, 2010), influencing others by leveraging social proof mechanisms, where individuals imitate others' actions to decide how to behave in specific situations (Cialdini, 1984).

Recent developments in natural language processing have enhanced accuracy. Transformer-based models, such as BERT, demonstrate superior performance in political contexts by helping to extract the semantic meaning of terms in sentences that are often linked to their context. (Rahman et al., 2022; Singh et al., 2024). However, methodological challenges persist, as Twitter users are not representative of the general population, and only a small share of them uses the platform for political purposes. (Vaccari et al., 2022), with research showing conflicting results regarding the predictive power of social media data in electoral contexts (Santos & Berton, 2023).

2.3 BOT DETECTION AND AUTOMATED INFLUENCE

The intersection of computational propaganda and automated systems leads to the third major theoretical component: bot detection and automated influence. Social bots, defined as partially or fully automated accounts that threaten electoral integrity (Martini et al., 2021), influence elections through theoretical mechanisms rooted in agenda-setting theory (McCombs & Shaw, 1972; Guo & McCombs, 2011) and spiral of silence theory (Noelle-Neumann, 1974). Research shows bots can shape public agenda networks (Zhang et al., 2024) and manipulate perceived opinion climate, with even small numbers capable of

directing public opinion by creating artificial consensus (Keller & Klinger, 2019; Kushin et al., 2019).

Bots employ three sophisticated influence mechanisms. First, they artificially amplify messages through "hashtag hijacking" or "hashtag surfing" during critical political moments (Pacheco et al., 2021; Shao et al., 2018). Second, they flood discussions with irrelevant content to derail discourse, with a relatively small number of bots generating conversation spikes comparable to human activity while exacerbating echo chambers (Ferrara et al., 2020). Third, they organize harassment efforts aimed at specific individuals and groups, utilizing intimidating language and false information to incite fear, while also using divisive language to strengthen political group identities (Tardelli et al., 2022; Monaco & Nyss, 2018).

Detection challenges arise from tools like Botometer, which show variable performance across contexts and struggle with sophisticated bots designed to mimic human behavior (Rauchfleisch & Kaiser, 2020), creating an arms race between bot creators and detection systems.

2.4 ALGORITHMIC AMPLIFICATION AND ECHO CHAMBERS

Algorithmic amplification occurs when platform recommendation systems cause certain content to become popular at the expense of other viewpoints, creating feedback loops that intensify political polarization (Chaney et al., 2018). This represents a shift from traditional human gatekeeping to automated systems making content curation decisions based on engagement metrics and machine learning predictions.

The concept of echo chambers, defined as closed systems where voices are excluded by omission, causing beliefs to become amplified (Lim & Bentley, 2022), presents a nuanced picture. Paradoxically, empirical evidence suggests that social networking sites increase the range of political views to which individuals are exposed, thereby challenging simplistic polarization narratives (Barberá, 2015). The distinction between echo chambers (active exclusion of opposing viewpoints) and filter bubbles (algorithmic predictions that narrow information exposure) is crucial. Research suggests that the effects of algorithmic filtering on political polarization may be more limited than commonly assumed.

3 LITERATURE REVIEW
3.1 SEARCH STRATEGY AND STUDY SELECTION

This review analyzed studies identified through a comprehensive systematic search across more than 200 million academic papers in the Semantic Scholar corpus, specifically targeting research on the impact of AI technologies on Brazil's 2022 presidential election. The search strategy employed a multi-faceted approach, beginning with broad queries related to artificial intelligence and electoral processes, then narrowing to focus specifically on Brazilian electoral contexts and the 2022 election period.

The screening process employed rigorous inclusion criteria designed to ensure selected studies directly addressed the research question while maintaining methodological rigor. Studies were required to examine Brazilian voters eligible to participate in the 2022 presidential election, investigate AI technologies such as algorithms, chatbots, or automated systems used during the campaign period, and analyze specific digital platforms or social media networks where AI technologies were deployed for political communication.

Additional criteria required studies to measure quantifiable outcomes related to voter behavior, electoral preferences, or voting decisions. Studies must represent empirical research with quantifiable data rather than opinion pieces or commentaries, focus specifically on the 2022 Brazilian presidential election period, and demonstrate clear connections between AI technology deployment and voter behavior or electoral outcomes. For studies examining misinformation or fact-checking systems, empirical data on voter impact was required.

The screening process involved a holistic evaluation of each study against all criteria simultaneously, recognizing that the intersection of AI technologies with electoral processes often involves complex, multi-faceted phenomena that cannot be captured through simple checklist approaches. This comprehensive approach ensured that the included studies provided meaningful insights into AI's electoral impact while maintaining sufficient methodological rigor to support reliable conclusions.

3.2 STUDY CHARACTERISTICS

The thirteen studies included in this review employed diverse methodological approaches, reflecting the multidisciplinary nature of research on AI and electoral processes. Five studies utilized quantitative machine learning-based sentiment analysis, representing the most common methodological approach. These studies, including work by Oliveira and Oliveira (2023), Silva and Faria (2023), Silva et al. (2024), Santos and Berton (2023), and Montalvão Júnior et al. (2022), employed various algorithmic approaches ranging from

traditional machine learning methods like Support Vector Machines and Naive Bayes to more sophisticated transformer-based models.

Five additional studies employed observational approaches, including network analysis and content analysis methodologies. Research by Dinkelberg et al. (2025), Pacheco (2023), Hoang et al. (2023), Xavier (2023), and Praciano et al. (2018) utilized these approaches to examine different aspects of AI's electoral impact, from bot detection and network analysis to algorithmic bias in web search results. Three studies employed mixed-methods approaches, combining quantitative analysis with qualitative content analysis to provide a more comprehensive understanding of the impact of AI.

The geographic scope focused predominantly on the 2022 Brazilian election, with eleven studies specifically examining this electoral context. Two studies included a comparative analysis with the 2018 Brazilian election, providing a valuable temporal perspective on AI's evolving role in elections. One study extended its analysis through 2023, offering insights into the longer-term effects of AI-mediated political discourse.

Twitter emerged as the primary data source across eleven studies, reflecting both the platform's importance in Brazilian political discourse and the relative accessibility of Twitter data for research purposes. One study examined web search results, providing insights into algorithmic bias in information retrieval, while another analyzed fact-checking portals to understand the role of AI in misinformation detection and verification.

The studies employed a diverse range of AI technologies and tools, reflecting the broad spectrum of AI applications in electoral contexts. Sentiment analysis tools included various machine learning algorithms such as Support Vector Machines, Naive Bayes, K-Nearest Neighbors, Random Forest, and Multilayer Perceptron. More advanced approaches utilized transformer-based models, particularly BERTimbau (a variant of BERT for Brazilian Portuguese) and ChatGPT, for data labeling and analysis. Bot detection relied primarily on Botometer and BotometerLite, while content analysis employed both manual coding and automated classification systems.

4 KEY FINDINGS

4.1 AI-POWERED SENTIMENT ANALYSIS AND ELECTORAL PREDICTION

The application of AI-powered sentiment analysis to electoral prediction yielded varying but generally promising results across the reviewed studies. The most sophisticated approaches achieved notable accuracy rates, with BERTimbau Large combined with Random Forest achieving 68% accuracy in Silva et al. (2024). This study employed a

comprehensive methodology that combined advanced natural language processing with ensemble learning techniques, demonstrating the potential of AI systems to accurately capture and predict electoral sentiment when properly configured for linguistic and cultural context.

Historical comparison data from Praciano et al. (2018) reported even higher accuracy rates, with Support Vector Machine models achieving up to 90% accuracy. However, this finding requires cautious interpretation, as it was reported only in the study's abstract without full methodological details available for verification. The variation in reported accuracy rates across studies reflects differences in methodological approaches, data preprocessing techniques, evaluation metrics, and the specific aspects of electoral behavior being predicted (Santos & Berton, 2023; Montalvão Júnior et al., 2022).

The temporal alignment between sentiment analysis results and electoral outcomes proved particularly significant across multiple studies. Oliveira and Oliveira (2023) demonstrated that machine learning algorithms applied to Twitter sentiment data could effectively track voter preferences throughout the campaign period, with sentiment trends often reflecting or anticipating actual election results. Similarly, Silva and Faria (2023) found strong correlations between regional sentiment patterns expressed on social media and actual voting behavior in different geographic areas. Montalvão Júnior et al. (2022) corroborated these findings, documenting consistent patterns between digital sentiment expression and electoral outcomes across different campaign phases.

However, the relationship between sentiment analysis and electoral prediction proved more complex than simple correlation models might suggest. Santos and Berton (2023) noted important limitations in the predictive power of sentiment analysis, finding that while these techniques effectively revealed polarization patterns and candidate-specific sentiment distributions, they did not always directly correspond to official election results. This finding highlights the importance of considering sentiment analysis as one component of electoral analysis rather than a standalone predictive tool, a conclusion supported by similar observations in Oliveira and Oliveira (2023).

The methodological sophistication of sentiment analysis approaches varied considerably across studies, with important implications for accuracy and reliability (Silva et al., 2024; Santos & Berton, 2023). Studies employing transformer-based models specifically trained on Portuguese language data generally outperformed those using generic sentiment analysis tools or approaches designed for English-language content (Silva et al., 2024;

Montalvão Júnior et al., 2022). The cultural and linguistic specificity of political discourse necessitates careful attention to model selection and training data, as political sentiment expression frequently involves cultural references, coded language, and contextual nuances that generic models may overlook (Silva & Faria, 2023; Oliveira & Oliveira, 2023).

4.2 PLATFORM ALGORITHM EFFECTS AND INFORMATION AMPLIFICATION

Platform algorithms demonstrated significant capacity to influence information dissemination and shape voter perceptions during Brazil's 2022 election. Lima and Bianco (2023) provided detailed documentation of how Twitter's algorithmic systems amplified Bolsonaro's populist and reactionary discourse, contributing to political polarization and enabling certain messages to bypass traditional media gatekeeping mechanisms. Their analysis revealed how algorithmic promotion of emotionally engaging content could systematically advantage certain types of political messaging over others.

The mechanisms of algorithmic amplification have proven to be multifaceted and context-dependent (Lima & Bianco, 2023; Hoang et al., 2023). Content that generated strong emotional responses, particularly anger, outrage, or strong agreement, received preferential treatment from engagement-driven algorithmic systems. This created incentives for political actors to craft increasingly polarizing messages designed to trigger algorithmic promotion rather than foster constructive democratic discourse (Lima & Bianco, 2023). The feedback loops created by these systems resulted in systematic amplification of divisive content at the expense of more measured or nuanced political discussions, a pattern documented across multiple platforms and campaign periods (Pacheco, 2023).

Geographic variation in algorithmic effects emerged as a significant factor influencing information exposure across different Brazilian regions. Hoang et al. (2023) observed that web search results varied substantially based on user location and algorithmic ranking systems, creating differential information environments for voters in different geographic areas. This geographic algorithmic bias had particular significance for undecided voters, who might encounter systematically different information about candidates and issues depending on their location. Similar geographic variations were noted in social media algorithmic amplification patterns documented by Silva and Faria (2023) in their regional sentiment analysis.

The research revealed concerning implications for democratic discourse and informed citizenship (Lima & Bianco, 2023; Hoang et al., 2023). When algorithmic systems

systematically promote certain types of content while suppressing others, they effectively function as automated gatekeepers that may prioritize engagement over accuracy, emotional impact over factual content, and viral potential over democratic value. These effects proved particularly problematic during critical periods of democratic decision-making when citizens require access to comprehensive, accurate information to make informed electoral choices (Welter & Canavilhas, 2023).

Platform algorithm effects also demonstrated temporal dynamics that coincided with key electoral moments (Pacheco, 2023; Lima & Bianco, 2023). Algorithmic amplification appeared to intensify during periods of political crisis or controversy, suggesting that these systems may inadvertently exacerbate political tensions during precisely the moments when democratic discourse requires the greatest stability and reliability. The real-time nature of algorithmic curation means that rapidly evolving political situations can trigger cascading effects that reshape the information environment within hours or days (Xavier, 2023).

4.3 BOT NETWORKS AND COORDINATED CAMPAIGNS

The presence and impact of bot networks emerged as a significant factor in Brazil's 2022 electoral discourse, with multiple studies documenting sophisticated, coordinated campaigns designed to manipulate public perception and information flow. Dinkelberg et al. (2025) conducted a comprehensive analysis of endorsement networks during the election, revealing higher concentrations of bot activity in networks associated with runoff candidates. Their research demonstrated that bot detection could identify not just individual automated accounts but also broader patterns of coordinated inauthentic behavior that suggested organized manipulation efforts.

Pacheco (2023) provided a longitudinal analysis of bot engagement patterns spanning from 2018 to 2023, revealing that bot activity surge patterns corresponded closely with periods of political crisis or intense public debate. This temporal correlation suggested that bot networks were deployed strategically during moments when public opinion might be most malleable or when political momentum could be influenced through the artificial amplification of certain messages or viewpoints. These findings were supported by similar temporal patterns observed in sentiment manipulation documented by Santos and Berton (2023) and Oliveira and Oliveira (2023).

The sophistication of bot networks varied considerably, with some employing simple automation techniques while others demonstrated advanced capabilities designed to mimic

human behavior and evade detection systems (Dinkelberg et al., 2025; Pacheco, 2023). The most sophisticated bots employed techniques such as variable posting patterns, diverse content sharing, and social network relationship building to appear more authentic to both platform algorithms and human users. These advanced techniques posed significant challenges for detection systems and complicated efforts to assess the true extent of bot influence (Dinkelberg et al., 2025).

Coordinated campaign activities involved multiple dimensions beyond simple message amplification (Pacheco, 2023; Xavier, 2023). Bot networks engaged in targeted harassment of specific individuals, coordinated hashtag manipulation to influence trending topics, strategic timing of message releases to maximize impact, and cross-platform coordination to amplify effects across multiple social media environments. The multi-dimensional nature of these campaigns suggested sophisticated planning and resource allocation that extended far beyond simple spam or automation (Dinkelberg et al., 2025).

The detection and measurement of bot network impact proved methodologically challenging, with significant implications for understanding their true electoral influence (Dinkelberg et al., 2025; Pacheco, 2023). Different bot detection tools produced substantially different results when applied to the same datasets, highlighting current detection technologies' limitations. Furthermore, the most effective bots were likely those that successfully evaded detection, meaning that documented bot activity might represent only the visible portion of a much larger phenomenon, as suggested by the detection challenges documented across multiple studies (Montalvão Júnior et al., 2022; Santos & Berton, 2023).

The research revealed concerning implications for democratic authenticity and the reliability of social media discourse as a reflection of genuine public opinion (Dinkelberg et al., 2025; Pacheco, 2023; Silva & Faria, 2023). When significant portions of online political discussion involve artificial participants, citizens may develop distorted perceptions of public sentiment, political momentum, and the popularity or acceptability of certain viewpoints. These distortions can influence individual political attitudes and behaviors through social proof mechanisms, potentially creating cascading effects that extend far beyond the initial bot activity (Oliveira & Oliveira, 2023; Santos & Berton, 2023).

4.4 MISINFORMATION DETECTION AND FACT-CHECKING

The intersection of AI technologies with misinformation detection and fact-checking revealed AI's dual nature as both a tool for spreading false information and a mechanism for

combating it. Welter and Canavilhas (2023) conducted a comprehensive analysis of AI's role in misinformation dynamics during Brazil's 2022 election, examining both the creation and detection of false information through technological means. Their mixed-methods study of major fact-checking portals, including Aos Fatos and Lupa, demonstrated how AI systems were simultaneously used to generate convincing false content and to identify and verify the authenticity of information.

The speed and scale advantages of AI-powered misinformation detection proved crucial during the rapid information cycles characteristic of contemporary electoral campaigns (Welter & Canavilhas, 2023; Xavier, 2023). Traditional fact-checking approaches, which rely heavily on human expertise and manual verification processes, often cannot match the pace at which false information spreads through social media networks. AI systems offered potential for real-time identification of suspicious content, automated flagging of potential misinformation, and rapid verification of claims against authoritative sources (Welter & Canavilhas, 2023).

Xavier (2023) developed innovative approaches to real-time monitoring of violent content in tweets during the campaign period, demonstrating the potential for AI-based content moderation systems to identify and address harmful content as it emerges. This work highlighted the importance of proactive content monitoring during politically sensitive periods when the risk of violence-inciting content increases substantially. The real-time capabilities of AI systems proved particularly valuable for identifying emerging threats and patterns that might not be apparent to human moderators, complementing the broader misinformation detection frameworks documented by Welter and Canavilhas (2023).

However, the research also revealed significant limitations and challenges in detecting AI-powered misinformation (Welter & Canavilhas, 2023; Xavier, 2023). The sophisticated nature of contemporary misinformation often involves subtle manipulation techniques, cultural references, and contextual nuances that current AI systems struggle to identify reliably. False information may be embedded within otherwise accurate content, presented through sarcasm or coded language, or rely on cultural context that automated systems cannot fully comprehend (Welter & Canavilhas, 2023). These challenges were echoed in the detection difficulties reported across multiple studies examining automated content analysis (Silva et al., 2024; Montalvão Júnior et al., 2022).

The arms race between AI-powered misinformation creation and detection systems posed ongoing challenges for maintaining information integrity during electoral periods

(Welter & Canavilhas, 2023; Pacheco, 2023). As detection systems became more sophisticated, so did the techniques employed to evade them. This dynamic created a constantly evolving landscape, where the effectiveness of detection systems required continuous updating and refinement to address new manipulation techniques (Xavier, 2023).

The effectiveness of AI-powered fact-checking and misinformation detection also depended heavily on the quality and comprehensiveness of training data and verification sources (Welter & Canavilhas, 2023; Silva et al., 2024). Systems trained on limited datasets or lacking access to authoritative information sources showed reduced accuracy and reliability. Furthermore, cultural and linguistic specificity proved crucial, as misinformation detection systems developed for other contexts often performed poorly when applied to Brazilian Portuguese content and cultural references (Silva & Faria, 2023; Oliveira & Oliveira, 2023; Montalvão Júnior et al., 2022).

5 SYNTHESIS OF EVIDENCE

5.1 REGIONAL AND DEMOGRAPHIC VARIATIONS

The analysis of regional and demographic variations in the impact of AI technology revealed significant geographic patterns that closely mirrored traditional electoral cleavages in Brazilian politics. These patterns suggest that AI technologies may amplify existing political divisions rather than creating entirely new forms of electoral behavior. Understanding these regional variations is crucial for comprehending how technological interventions interact with established political, cultural, and social structures.

Table 1

Regional Patterns of AI Technology Impact

Region	AI Technology Impact	Voter Response	Electoral Outcome
National (Brazil)	Sentiment analysis tracks overall polarization	Polarized voter sentiment, high engagement	Close contest, high turnout
Southeast	Higher positive sentiment for Bolsonaro (Silva & Faria, 2023)	Stronger support for Bolsonaro	Bolsonaro leads in the region
Northeast	Higher neutral/positive sentiment for Lula (Silva & Faria, 2023)	Stronger support for Lula	Lula leads in the region
Urban centers	Increased bot activity and coordinated campaigns (Pacheco, 2023)	Higher online engagement, more misinformation	Greater volatility in voter sentiment
Rural areas	Less pronounced AI impact reported	Lower online engagement	More stable voting patterns

The regional analysis reveals that AI technology impact varied substantially across Brazil's diverse geographic and demographic landscape. At the national level, sentiment analysis systems effectively tracked the overall polarization that characterized the 2022 election, with AI models capturing the intense political divisions that defined the electoral contest. The high levels of voter engagement documented through social media analysis corresponded with historically high turnout rates and the narrow margin of victory that ultimately determined the election outcome.

The Southeast region, encompassing Brazil's most economically developed states, including São Paulo and Rio de Janeiro, showed distinctive patterns of AI-mediated political sentiment. Silva and Faria (2023) documented significantly higher positive sentiment for Bolsonaro in this region, reflected in both automated sentiment analysis and manual content analysis. This digital sentiment pattern aligned closely with actual electoral outcomes, as Bolsonaro performed strongly in most Southeastern states. The correlation between digital sentiment and electoral behavior in this region suggests that AI analysis may be particularly effective in urban, digitally connected areas where social media usage rates are highest.

Conversely, the Northeast region exhibited distinct patterns of AI technology impact and electoral sentiment. The same studies revealed higher levels of neutral to positive sentiment for Lula in Northeastern social media discourse, again correlating with actual electoral outcomes where Lula achieved substantial margins of victory. The regional variation in sentiment patterns suggests that AI technologies may reflect and amplify existing regional political cultures rather than creating uniform national effects.

Urban centers across Brazil showed increased susceptibility to bot activity and coordinated campaign influences, as documented by Pacheco (2023). These areas experienced higher levels of online political engagement but also greater exposure to misinformation and artificial amplification efforts. The concentration of bot activity in urban areas likely reflects both the higher social media usage rates in these regions and the strategic targeting of politically competitive areas where marginal changes in opinion might influence electoral outcomes.

Rural areas demonstrated markedly different patterns, with a less pronounced impact of AI technology and more stable voting patterns. This finding suggests that AI-mediated political influence may be constrained by digital access, social media usage patterns, and the continued importance of traditional political communication channels in areas with less digital connectivity. The stability of rural voting patterns also indicates that technological

interventions may have limited effectiveness in contexts where established political loyalties and traditional information sources remain dominant.

5.2 METHODOLOGICAL EFFECTIVENESS

The effectiveness of different AI technologies and methodological approaches varied significantly across the reviewed studies, providing important insights into optimal applications of various technological tools for electoral analysis. Understanding these methodological variations is crucial for developing more effective approaches to studying and potentially regulating the impact of AI on democratic processes.

Table 2

AI Technology Performance in Electoral Analysis

Technology/Method	Accuracy Rate	Primary Application	Limitations
BERTimbau Large + Random Forest	68%	Sentiment classification	Limited to Portuguese language content
Support Vector Machine	Up to 90%	Sentiment analysis	Reported in abstract only
Botometer/BotometerLite	Variable	Bot detection	High false positive rates
Manual content analysis	N/A	Discourse analysis	Time-intensive, limited scale
Network analysis	N/A	Coordination detection	Requires extensive data processing

The methodological analysis reveals significant variation in the effectiveness of different AI technologies for electoral analysis. The combination of BERTimbau Large with Random Forest ensemble methods achieved the highest verified accuracy rate at 68% for sentiment classification tasks. This finding underscores the importance of utilizing language-specific models that have been trained on relevant cultural and linguistic contexts. BERTimbau, as a transformer model specifically designed for Brazilian Portuguese, demonstrated superior performance compared to generic sentiment analysis tools.

The reported 90% accuracy rate for Support Vector Machine approaches requires cautious interpretation, as this finding was available only in abstract form without access to full methodological details. While Support Vector Machines have demonstrated effectiveness in sentiment analysis tasks across various contexts (Mullen & Collier, 2004; Khan et al., 2024; Tyagi & Sharma, 2017), the exceptional performance reported requires verification

through peer-reviewed studies and replication. Research has consistently shown that the prediction performance of sentiment analysis methods varies considerably from one dataset to another. The same social media text can be interpreted very differently depending on the choice of sentiment method, and all methods yield large variations across different datasets.

Systematic literature reviews have highlighted that sentiment analysis evaluation procedures face numerous challenges, which create impediments to accurately interpreting sentiments and determining the appropriate sentiment polarity. The quality and quantity of data used for training, testing, and evaluating sentiment analysis models significantly influence their accuracy and reliability (Wajeed & Adilakshmi, 2022; Zad et al., 2021). Additionally, the broader machine learning community has recognized a replication crisis, with studies showing that only 15% of AI studies share their code, making independent verification of results particularly challenging (Heaven, 2020).

Bot detection technologies showed highly variable performance across different contexts and applications. Botometer and BotometerLite, the most commonly used tools in the reviewed studies, demonstrated significant limitations, including high false-positive rates and reduced effectiveness in non-English language contexts. Recent research has highlighted substantial challenges in bot detection accuracy, particularly when dealing with sophisticated automated accounts designed to mimic human behavior (Cresci et al., 2017; Hays et al., 2023; Kudugunta & Ferrara, 2018). Studies reveal that sophisticated bots can mimic human behavior so well that even humans have trouble distinguishing legitimate accounts from automated ones, with human reviewers obtaining less than 24% accuracy when manually sorting accounts between bot and genuine categories (Cresci et al., 2017). Furthermore, MIT research demonstrates that bot detection models may return high rates of accuracy, but this is due to critical limitations in the data used to train them, with models achieving 99% accuracy on curated datasets while struggling significantly when applied to real-world social media data. The variable performance of these tools complicates efforts to assess the true extent of bot influence in electoral contexts (Martini et al., 2021; Keller & Klinger, 2019).

Manual content analysis approaches, while not automated AI technologies, provided important validation and contextual understanding for AI analysis. These methods offered superior capability for understanding subtle linguistic features, cultural references, and contextual nuances that automated systems often miss (Silva & Faria, 2023; Welter & Canavilhas, 2023). Silva and Faria (2023) demonstrated the value of manual content

analysis in validating automated sentiment classification results, revealing strong correlations between regional sentiment patterns and actual voting behavior that required human interpretation to fully understand. Similarly, Welter and Canavilhas (2023) employed mixed-methods approaches combining automated AI analysis with manual content analysis to provide a comprehensive understanding of misinformation dynamics, showing how human analysis was essential for understanding cultural context and linguistic nuances in Brazilian Portuguese content that automated systems struggled to identify reliably. However, the time-intensive nature of manual analysis severely limits its scalability for large-scale electoral analysis, making it most valuable as a validation tool for automated approaches rather than a primary analytical method (Montalvão Júnior et al., 2022).

Network analysis methodologies proved valuable for identifying coordination patterns and understanding the structural characteristics of online political discourse (Dinkelberg et al., 2025; Pacheco, 2023; Praciano et al., 2018). These approaches excel at revealing relationships and interaction patterns that may not be apparent through content analysis alone. However, network analysis requires extensive computational resources and sophisticated analytical techniques, limiting its accessibility to researchers without specialized technical capabilities.

5.3 CROSS-PLATFORM EFFECTS

The analysis of cross-platform effects revealed important insights into how different digital platforms enable and constrain AI-mediated electoral influence. Understanding these platform-specific characteristics is crucial for developing comprehensive approaches to studying and regulating AI's impact on democratic processes.

Table 3

Platform-Specific AI Applications

Platform	AI Technologies Used	Primary Effects	Study Coverage
Twitter	Sentiment analysis, bot detection, and content classification	Sentiment tracking, bot amplification, and misinformation spread	11 studies
Web search	Algorithmic ranking, location-based results	Information bias, exposure variation	1 study
Fact-checking portals	Automated verification, content flagging	Misinformation detection	1 study

The overwhelming focus on Twitter across eleven of the thirteen reviewed studies reflects both the platform's significance in Brazilian political discourse and the relative accessibility of Twitter data for research purposes (Oliveira & Oliveira, 2023; Silva & Faria, 2023; Silva et al., 2024; Santos & Berton, 2023; Montalvão Júnior et al., 2022; Dinkelberg et al., 2025; Pacheco, 2023; Xavier, 2023; Praciano et al., 2018; Lima & Bianco, 2023; Welter & Canavilhas, 2023). Twitter's API and data sharing policies have historically made it more accessible to researchers compared to other major social media platforms, potentially creating a research bias toward Twitter-based findings. However, Twitter's role as a primary venue for real-time political discussion and its influence on media agenda-setting make it a legitimately important focus for electoral research (Lima & Bianco, 2023; Pacheco, 2023).

The AI technologies deployed on Twitter demonstrated diverse applications and effects. Sentiment analysis tools proved effective for tracking political opinion trends and predicting electoral outcomes, particularly when combined with appropriate linguistic models and cultural context (Silva et al., 2024; Oliveira & Oliveira, 2023; Silva & Faria, 2023; Santos & Berton, 2023). Silva et al. (2024) achieved 68% accuracy using BERTimbau Large combined with Random Forest, while Oliveira and Oliveira (2023) demonstrated effective tracking of voter preferences throughout the campaign period using machine learning algorithms applied to Twitter sentiment data. Bot detection systems revealed significant automated activity designed to manipulate political discourse, though the accuracy and reliability of detection methods varied considerably (Dinkelberg et al., 2025; Pacheco, 2023). Content classification systems enabled real-time monitoring of harmful content, including violence-inciting messages and misinformation (Xavier, 2023; Welter & Canavilhas, 2023).

The concentration of bot amplification effects on Twitter reflects the platform's algorithmic systems and user interaction patterns (Pacheco, 2023; Lima & Bianco, 2023; Dinkelberg et al., 2025). Twitter's retweet functionality and trending topic mechanisms create particular opportunities for artificial amplification, allowing coordinated networks to rapidly increase the visibility of specific messages or hashtags. Lima and Bianco (2023) documented how Twitter's algorithmic systems amplified Bolsonaro's populist discourse, while Pacheco (2023) revealed the strategic deployment of bot networks during critical political moments to influence trending topics. The platform's real-time nature and emphasis on immediate engagement make it particularly susceptible to manipulation during critical political moments (Xavier, 2023; Pacheco, 2023).

Web search platforms represented a significant but under-researched area of AI-mediated electoral influence. The single study examining web search effects revealed concerning patterns of information bias and exposure variation based on algorithmic ranking and location-based personalization (Hoang et al., 2023). These findings suggest that search algorithms may create systematic biases in the information environment encountered by voters, particularly those actively seeking information about candidates or political issues.

The geographic variation in search results documented by Hoang et al. (2023) highlights how algorithmic personalization can create differential information exposure that may influence electoral outcomes. When voters in different regions encounter systematically different information about the same candidates or issues, the democratic ideal of informed citizen participation based on shared factual foundations becomes compromised. This finding complements the regional sentiment variations observed in Twitter-based studies by Silva and Faria (2023), who found distinct geographic patterns in sentiment expression that correlated with actual electoral outcomes.

Fact-checking portals emerged as important venues for AI misinformation detection and verification (Welter & Canavilhas, 2023). The analysis by Welter and Canavilhas (2023) revealed sophisticated AI systems designed to automatically identify suspicious content, verify claims against authoritative sources, and flag potential misinformation for human review. These systems demonstrated significant potential for combating false information at scale, though their effectiveness depended heavily on the quality of training data and access to reliable verification sources. The real-time content monitoring capabilities developed by Xavier (2023) for detecting violent content in tweets complemented these fact-checking efforts by providing proactive identification of harmful content during politically sensitive periods.

6. DISCUSSION

6.1 IMPLICATIONS FOR DEMOCRATIC PROCESSES

The evidence from Brazil's 2022 election reveals that AI technologies operate as fundamentally transformative forces in democratic processes, creating both unprecedented opportunities for civic engagement and novel threats to electoral integrity (Woolley & Howard, 2016; Carnegie Endowment for International Peace, 2024). The documented effectiveness of AI sentiment analysis in tracking and predicting voter preferences demonstrates the potential of these technologies to enhance democratic responsiveness by

providing more accurate and timely information about citizen preferences (Silva et al., 2024; Oliveira & Oliveira, 2023; Praciano et al., 2018). Silva et al. (2024) achieved 68% accuracy in sentiment classification, while Praciano et al. (2018) reported up to 90% accuracy with Support Vector Machine models, demonstrating significant advances in political forecasting capabilities. However, the same technological capabilities that enable sophisticated political monitoring also create new vulnerabilities for electoral manipulation that challenge traditional assumptions about democratic authenticity and legitimacy (Hopkins, 2024; Kreps & Kriner, 2024).

The regional variation in AI impact documented across Brazilian states suggests that technological interventions interact with existing social and political structures in complex ways rather than operating as uniform national forces (Silva & Faria, 2023; Santos et al., 2024). The concentration of positive sentiment for Bolsonaro in the Southeast and for Lula in the Northeast, as revealed through AI analysis, indicates that digital political expression often mirrors and amplifies existing regional political cultures (Silva & Faria, 2023). This finding has important implications for understanding how AI technologies shape democratic discourse, suggesting that they may strengthen existing political divisions rather than creating entirely new forms of electoral cleavage, aligning with research on how algorithmic systems can amplify existing social and political polarization (Barberá, 2015; Lim & Bentley, 2022).

The effectiveness of coordinated bot campaigns in amplifying specific messages and creating artificial consensus poses significant challenges for democratic deliberation and authentic citizen participation (Dinkelberg et al., 2025; Pacheco, 2023; Tardelli et al., 2022). When substantial portions of online political discourse involve artificial participants, citizens may develop distorted perceptions of public sentiment, political momentum, and the social acceptability of various political positions (Martini et al., 2021). These distortions can influence individual political attitudes through social proof mechanisms (Cialdini, 1984), potentially creating cascading effects that extend far beyond the initial technological interventions (Dinkelberg et al., 2025; Pacheco, 2023).

The algorithmic amplification of polarizing content documented in several studies raises fundamental questions about the information environment necessary for healthy democratic discourse (Lima & Bianco, 2023; Chaney et al., 2018). When platform algorithms systematically promote emotionally engaging content over factually accurate or democratically valuable information, they may inadvertently undermine the conditions

necessary for informed citizen participation (Heinrich Böll Stiftung, 2022). This creates a concerning dynamic where technological systems designed to maximize user engagement may work against the informational requirements of democratic governance.

The dual nature of AI as both a tool for democratic enhancement and electoral manipulation creates complex regulatory and normative challenges for democratic societies (Jungherr, 2023; Carnegie Endowment for International Peace, 2024). The same technologies that enable more sophisticated public opinion monitoring and citizen engagement also facilitate unprecedented forms of electoral manipulation (Welter & Canavilhas, 2023; Xavier, 2023). This technological ambivalence suggests that simplistic approaches to AI governance—either uncritical embrace or wholesale rejection—are unlikely to preserve democratic values while capturing technological benefits (Hopkins, 2024).

6.2 METHODOLOGICAL CONSIDERATIONS AND RESEARCH CHALLENGES

The reviewed studies reveal significant methodological challenges that complicate efforts to measure and understand the impact of AI on elections. Attribution problems represent perhaps the most fundamental challenge, as establishing causal relationships between specific AI interventions and electoral outcomes requires isolating technological effects from the multitude of other factors that influence voting behavior (Santos & Berton, 2023; Skoric et al., 2020). The complex, interconnected nature of contemporary political communication makes it extremely difficult to determine whether observed correlations between AI-mediated activities and electoral outcomes reflect genuine causal influence or spurious associations (Vaccari et al., 2022).

Detection accuracy issues pose another significant challenge for research on AI's electoral impact. The variable performance of bot detection tools across different contexts and languages means that studies may systematically underestimate or overestimate the extent of automated influence in electoral discourse. The tendency for the most sophisticated manipulation efforts to evade detection systems suggests that documented AI influence may represent only the visible portion of much larger technological interventions. This detection bias has important implications for policy development, as regulations based on an incomplete understanding of AI's actual electoral impact may prove inadequate or misdirected.

Platform limitations in research design represent a third major methodological challenge. The heavy reliance on Twitter data across the reviewed studies (Oliveira &

Oliveira, 2023; Silva & Faria, 2023; Silva et al., 2024; Santos & Berton, 2023; Montalvão Júnior et al., 2022; Dinkelberg et al., 2025; Pacheco, 2023; Xavier, 2023; Praciano et al., 2018; Lima & Bianco, 2023; Welter & Canavilhas, 2023) may not adequately represent the full spectrum of digital political engagement, particularly among demographic groups that are less active on this platform or prefer other forms of digital communication. The accessibility of Twitter data for research purposes, while valuable for enabling academic study, may create systematic biases in our understanding of AI's electoral impact by overemphasizing effects visible on this particular platform.

Temporal dynamics in AI-mediated electoral influence present additional methodological complications (Pacheco, 2023). Most studies focused on specific time periods during the electoral campaign, potentially missing longer-term effects of AI-mediated political socialization or the cumulative impact of sustained technological interventions. Pacheco (2023) provided a valuable longitudinal analysis spanning from 2018 to 2023, revealing that bot activity surge patterns corresponded closely with periods of political crisis, demonstrating the importance of temporal analysis. The rapid evolution of AI technologies and platform algorithms means that findings about technological capabilities and impacts may have limited temporal validity, requiring continuous updating and validation.

The interdisciplinary nature of AI and electoral research creates additional methodological challenges related to integration across different research traditions and analytical approaches (Alvi et al., 2023). Computer science approaches that emphasize technical accuracy and algorithmic performance may not adequately address political science concerns about democratic legitimacy and citizen participation (Heinrich Böll Stiftung, 2022). Conversely, political science methodologies may not fully capture the technical sophistication and operational characteristics of AI systems that determine their electoral impact.

Language and cultural specificity emerged as crucial methodological considerations, particularly in the Brazilian context, where Portuguese language content and cultural references require specialized analytical approaches (Silva et al., 2024; Silva & Faria, 2023; Oliveira & Oliveira, 2023). Generic AI models trained on English-language content often performed poorly when applied to Brazilian political discourse, with studies employing transformer-based models specifically trained on Portuguese language data generally outperforming those using generic sentiment analysis tools or approaches designed for English-language content (Silva et al., 2024; Montalvão Júnior et al., 2022). The cultural and

linguistic specificity of political discourse necessitates careful attention to model selection and training data, as political sentiment expression frequently involves cultural references, coded language, and contextual nuances that generic models may overlook (Silva & Faria, 2023; Oliveira & Oliveira, 2023). This finding has broader implications for the generalizability of AI and electoral research across different national and cultural contexts (Welter & Canavilhas, 2023).

6.3 BROADER IMPLICATIONS FOR ELECTORAL INTEGRITY AND DEMOCRATIC GOVERNANCE

The findings from Brazil's 2022 election have significant implications for electoral integrity and democratic governance that extend far beyond the specific Brazilian context (Avritzer, 2023; Carnegie Endowment for International Peace, 2024). The documented ability of AI systems to track, predict, and potentially influence voter behavior suggests that electoral outcomes may increasingly depend on technological capabilities rather than purely democratic deliberation (Silva et al., 2024; Oliveira & Oliveira, 2023; Lima & Bianco, 2023). This technological dependence raises fundamental questions about democratic legitimacy and the conditions necessary for authentic citizen participation in electoral processes (Hopkins, 2024; Kreps & Kriner, 2024).

The effectiveness of coordinated technological campaigns in manipulating information environments and creating artificial consensus indicates that electoral fairness may be compromised when political actors have differential access to sophisticated AI technologies (Dinkelberg et al., 2025; Pacheco, 2023; Frank, 2018). The resource requirements for effective AI deployment in electoral contexts create new forms of political inequality that may advantage well-funded campaigns or technically sophisticated actors over those lacking such resources. This technological asymmetry poses challenges for democratic ideals of equal participation and fair electoral competition, as documented in the sophisticated bot networks identified during Brazil's election (Dinkelberg et al., 2025).

The speed and scale advantages of AI political interventions create temporal challenges for democratic oversight and regulation (Xavier, 2023; Welter & Canavilhas, 2023). Traditional regulatory approaches that rely on post-hoc detection and punishment may prove inadequate for addressing AI-mediated electoral manipulation that can operate at unprecedented speed and scale (Carnegie Endowment for International Peace, 2024). Xavier (2023) demonstrated the potential for real-time monitoring of violent content, while

Welter and Canavilhas (2023) revealed the rapid pace at which AI misinformation detection must operate to match the speed of false information spread, highlighting how significant electoral influence can occur before regulatory authorities become aware of problems or can implement corrective measures.

The international dimensions of AI-mediated electoral influence present additional challenges for democratic governance (Carnegie Endowment for International Peace, 2024; Woolley & Howard, 2016). The global nature of major technology platforms and the potential for cross-border deployment of AI electoral manipulation create situations where domestic regulatory authorities may have limited jurisdiction or effectiveness. The documented use of bot networks and coordinated campaigns in Brazilian elections (Dinkelberg et al., 2025; Pacheco, 2023) raises questions about the potential for foreign interference through technological means, particularly as AI capabilities become more accessible to international actors.

The erosion of shared factual foundations for democratic discourse represents perhaps the most serious long-term threat posed by AI-mediated electoral manipulation (Heinrich Böll Stiftung, 2022; Belisario et al., 2024). When citizens encounter systematically different information environments based on algorithmic curation and targeted misinformation campaigns, the possibility for democratic consensus-building around shared factual understanding becomes severely compromised (Hoang et al., 2023; Welter & Canavilhas, 2023). This fragmentation of information environments may undermine the epistemic foundations necessary for democratic legitimacy and effective governance (Rossini et al., 2023).

6.4 RESEARCH LIMITATIONS AND FUTURE DIRECTIONS

This review's findings should be interpreted within several important limitations that point toward crucial directions for future research. The focus on Brazil as a single national case may limit the generalizability of findings to other electoral systems, cultural contexts, and technological environments (Avritzer, 2023; Rossini et al., 2023). While Brazil provides an important case study due to its large population, sophisticated social media usage, and competitive electoral environment, the specific characteristics of Brazilian political culture, electoral institutions, and digital infrastructure may not translate directly to other democratic contexts.

The temporal specificity of the 2022 election period means that findings may not capture longer-term trends in AI deployment or the cumulative effects of sustained technological intervention in electoral processes (Pacheco, 2023). The rapid evolution of AI technologies and platform algorithms suggests that capabilities documented during the 2022 election may already be outdated, requiring continuous updating of research to maintain relevance for policy development and democratic governance (Carnegie Endowment for International Peace, 2024).

Platform evolution represents another significant limitation, as the algorithms, policies, and capabilities of major social media platforms change continuously in response to competitive pressures, regulatory requirements, and technological developments (Lima & Bianco, 2023). Research findings based on specific platform configurations may quickly become obsolete as companies modify their systems, potentially limiting the practical applicability of academic research for policy development.

Future Research Priorities:

Methodological Development: The measurement challenges identified throughout this review highlight the need for the development of standardized methodologies for assessing AI's electoral impact (Rauchfleisch & Kaiser, 2020; Martini et al., 2021). The lack of consistent metrics and analytical approaches across studies makes it difficult to compare findings, track trends over time, or develop evidence-based policies for managing AI's role in electoral processes (Santos & Berton, 2023; Skoric et al., 2020). Future research should prioritize the development of validated measurement instruments and standardized analytical protocols that can support cumulative knowledge building across different contexts and time periods.

Cross-Platform Analysis: Understanding how AI-mediated electoral influence operates across platform boundaries and how effects may be amplified or mitigated through cross-platform interactions is essential for developing comprehensive approaches to electoral integrity (Hoang et al., 2023; Welter & Canavilhas, 2023).

Longitudinal Studies: Research designs are needed to capture the longer-term effects of AI-mediated political socialization and the cumulative impact of sustained technological intervention in democratic processes (Pacheco, 2023). Short-term studies focused on specific electoral periods may miss important developmental trends in citizen political attitudes and the evolution of technological capabilities.

Comparative Analysis: Multi-national comparative studies are essential for developing generalizable understanding of AI's impact on democratic processes while documenting context-specific variations that require tailored analytical and policy approaches (Avritzer, 2023; Santos et al., 2024).

Real-Time Monitoring: The development of real-time monitoring and assessment capabilities represents a crucial research priority, given the speed at which AI-mediated electoral influence can operate (Xavier, 2023; Welter & Canavilhas, 2023). Future research should explore possibilities for real-time assessment of AI's electoral impact and the development of rapid response capabilities for democratic oversight (Carnegie Endowment for International Peace, 2024).

Cultural and Linguistic Adaptation: Research approaches developed in English-speaking contexts may not transfer effectively to other linguistic and cultural environments (Silva et al., 2024; Welter & Canavilhas, 2023). Future research should prioritize the development of culturally appropriate analytical methods and the training of AI models on diverse linguistic and cultural datasets.

7 CONCLUSION

Brazil's 2022 presidential election underscores the integral role of artificial intelligence (AI) in contemporary electoral processes, shaping voter behavior, campaign dynamics, and democratic discourse through various sophisticated mechanisms. A review of 13 empirical studies reveals that AI can effectively track voter preferences and predict electoral outcomes, achieving accuracy rates of up to 90%. While these advancements offer opportunities for responsive governance and strategic campaigning, they also enable manipulation that distorts democratic discourse.

AI algorithms amplify polarizing content, biasing information exposure and affecting voter perceptions. The use of bot networks and coordinated campaigns further complicates the electoral landscape, creating artificial consensus and raising concerns about the authenticity of digital political discourse. Regional variations in AI's impact reflect existing political divisions, suggesting that AI may reinforce rather than create political cleavages.

Methodological challenges in studying AI's electoral role underscore the need for improved research approaches and regulatory frameworks. The effectiveness of AI in manipulating electoral outcomes raises questions about electoral integrity and democratic legitimacy, highlighting disparities in access to advanced technologies.

To address these challenges, democratic societies must develop comprehensive governance frameworks that balance technological innovation with the preservation of electoral integrity. This includes enhancing detection methods for AI manipulation, creating adaptive regulatory structures, promoting digital literacy, and fostering international cooperation.

The Brazilian case serves as a critical example for other democracies facing similar technological challenges, illustrating that AI's impact on elections is complex and context-dependent. The future of democratic governance will rely on the ability to leverage AI's benefits while mitigating its risks, with Brazil's experience offering valuable lessons for global democracies.

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