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Article

# The moderating effect of digital literacy on the link between e-government effectiveness and trust in government

Seulki Lee-Geiller

Institution for Social and Policy Studies, Yale University, New Haven, CT, USA

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**Corresponding author**
Seulki Lee-Geiller
Tel: +1-203-432-6660
E-mail: seulki.lee-geiller@yale.edu



**ORCID**
Seulki Lee-Geiller
https://orcid.org/0000-0001-5183-6631

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**Availability of data and material**
Upon reasonable request, the datasets of this study can be available from the corresponding author.

**Authors' contributions**
The article is prepared by a single author.

**Abstract**

Trust in government is crucial for effective governance in modern democratic societies, given its role in establishing government legitimacy. However, public trust has significantly declined, which has prompted questions about the potential of e-government to restore it. Despite widespread adoption of e-government, research on its impact on public trust has produced mixed findings. Addressing this gap, this study investigates the complex relationship between e-government and public trust, emphasizing the moderating role of digital literacy. Analyzing a sample of approximately 1,900 New Jersey residents, we reveal a positive association between favorable evaluations of e-government effectiveness and trust in the New Jersey government, with digital literacy playing a positive moderating role. This study contributes to the existing literature by addressing the intricate relationship between e-government, citizen perceptions of government performance, and trust in government, while providing valuable policy insights on enhancing e-government services and citizens' digital literacy levels to cultivate trust.

**Keywords:** Public trust, e-government, digital literacy, government performance, e-governance

## Introduction

Trust in government is of paramount importance in contemporary democratic societies. Scholars have emphasized its multifaceted nature, highlighting its role in conferring legitimacy and ensuring effective governance (Hartley, 2021; Herian, 2014; Levi, 1998; Nye et al., 1998; Rothstein & Uslaner, 2005). Additionally, research has highlighted the pivotal role of trust in fostering citizen engagement and compliance with laws and government initiatives (Norris, 1999; Nye et al., 1998). The erosion of public trust has been a growing concern, as evidenced by the substantial decline observed worldwide since the 1960s (Kehoe, 2022; Pew Research Center, 2020). This decline has prompted inquiries into the factors that contribute to the formation and maintenance of public trust in government institutions.

As extensively documented in the literature, trust in government is contingent on various interconnected factors, including a lack of transparency, weak political integrity, inefficiency, and

inflexibility in public bureaucracies, as well as societal perceptions (Chanley et al., 2000; Foa & Mounk, 2017; McLaren, 2007; Nannestad & Paldam, 1997; Putnam, 2000; Rivas, 2005). In response to the critical challenge of declining public trust, recent scholarship has increasingly focused on e-government as a potential tool for enhancing trust in government institutions (Ho, 2002; Jun & Weare, 2011; Randma-Liiv, 2022). E-government initiatives have received positive attention because of their potential to improve transparency, accountability, and public service delivery (Anshari & Lim, 2017; Chadwick & May, 2003; Fountain, 2014; Ho, 2002; Thomas & Streib, 2003; Tolbert & Mossberger, 2006).

In anticipation of these benefits, we have witnessed the rapid adoption of e-government systems by governments worldwide since the late 1980s. As of 2020, 193 countries have adopted some form of e-government to improve interactions with citizens (United Nations Department of Economic and Social Affairs, 2020). The expanding adoption of e-government applications also means that citizens increasingly use these platforms to interact with their government. Indeed, recent survey data indicates roughly half of the population in the United States (the US) has already used and prefers accessing public services provided through governmental digital platforms (Horrigan & Rainie, 2015; West, 2019). Specifically, the Pew Research Survey (2014) reports that two-thirds of the US population has used e-government services from either federal, state, or local government websites. Moreover, the Brookings Institution (2019) revealed that 51% of nationally sampled respondents in the US have indicated their preference for accessing public services through digital or mobile platforms, while only 9% prefers offline public service access.

Despite this, the relationship between e-government and public trust remains complex and multifaceted, as evidenced by mixed findings in the literature. Some studies suggest that e-government use is positively associated with trust in government (Chen et al., 2023; Pérez-Morote et al., 2020; Tolbert & Mossberger, 2006). On the other hand, others offer evidence of an insignificant association between e-government use and trust in government (Horsburgh et al., 2011; Morgeson et al., 2011) and emphasize the importance of user experience in linking the two (Welch et al., 2005). Moreover, a third vein of research finds a negative correlation between e-government use and trust in government (Porumbescu, 2016).

Addressing this research gap, this study explores the complex dynamics of public trust in the context of e-government and examines the moderating role of digital literacy. The investigation is anchored in the understanding that while the effectiveness of e-government has the potential to positively influence trust in government, the role of digital literacy in shaping this relationship has not been adequately explored. In doing so, we draw on a novel, representative sample of New Jersey residents collected by the Eagleton Institute of Politics at Rutgers University–New Brunswick, which surveyed approximately 1,900 adults in New Jersey between June 14 and July 5, 2022. Using multiple linear regression analyses, we confirm our hypotheses, which demonstrate a statistically significant association between residents' positive perceptions of e-government effectiveness and their trust in the New Jersey government, with this relationship positively moderated by their level of digital literacy.

The findings of our study resonate with the existing literature and practice in multiple ways. Firstly, while previous research has primarily focused on e-government adoption or usage, our study highlights the critical role of positive evaluations of e-government effectiveness in enhancing


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residents' trust in the state government. This provides practitioners with a recommendation for improving e-government service quality while promoting citizens' usage. Secondly, our study provides initial evidence of the positive link between e-government effectiveness and trust in government at the state level. Finally, our study reveals the moderating role of individual citizens' digital literacy levels, presenting timely policy implications for harnessing e-government to achieve the overarching governance objective of rebuilding trust in government.

The subsequent sections provide a comprehensive review of the relevant literature on trust in government and the role of e-government, as well as the significance of digital literacy, which serves as the basis for developing hypotheses. The method section then outlines the study design, data collection process, and analytical procedures. Subsequently, we present the results of our analyses. Finally, we discuss the theoretical and practical implications, along with an examination of the limitations and suggestions for future research.

## Literature Review

### Understanding trust in government

Public trust in government, as defined by Miller & Listhaug (1990), refers to citizens' evaluations of political authorities and public institutions in relation to their normative expectations. This implies that citizens perceive their governments as trustworthy when their expectations of what the government should be and do are met. In the context of a democratic society, trust in government plays a pivotal role. Trust in government signifies the belief that the power it possesses is rightful and that decisions are made on behalf of the population, thereby conferring legitimacy to its rule and ensuring political stability (Rothstein & Uslaner, 2005).

Trust in government also fosters citizen engagement in democratic processes, such as voting and public discourse, which, in turn, serves as a mechanism for holding government accountable (Norris, 1999). Moreover, citizens are more inclined to comply with laws and cooperate with government initiatives when they trust that their government acts in their best interests (Levi, 1998; Nye et al., 1998). In times of crisis, the significance of public trust becomes even more pronounced, as it facilitates efficient coordination and effective communication between government authorities and citizens, ultimately aiding in successful crisis management (Boin et al., 2016). In this manner, trust in government serves to reinforce the social fabric in democratic societies by fostering cooperation, reducing conflict, and enhancing citizen engagement (Campbell, 2023; Putnam, 2000).

Considering the significant decline in trust in governments worldwide since the 1960s (Pew Research Center, 2020), political scientists have started developing a substantial body of research on this topic (Keele, 2007). Studies reveal that political integrity is crucial for public trust in government. Official misconduct and lack of transparency erode confidence in public institutions (Chanley et al., 2000; Foa & Mounk, 2017; McLaren, 2007; Miller & Listhaug, 1990; Rivas, 2005; Rothstein, 2000; Treisman, 2000). Economic mismanagement further undermines trust, as citizens disengage when feeling economically vulnerable (Elliott, 2023; Hetherington, 1998; Nannestad & Paldam, 1997; Wroe, 2016). Empirical U.S. data confirms that distrust correlates with perceptions of poor political and economic governance (Chanley et al., 2000).

Overall, these factors are linked to citizens' negative perceptions of government performance, characterized by ineffectiveness, inefficiency, and incompetence (Keele, 2007). In other words, the capacity of government institutions to fulfill their responsibilities to serve their citizens plays a pivotal role in shaping public trust. As low public trust is problematic for effective democratic governance, resulting in reduced support for government actions and negative evaluations, and reluctant citizen engagement (Hetherington, 1998), it is crucial to explore strategies for restoring trust in government.

### Enhancing trust in government through e-government

The burgeoning literature underscores the potential of e-government to address the erosion of trust in government. This idea is based on the expectation that e-government platforms can enhance accessibility to essential government information and transparency in decision-making processes (United Nations, 2018). In doing so, these platforms not only serve to mitigate corruption but also foster a culture of public accountability. In fact, numerous studies have found that e-government adoption is significantly correlated with reduced corruption levels within government (Darusalam et al., 2019; Ionescu, 2015; Neeman et al., 2008; Park & Kim, 2020). Enhanced transparency and a concurrent reduction in corrupt practices are expected to help restore public trust, as they can foster political integrity.

Furthermore, e-government initiatives have demonstrated their potential to improve public service delivery. By leveraging information and communication technologies (ICTs), these initiatives streamline public administrative processes, making them more efficient and effective (Tolbert & Mossberger, 2006). Simultaneously, these endeavors extend the accessibility of public services to citizens through personalized online transactions. This can be achieved by offering citizens recommendations aligned with their needs using databases or big data of user profiles and services (Anshari & Lim, 2017; Guo & Lu, 2007).

In addition, e-government systems can enhance communication and feedback mechanisms between government and citizens by providing online channels. This enables citizens to express their concerns, seek assistance, and receive appropriate responses in a timely manner (Fountain, 2014). The interactive feedback mechanisms also help the government learn about and address the needs of citizens. Consequently, this can help bridge the gap between citizens' expectations and the government's capacity to respond, ultimately improving public perceptions of government performance (Chadwick & May, 2003; Clift, 2004; Thomas & Streib, 2003; West, 2004), an essential factor implicated in shaping trust in government.

E-government's potential to enhance trust in government is a subject of ongoing inquiry, and empirical evidence reveals a mixed landscape. Several studies have highlighted a positive association between citizens' use of e-government and their trust in government. For example, Tolbert & Mossberger (2006) discovered that more frequent visits to a local government website were positively correlated with higher trust in local government, even when adjusting for other demographic variables. Similarly, Lee & Kwak (2011) found that active engagement with e-government services is positively associated with trust in government. Furthermore, e-government use and trust in government appeared to form a mutually reinforcing relationship, as


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suggested in a study by Pérez-Morote et al. (2020).

On the other hand, other studies offer evidence of an insignificant association between e-government use and trust in government (Horsburgh et al., 2011; Morgeson et al., 2011). Furthermore, Porumbescu (2016) uncovered a negative relationship between increased use of e-government websites and citizens' satisfaction, as well as perceptions of public sector trustworthiness at the municipal level. These findings necessitate more detailed attention to interactive aspects between citizens and e-government services, which involve citizens perceptions and experiences of using these services (Lee et al., 2020a, 2020b). That is because the mixed evidence may be attributed to disparities in e-government development levels and citizens' perceptions of these services.

The varied findings of studies on e-government use may stem from an assumption regarding the guaranteed quality of e-government services, which may not hold true in practice. Considering the varied levels of e-government service quality, it is crucial to challenge this assumption and pursue a more nuanced assessment of e-government's impact on public trust by focusing on the perceived quality of e-government services.

Interestingly, studies examining the impact of citizens' perceptions of e-government services on their trust in government have yielded relatively consistent findings. Rodríguez Bolívar (2015) established a positive association between citizens' trust in e-government services and trust in government. While Horsburgh et al. (2011) did not find a direct correlation between trust in e-government systems and trust in government, they uncovered a positive relationship between citizens' support for government investment in e-government initiatives and trust in government. This suggests that the greater the extent to which citizens perceive the development of e-government services as beneficial, the higher their trust in government. Additionally, research by Li & Shang (2023) revealed that citizens' evaluation of government integrity, performance, and responsiveness influences the indirect effect of e-government use on public trust.

Furthermore, citizens' perceptions of the quality of e-government services and their evaluations of these services have emerged as pivotal factors influencing trust in government. In a global scale analysis, Estevez & Janowski (2013) argued that e-government maturity, characterized by service quality, transparency, and participation, can enhance trust in government. Similarly, Gracia & Casaló Ariño (2015) revealed a significant effect of positive perceptions of e-government service quality on trust in government in the context of Spain.

In summary, despite the disparate outcomes of research on e-government use, focusing on citizens' perceptions of e-government proves to be a more reliable approach to understand its influence on trust. The literature consistently reports that positive perceptions of e-government services consistently correlate with higher levels of trust in government. Therefore, a thorough investigation into how these perceptions of e-government's effectiveness shape trust becomes imperative. Such an analysis promises to yield greater insight into the role of e-government in cultivating trust. These observations concur with the evidence that government performance markedly affects public trust. Similarly, individual experiences with e-government services can have a significant impact on citizens' trust levels in their government.

The examination of e-government's impact on trust in government becomes particularly illuminating when considered at the state level within the administrative structures of the US.

Such an approach is critical as it allows for an in-depth understanding of the intricate workings of e-government initiatives within the diverse administrative frameworks of different states (Doonan, 2013). Notably, the adoption and implementation of e-government can vary significantly among states, owing to variations in policy priorities, resources, and governance structure.

Moreover, as residents rely on their state governments for hands-on public services primarily provided by the state government, including education, public health, transportation, public safety, and social welfare programs, a significant portion of which is now provided through e-government platforms, it is essential to understand the dynamics between perceived effectiveness of e-government services and public trust at the state level. Scrutinizing the role of e-government effectiveness in shaping trust in state government will allow to design tailored strategies and policy recommendations (Gil-García & Pardo, 2005). Therefore, we propose a hypothesis:

- Hypothesis 1: Residents with a higher perception of e-government effectiveness are likely to have a higher level of trust in the state government.

### Moderating effect of digital literacy in the e-government-trust relationship

E-government holds the promise of improving government performance.; however, its effectiveness does not automatically guarantee an increase in public trust. This inference is drawn from two sets of evidence: the complex relationship between government performance and public trust, and the effect of digital mediation in the e-government context.

First, despite the expectations of enhancing public trust, extensive efforts to improve government performance through public reforms have fallen short of restoring public trust to the levels seen in the 1950s. Suggesting that government performance alone cannot fully explain the formation of trust in government, Keele's research (2007) highlighted the pivotal role of social conditions. Particularly, social capital, referring to social connections and interpersonal trust within communities (Putnam, 2000), was highlighted. As low social capital among citizens implies a fragile basis for social and civic life, subsequently undermining the government-citizen relationship (Park & Hwang, 2009; Zinnbauer, 2007), it was suggested to have limited the positive effect of improving government performance on restoring public trust.

In this advent of digital age, research suggests that ICTs can empower individual to strengthen social capital by fostering connections and enhancing communication (Quan-Haase & Wellman, 2004; Widén et al., 2021), while favoring those with existing social capital and potentially exacerbating disparities considering its skill acquisition functions (Zhao & Elesh, 2007). From the perspective of democratic governance, these disparities are critical as they lead to unequal access to online public services and hinder political participation. Belanger & Carter's (2006) research revealed that various social and demographic factors impact citizens' perceptions of e-government services and emphasized the importance of understanding and utilizing online tools for public services. Similar evidence was found in a study by Pérez-Morote et al. (2020), which revealed a positive correlation between citizens' education levels and their use of e-government services.

These findings align with the concept of digital literacy, defined by Martin (2005) as the ability to effectively navigate, evaluate, and create information using technologies. As e-government relies


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on digital platforms to deliver services and information, digital literacy significantly influences an individual's ability to use e-government platforms effectively to search, retrieve, and evaluate information (Beam et al., 2018; Park, 2007). To be specific, high levels of digital literacy enable citizens to conduct online transactions with e-government systems, such as submitting forms and making payments, and empower them to actively engage in public decision-making processes using digital tools such as online public forum and e-voting (Bakardjieva et al., 2012; Jones & Mitchell, 2016). Conversely, individuals with lower levels of digital literacy may experience internet-related anxiety (Choi et al., 2017), deterring them from using online public services.

Considering social capital's role in shaping trust in government and its interactive relationship with digital literacy, it is essential to investigate the effect of digital literacy on the link between e-government and public trust. Understanding this is crucial, particularly given data from the National Center for Education Statistics, which indicates that approximately 16 percent of the U.S. population lacks digital literacy (Mamedova & Pawlowski, 2018). In European countries, it has been found that varying levels of digital skills create a digital divide, acting as a deterrent to e-government adoption, particularly among the older population (Botrić & Božić, 2021; Valle et al., 2022). Despite the acknowledged importance of digital literacy, empirical research on its role in e-government and its influence on enhancing public trust remains fragmented. Previous studies have affirmed the significance of digital skills in the uptake of e-services and e-participation. For instance, Mossberger et al. (2007) found that citizens' awareness and digital skills significantly influence their positive perceptions and adoption of e-government services. A study conducted by Li & Li (2022) demonstrated a positive association between digital literacy and online political participation. Furthermore, citizens' positive digital interactions with e-government services have been identified as key indicators of trust in state and local authorities (O'Leary et al., 2021).

Another line of research highlights the potential role of digital literacy in the dynamic between e-government and trust. Tomaszewicz (2015) investigated the relationship between the digital skills of citizens and public officials and e-government development, but no direct correlation was found. Conversely, Im et al. (2014) highlighted the potential of e-government use to mitigate the negative correlation between the extent of internet use and public trust in government. This suggests that although digital literacy, measured by the time spent online, may directly deteriorate trust in government, its application via e-government platforms could mitigate some of the distrust in government associated with internet usage. Additionally, literature emphasizes the importance of cultivating 'digital trust'–a confidence in using digital technologies–as proposed by Capgemini (2021). This form of trust, critical for the acceptance of public sector digital services, is shaped by the level of information literacy, as supported by Lee et al. (2020b).

These studies collectively indicate that digital literacy is influential in shaping the interaction between government and citizens through e-government services. Nonetheless, its role is not necessarily directly correlated with e-government effectiveness or trust in government. Digital literacy should thus be considered a moderating factor that affects the conditions under which e-government can enhance or diminish public trust, rather than a direct catalyst in e-government development and public trust. In this context, we propose the following hypothesis:

- Hypothesis 2: The link between residents' perception of e-government effectiveness and their trust in state government is stronger when their digital literacy levels are higher.

# Method

### Context

New Jersey is a diverse and economically prosperous state with a strong public education system and access to top-ranked universities in the region. Home to over 9 million residents, it is the 11th most populous state in the country, with a significant population of African American, Hispanic, and Asian residents (PopulationU.Com, 2023). Approximately 22 percent of the state's population are immigrants from Latin America and Asia, with smaller numbers from Europe, Africa, and other regions. New Jersey is politically diverse, with a mix of liberal and conservative voters. While there is a significant Republican presence in certain parts of the state, it has tended to vote for Democratic candidates in national elections in recent years (Official site of the State of New Jersey, n.d.). Meanwhile, the state experiences significant disparities in income and wealth expressed in geographical separation, with the wealthiest communities residing in the northern part of the state and some of the poorest communities located in the southern part of the state (Median Household Income in 2021, 2021).

The New Jersey state government has made significant investments in e-government infrastructure and services in recent years, with the goal of making government more accessible, efficient, and transparent (NJ Office of Information Technology, 2023). E-government services include online portals for paying taxes, renewing driver's licenses, and accessing public records. The state also provides online tools for citizens to report issues related to the use of public infrastructure. The New Jersey Open Public Records Act requires government agencies to provide access to public records through electronic means, such as emails and online portals. The New Jersey Department of Information Technology provides guidance and policies related to e-government initiatives, including the state's enterprise architectures and information security standards. Further, New Jersey's Digital Government Service and Technology Act establishes the Office of Information Technology which is responsible for coordinating and overseeing the state's e-government initiatives, including the development and implementation of online services and portals.

Overall, New Jersey's dynamic demographic landscape, encompassing diverse ethnic communities and significant immigrant populations, along with its notable political diversity, presents an ideal setting for investigating the interplay between e-government effectiveness, public trust, and the moderating role of digital literacy. The state's robust e-government infrastructure, coupled with its initiatives for enhancing accessibility and transparency, provides fertile ground for exploring how digital literacy influences the relationship between e-government effectiveness and public trust across various socioeconomic strata and geographic regions within the state.

### Data

For this study, we used a representative sample of New Jersey residents, which was commissioned by the New Jersey State Policy Lab and conducted by the Eagleton Institute of Politics at Rutgers


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University–New Brunswick. The data collection process involved administering a comprehensive questionnaire in English and Spanish to a random sample of 1,887 adults residing in New Jersey. The survey was conducted over three weeks, from June 14 to July 5, 2022.

We used random digit dialing (RDD) technique, which involves contacting people for a survey using telephone numbers generated at random (Buskirk & Best, 2012). To ensure a diverse representation, we employed a variety of methods to reach out to potential respondents. Approximately 70% of the survey participants were contacted through their cell phones, while the remaining 30% were reached via landlines. We incorporated a post-stratification weighting process, to ensure that the sample demographics reflect the target population parameters. The data from New Jersey's residential adult population were weighted in two stages to ensure representativeness. Initially, the weighting corrected for varying selection probabilities in the RDD samples, accounting for household size, individual telephone usage, and overlaps in landline and cell phone sample frames (Buskirk & Best, 2012).

This was followed by a second stage where sample demographics were balanced by race, using the SPSSINC RAKE module, to align with benchmarks from the 2019 American Community Survey PUMS data (United States Census Bureau, 2019). Weights were also trimmed to limit the influence of individual interviews. Post-data collection adjustments were necessary to address deviations from simple random sampling and integrate them into significance tests. Sampling error, inherent in all surveys, was acknowledged, with a simple sampling error of ±2.8 percentage points at a 95% confidence interval for 1,976 New Jersey adults, adjusted for a design effect of 1.64. This adjustment indicates a margin of error for the entire population, providing a confidence level for the representativeness of the sample's responses. This approach allowed us to gather a comprehensive and inclusive dataset.

Table 1 provides an overview of the demographic information of the respondents. In terms of gender composition, the random sample of 1,887 residents consisted of 50% male, 48% female, 1% identifying as transgender, and 1% falling into other categories or refusing to answer. The age distribution is skewed towards older age groups, with individuals aged 65 and over forming the largest segment at 22%. The combined group of 50–64-year-olds constitutes 37%, and the 35–49 age range accounts for 20%. Young adults from 25–34 make up 15%, and those aged 21–24 are 6%. The 18–20 age group is the smallest at 2%. The political orientations of the participants were distributed as follows: 38% identified as Democrats, 17% as Republicans, 30% as Independent, and 15% falling into other categories or refusing to disclose their political affiliation. Furthermore, the educational background of the respondents was also captured in the survey: 31% reported having a bachelor's degree, 27% indicated holding a graduate degree, and 16% reported having some college educational experience. By using this diverse and representative sample, including participants from various demographic backgrounds, we aimed to ensure the validity and generalizability of our findings, enabling us to draw robust conclusions and make informed recommendations based on the study results. It is noteworthy that while race may influence our main model, we intentionally excluded this variable considering its correlations with other variables, such as education and political orientation. As New Jersey is highly diverse in terms of racial composition, including the race variable may make it difficult to separate the effects of race from other factors and inflate

**Table 1.** Demographic information

| | n | % |
|---|---|---|
| Gender | | |
| Male | 936 | 50 |
| Female | 914 | 48 |
| Trans | 15 | 1 |
| Others | 7 | 0 |
| Refused | 15 | 1 |
| Age | | |
| 18–20 | 43 | 2 |
| 21–24 | 126 | 6 |
| 25–29 | 107 | 7 |
| 30–34 | 143 | 8 |
| 35–44 | 340 | 9 |
| 45–49 | 164 | 11 |
| 50–54 | 198 | 18 |
| 55–64 | 350 | 19 |
| 65 and over | 409 | 22 |
| Political orientation | | |
| Democrat | 711 | 38 |
| Republican | 329 | 17 |
| Independent | 571 | 30 |
| Others | 199 | 11 |
| Refused | 77 | 4 |
| Education | | |
| 8th grade or less | 6 | 0 |
| High school incomplete | 21 | 1 |
| High school complete | 188 | 10 |
| Vocational/technical school | 71 | 4 |
| Some college | 302 | 16 |
| Junior college graduate | 190 | 10 |
| 4 year college graduate | 592 | 31 |
| Graduate work | 513 | 27 |
| Refused | 4 | 0 |
| Total | 1,887 | |

standard errors.

To address potential common method bias, a marker variable was incorporated, which is theoretically irrelevant to the model, serving as a test for the presence of this bias (Lindell & Whitney, 2001). The chosen marker variable relates to residents' opinions on the legalization of personal possession of cannabis, which is unrelated to the theoretical framework of the study. Respondents were asked to indicate their level of support for legalizing the possession of small amounts of marijuana for personal use by adults. To assess the extent of common method bias, we analyzed the correlations between the marker variable and three primary variables of interest. The resulting low correlation coefficients with trust in state government (0.072), perceived effectiveness of e-government (0.085),


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and digital literacy (0.167) imply that common method bias is unlikely to be a significant concern in this dataset. This indicates that the marker variable serves as a valid proxy for common method bias, without being substantively related to the main variables you are examining.

### Measures

We hypothesize that positive perceptions of e-government effectiveness (an independent variable) will be positively associated with trust in state government (a dependent variable), and that this relationship will depend on individuals' levels of digital literacy (a moderating variable).

To measure trust in state government as the dependent variable, we asked respondents *"please indicate how much you trust your state government to improve the quality of life for most people"*, adopting the Edelman Trust Barometer (Edelman, 2022), in a four-point Likert-type scale, ranging from "a great deal" to "not very much".

The independent variable, perceived e-government effectiveness, was measured by asking *"governments use technology to increase transparency, improve communication between government agencies, and allow people and businesses to conduct government business online, such as filing taxes, requesting forms, paying bills, or commenting on proposed regulation. How good of a job do you think the state of New Jersey is doing in using technology to fulfill these functions?"* and rating on a four-point Likert-type scale, ranging from "a very good job" to "not a good job at all".

Digital literacy was incorporated as a moderating variable, we asked "in terms of your internet skills, do you consider yourself to be…" to rate on a five-point scale, ranging from "expert" to "not at all skilled". We used the term, "internet skills", to enhance the comprehensibility of the concept Hargittai (2005) as "digital literacy" may not be widely recognized among the general population.

Additionally, we considered various demographic factors as control variables, including gender, age, political orientation, and education levels. By including these control variables, we aimed to account for potential confounding factors and ensure that our analysis provides a comprehensive understanding of the relationship between perceived e-government effectiveness, trust in state government, and digital literacy.

### Analyses

To examine the relationship between perceived e-government effectiveness (E) and trust in state government (T) and test for the presence of a moderating effect of digital literacy (D) in this relationship, we conducted a series of multiple linear regression analyses using the ordinary least squares (OLS) method in R. This method allows for the examination of the complex interplay between these variables, accounting for potentially implicating factors and providing valuable insights into their associations. According to Hair et al. (2010), multiple linear regression analysis is a robust statistical technique commonly used to assess the relationships among multiple variables and is well-suited for examining the moderating effects of certain factors within a model. The baseline model for this study is first estimated as:

$$Y_T = \beta_0 + \beta_1 X_E + \beta_2 M_D + \beta_3 X_E M_D + \varepsilon \quad (1)$$

In each model, we controlled for key demographic variables such as gender (G), political orientation (P), education (Ed), and age (A) by adding one at a time to independently evaluate the effect of each variable as follows:

$$Y_T = \beta_0 + \beta_1 X_E + \beta_2 M_D + \beta_3 X_E M_D + \beta_4 X_G + \varepsilon \quad (2)$$

$$Y_T = \beta_0 + \beta_1 X_E + \beta_2 M_D + \beta_3 X_E M_D + \beta_5 X_P + \varepsilon \quad (3)$$

$$Y_T = \beta_0 + \beta_1 X_E + \beta_2 M_D + \beta_3 X_E M_D + \beta_6 X_{Ed} + \varepsilon \quad (4)$$

$$Y_T = \beta_0 + \beta_1 X_E + \beta_2 M_D + \beta_3 X_E M_D + \beta_6 X_A + \varepsilon \quad (5)$$

$$Y_T = \beta_0 + \beta_1 X_E + \beta_2 M_D + \beta_3 X_E M_D + \beta_4 X_G + \beta_5 X_P + \beta_6 X_{Ed} + \varepsilon \quad (6)$$

Fig. 1 displays conceptual models. By conducting a series of multiple regression analyses for alternative model specifications, we identify potential sources of bias or omitted variable problems. In other words, this serves as robustness checks in moderated multiple regression analysis, through which the results of the baseline model for this study can gain greater validity and reliability (Gelman & Hill, 2006).

Additionally, to interpret the interaction effects, we plotted the simple slopes of perceived e-government effectiveness on trust in state government at different levels of digital literacy (i.e., one standard deviation above and below the mean) and tested for statistical significance using t-tests. Simple slope analysis is a widely recognized method for interpreting interaction effects in moderation analysis (Aiken et al., 1991).

## Results

Descriptive statistics, as presented in Table 2, provide an overview of the central tendencies

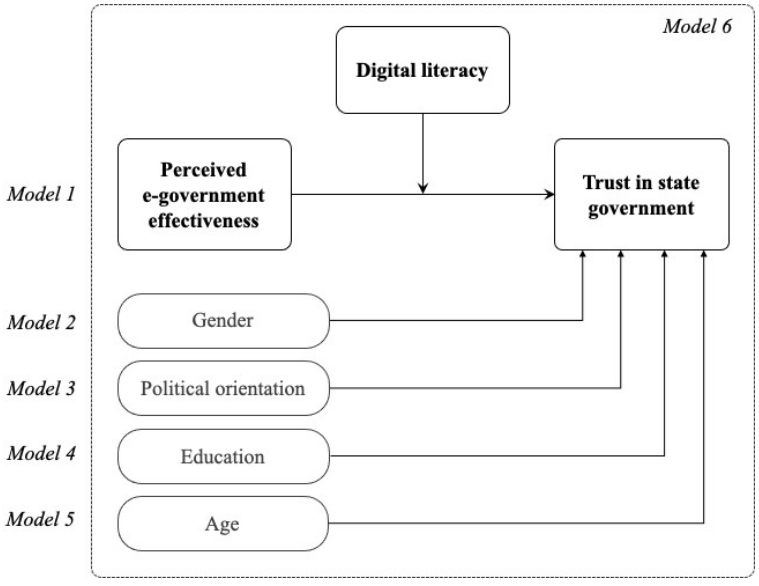


**Fig. 1.** Conceptual model specifications.


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**Table 2.** Descriptive statistics

| | n | Min | Max | Mean | Std |
|---|---|---|---|---|---|
| Perceived e-government effectiveness | 1,887 | 1 | 4 | 2.52 | 0.92 |
| Trust in New Jersey government | 1,887 | 1 | 4 | 2.62 | 0.98 |
| Digital literacy | 1,887 | 1 | 5 | 2.43 | 0.95 |

and variabilities within the dataset, encompassing three variables: the respondents' perceptions of e-government effectiveness, trust in state government, and digital literacy.

The mean perception of e-government effectiveness is approximately at the midpoint, with a value of 2.52. This suggests that, on average, respondents hold a moderate view regarding the effectiveness of e-government initiatives. Similarly, the mean trust in state government slightly surpasses the midpoint, with a value of 2.62. This indicates that, on average, respondents exhibit a moderate level of trust in their state government. In contrast, the mean digital literacy score falls slightly below the midpoint, with a value of 2.43.

Regarding variability, all three datasets demonstrate similar levels of standard deviations. In this context, the standard deviations range from 0.92 to 0.98, signifying that the data points are relatively dispersed yet have comparable levels of variability across the three variables.

The dataset's balanced representation of central tendencies and variabilities, according to Maxwell et al. (2017), ensures robust and reliable statistical analyses. Similar standard deviations and mid-point clustered mean values across the variables establish a solid foundation for exploring the interplay between these variables.

### The link between perceived e-government effectiveness and trust in state government

Table 3 presents the estimates derived from analyzing the data using five distinct models, with the aim of investigating the relationship between perceived e-government effectiveness and trust in state government while accounting for various demographic variables.

In the baseline model (Model 1), a notable and positive association between perceived e-government effectiveness and trust in state government is observed. This indicates that an increase in the perception of e-government effectiveness is associated with a corresponding increase in trust in state government. This positive association is found to be within a high level of statistical significance, with a p-value of 0.00.

### The sustained link with control variables

To ensure the robustness of our findings, an examination of the relationship in alternative model specifications (Models 2 to 6) controlling for different demographic variables was conducted. Remarkably, the consistent presence of the positive association between perceived e-government effectiveness and trust in state government across all six models reinforces the reliability of the results. This demonstrates the independence of this link from specific model specifications or the inclusion of demographic variables. Additionally, the statistical significance of this association is sustained across all models, with a p-value of 0.00.

It is worth noting that the coefficient of perceived e-government effectiveness in Model 2 stands

**Table 3.** Main findings

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Perceived e-gov effectiveness | 0.34 (0.00)*** | 0.03 (0.00)*** | 0.24 (0.00)*** | 0.34 (0.00)*** | 0.35 (0.00)*** | 0.28 (0.00)*** |
| Digital literacy | –0.12 (0.07)# | –0.11 (0.10)# | –0.13 (0.04)* | –0.13 (0.05)# | –0.12 (0.1)# | –0.14 (0.04)* |
| Age | | | | | 0.00 (0.66) | 0.02 (0.03)* |
| Education | | | | 0.03 (0.04)* | | –0.02 (0.15) |
| Gender (base=male) | | | | | | |
| Non-male | | –0.16 (0.00)*** | | | | –0.12 (0.01)** |
| Political orientation (base=democrat) | | | | | | |
| Republican | | | 0.85 (0.20)*** | | | 0.84 (0.00)*** |
| Independent | | | 0.57 (0.00)*** | | | 0.56 (0.00)*** |
| Other political | | | 0.70 (0.00)*** | | | 0.70 (0.00)*** |
| Perceived e-gov effectiveness x Digital literacy | 0.05 (0.04)* | 0.05 (0.05)# | 0.05 (0.04)* | 0.05 (0.04)* | 0.05 (0.06)# | 0.05 (0.04)* |
| $R^2$ | 0.1864 | 0.1934 | 0.2997 | 0.1870 | 0.1871 | 0.3031 |
| $R^2$ excluding moderating variable | 0.1845 | 0.1916 | 0.2990 | 0.1847 | 0.1854 | 0.3009 |
| $R^2$ difference | 0.0019 | 0.0018 | 0.0007 | 0.023 | 0.0017 | 0.0022 |
| F-value | 4.3974 | 4.2021 | 1.8822 | 53.2706 | 3.9379 | 5.9443 |

# p<0.1, * p<0.05, ** p<0.01, *** p<0.001.

out as significantly lower (0.03) compared to the coefficients observed in the other models, which range between 0.24 and 0.34. This discrepancy indicates that the presence of the gender variable may influence the association between perceived e-government effectiveness and trust in state government.

Upon closer examination, we observed that the non-male category of the gender variable displays a negative coefficient (–0.16) in Model 2 and (–0.12) in Model 6, with highly significant p-values (0.00 and 0.01, respectively). This suggests an interesting point: when focusing on perceived e-government effectiveness, being non-male is associated with a lower degree of trust in state government relative to being male. Furthermore, when controlling the gender variable as presented in Model 2, the statistical significance of the interaction effect between perceived e-government effectiveness and digital literacy slightly decreases.

In Model 5, the age variable did not exhibit statistically significant correlations with trust in government. This may have been influenced by the skewed sample towards older age groups, who typically have lower levels of digital literacy. However, when all other demographic variables were included, both the coefficient and statistical significance of the age variable increase in Model 6. This indicates that the relationship between age and trust in government may be contingent on or interact with other demographic variables.

In addition, we further explored the relationship between political orientation and trust in state government in Models 3 and 6. It was observed that all categorical variables for political orientation, specifically those based on the Democrat category, exhibited statistically significant associations with trust in state government. Specifically, being Republican showed the highest coefficient values of 0.84 and 0.85, indicating a stronger association between being Republican and an increase in trust in state government when controlling for perceptions of e-government effectiveness. These associations remained significant even after including the gender variable in Model 5.

Regarding the education variable, it demonstrated a positive association with trust in state


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government in Model 4, with a coefficient of 0.03 and a fairly significant p-value of 0.04. This suggests that higher levels of education are associated with increased trust in state government. However, in Model 6, where gender and political variables were controlled in addition to age and education, the association between education and trust in state government became statistically insignificant. This implies that the influence of education on trust in state government may be influenced by gender and political orientation factors.

### Moderating effect of digital literacy on the link

We also examined the moderating role of digital literacy in the link between perceived e-government effectiveness and trust in state government. Our analysis revealed that digital literacy demonstrates a meaningful moderating effect in four out of the five models, except in Model 2. This finding suggests that digital literacy plays a significant role in influencing the relationship between perceived e-government effectiveness and trust in state government.

Furthermore, the integration of a moderating variable, digital literacy, into a series of models has demonstrated varied impacts on the models' explanatory power. For most models, except for Model 3, the inclusion of the moderating variable resulted in an increase in $R^2$, signifying that it accounted for additional variance in the dependent variable. Specifically, Model 6 showed a modest rise in $R^2$, suggesting that the moderator provides a significant, albeit small, contribution to explaining trust in state government.

The F-values indicates the statistical significance of this contribution. Models 1 and 2 reported F-values that denotes a statistically meaningful increase in the models' explanatory power. However, Model 3 showed a lower F-value, implying a less significant contribution from the moderating variable. In contrast, Model 4 presented an exceptionally high F-value, strongly indicating that the moderating variable considerably enhances the models' explanatory capacity. Model 5 showed a moderate F-value, which points to a significant contribution, although not as pronounced as in some other models. Lastly, Model 6's F-value also indicated a significant improvement in the model's fit by introducing the moderating variable.

To gain further insights into the relationship between perceived e-government effectiveness and trust in state government at different levels of digital literacy, we conducted a simple slope analysis. The results of this analysis are presented in Table 4 and visually represented in Fig. 2. At one standard deviation below the mean of digital literacy, the simple slope analysis revealed a statistically significant positive relationship between perceived e-government effectiveness and trust in state government, with a slope estimate of 0.41 ($p<0.000$). This suggests that as perceived e-government effectiveness increases by one unit, trust in state government is expected to increase by 0.41 units

**Table 4. Simple slope analysis**

| | Estimated points of trust in State Gov | | Simple slopes analysis (df=1,887) | | | |
|---|---|---|---|---|---|---|
| | Low E-gov (–1 SD) | High E-gov (+1 SD) | Simple slope | St error | t-value | p-value |
| Low digital literacy (–1 SD) | 2.23 | 2.99 | 0.41 | 0.03 | 13.10 | 0.00*** |
| High digital literacy (+1 SD) | 2.15 | 3.08 | 0.51 | 0.03 | 15.20 | 0.00*** |

*** p<0.001.

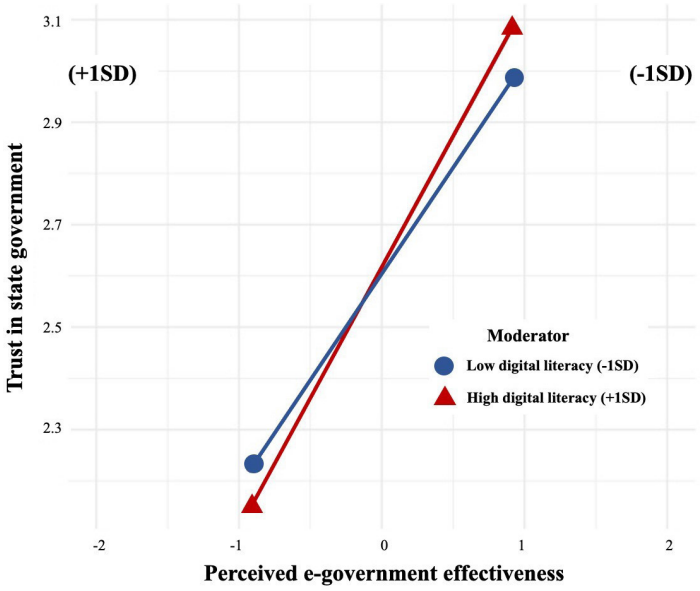


**Fig. 2.** Plotted simple slopes.

when digital literacy is at this lower level. Similarly, at one standard deviation above the mean of the digital literacy level, the simple slope analysis showed a statistically significant positive relationship, with a slope estimate of 0.51 ($p<0.000$). This indicates that as perceived e-government effectiveness increases by one unit, trust in state government is expected to increase by 0.51 units when digital literacy is at this higher level.

Fig. 2 graphically illustrates the plotted simple slopes, revealing a nuanced interpretation of the models. Overall, both lines slope upward, indicating a positive relationship between perceived effectiveness and trust in state government, regardless of an individual's level of digital literacy. Notably, for individuals with high digital literacy, the mean of trust in state government is lower for higher literacy group when perceived e-government effectiveness is low (below 0). This is illustrated by the simple slope, where the red line (high digital literacy) is positioned below the blue line (low digital literacy) when perceived e-government effectiveness is less than 0. This may be due to a higher confidence level in the perception of e-government effectiveness among groups with higher digital literacy, which directly influences their evaluations of government performance. In other words, individuals with higher digital literacy are more certain about their assessments of government performance through e-government systems, making them more likely to be disappointed by poor e-government services. In summary, both high and low digital literacy levels are positively correlated with trust in state government as a function of perceived e-government effectiveness, which confirms digital literacy's moderating role. However, the extent of this moderating effect varies across different levels of perceived e-government effectiveness, particularly within its negative range.

## Discussion

This study investigates how citizens' perceptions of e-government effectiveness affect their trust


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in state government, with attention to the moderating role of digital literacy. Our findings confirm the positive and statistically significant association between positively perceived e-government effectiveness and trust in state government, even when controlling for demographic factors. Moreover, the results highlight the crucial role of digital literacy in positively influencing this relationship. These findings have significant implications for our understanding of the dynamics of trust in government and government performance, particularly with regards to e-government effectiveness and the attribute of digital literacy among citizens. They also yield practical insights for public managers and administrators to consider for improving public trust through e-government.

### Theoretical implications

Extensive research has suggested a positive link between good government performance and trust in government, as noted by Chanley et al. (2000), Keele (2007), and Nannestad & Paldam (1997). Given the advancements in technology in the digital age and the subsequent adoption of e-government, it has become crucial to examine the implications of government performance on public trust in the context of e-government. Despite a substantial body of literature, the precise relationship between the use of e-government and public trust remains ambiguous, with mixed findings reported by various studies (e.g., Horsburgh et al., 2011; Pérez-Morote et al., 2020; Porumbescu, 2016). This disparity has created a noticeable gap in knowledge concerning the relationship between e-government-enabled improvements in performance and public trust. This gap forms the focal point of this study, which centers on citizens' perceptions of government performance in the context of e-government, specifically their evaluations of e-government effectiveness, and its impact on their trust in government.

The empirical findings of our study offer robust evidence supporting Hypothesis 1, revealing a significant and positive correlation between perceived e-government effectiveness and trust in state government. This implies that as individuals perceive higher effectiveness in e-government services, their trust in state government tends to strengthen. The validation of Hypothesis 1 emphasizes the notion that positive experiences with e-government services are intrinsically linked to increased levels of public trust in government, which aligns with previous research findings that focused on citizens' perceptions of e-government services (Estevez & Janowski, 2013; Gracia & Casaló Ariño, 2015). Given the varied results observed in studies concentrating on e-government use, this also suggests that measuring citizens' perceptions of e-government provides a more precise and consistent understanding of the impact of e-government initiatives on public trust.

Furthermore, this study provides initial evidence of the positive impact of e-government effectiveness on public trust at the state level, illuminating the potential to realize theoretical expectations of rebuilding public trust through e-government initiatives. A large body of literature has suggested the significance of government performance in shaping public trust and the crucial role that e-government can play in improving performance (Chanley et al., 2000; Keele, 2007; McLaren, 2007; Rivas, 2005; Rothstein, 2000). However, the mixed findings on the link between e-government use and trust in government have been puzzling. Considering the unique responsibilities that state governments uphold in the US governance structure, providing a wide range of public services that closely touch upon residents' lives, our findings at the state level

validate this thesis in the context of e-government, as suggested by prior studies, even in the context of e-government. Additionally, considering the influence of varying governance structures and resources across states on e-government policies, it underscores the need for active consideration of these factors in future research to draw a more nuanced picture. This is particularly important as public perceptions of government performance may be formed holistically through their interactions with governments both offline and online.

Furthermore, our study sheds light on the critical role that digital literacy plays in realizing the potential of e-government for rebuilding public trust, confirming Hypothesis 2. The presence of digital literacy amplifies the strength of this relationship, as evidenced by the steeper slope estimate observed at higher levels of digital literacy. That is because digital literacy empowers citizens to proficiently communicate and interact with their government (Botrić & Božić, 2021; Mossberger et al., 2007; Valle et al., 2022). This finding is particularly insightful as we have witnessed the persistence of low public trust despite the progress in government performance, illuminating the intricate nature of the performance-trust link. However, the interplay between e-government and digital literacy can be characterized as interrelated, as the moderating effect of digital literacy diminishes when citizens perceive negative perceptions toward e-government effectiveness, as indicated by their perceived e-government effectiveness falling below 0. Therefore, it is imperative to avoid nurturing negative perceptions of e-government effectiveness to expect a significant moderating effect of digital literacy.

Moreover, highlighting the crucial role of digital literacy in shaping trust through e-government resonates with the concept of social capital. According to Keele (2007), social capital is pivotal in rebuilding trust, in addition to government performance. High levels of social capital can help build confidence in engaging in one's communities, ultimately promoting political efficacy. Prior studies have suggested the significant role of digital literacy in fostering social capital (Quan-Haase & Wellman, 2004; Widén et al., 2021), indicating that high digital literacy represents a comprehensive asset for citizens' learning, community engagement, and online political participation in the digital age (Chen, 2013; Li & Li, 2022; Zhao & Elesh, 2007). This underscores an additional pathway for the influence of digital literacy in restoring public trust, wherein citizens' trust is shaped through their ability to engage actively in society through the proficient use of digital platforms.

In summary, these findings provide valuable insights into the intricate dynamics of public trust in the domain of e-government, emphasizing the importance of citizens' perceptions of e-government services alongside their competence and understanding in utilizing such services. They also build upon the existing body of research that has underscored the relevance of social and demographic factors in understanding public trust within the realm of digital governance (Christensen & Lægreid, 2020; Keele, 2007; Konstantinou et al., 2021).

### Practical implications

Our findings have practical implications for policymakers and public administrators focused on improving public trust in the context of e-government. First, it highlights the need for targeted interventions and continued investments in digital infrastructure and capacity-building at the state level. Equitable access requires strategic investments in technology, user-friendly interface design,


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and comprehensive digital service training, especially for individuals with lower digital literacy. Customizing e-government services to state-specific needs fosters transparency and accountability and enhances citizen engagement and satisfaction with public services. Ultimately, improving the quality of e-government services can enhance public trust.

Additionally, the study emphasizes the need to promote digital literacy initiatives in facilitating democratic e-governance. Recognizing that neglecting digital literacy could marginalize certain segments of the population, this study advocates for tailored programs, including educational campaigns, training workshops, and user support systems. For example, the mandate in New Jersey requiring a K–12 digital literacy course stands as a proactive step in countering misinformation and nurturing proficient digital citizens (Burney, 2023). This initiative sets a positive precedent for advancing e-governance in the US (Sitrin, 2023), establishing a strong legal framework for a digitally literate populace. Moreover, providing accessible digital learning courses for less tech-savvy groups, such as senior residents encountering challenges with e-government services, is crucial. Prioritizing long-term digital inclusion programs is pivotal to realize the benefits of e-government and enhancing government-citizen connectivity.

Furthermore, prioritizing digital literacy can bolster social capital and civic engagement, reflecting its broader societal implications on promoting informed and active citizenship (Li & Li, 2022). Encouraging digitally literate citizens to participate in online political discourse and community engagement fosters transparent governance and builds trust in government. Effectiveness digital inclusion programs can also mitigate risks related to misinformation and disinformation in e-governance (Mihailidis & Viotty, 2017), as digitally literate individuals are more adept at critically evaluating the credibility and reliability of online information.

### Limitations and future research directions

While this study provides insightful perspectives on the interplay between e-government, government performance and public trust, several limitations call for further investigation. First, it primarily focuses on e-government effectiveness at the state level, leaving unanswered questions about its implications at the local and federal levels. Future research should explore these dynamics across various governance tiers.

Another limitation concerns about the methodology. While using OLS regression methods, we can identify relationship between variables, these do not necessarily indicate causation and may overlook more complex, potentially non-linear, interactions. Additionally, the survey data are subject to measurement errors, often due to the issue construct validity and reliability issues and the incorrect self-reporting bias, which can lead to inconsistent and inaccurate OLS estimates. Also, although we incorporated a marker variable to mitigate common method bias, this approach is not foolproof; the marker variable may not account for all sources of common method variance. Moreover, the subjective measurement of digital literacy, which may not fully capture individuals' actual proficiency in utilizing digital technologies. Further studies should consider using standardized metrics or performance-based evaluations to ensure a more accurate assessment.

Building on our discussions, further exploration is necessary to understand how digital literacy influences the perception of e-government effectiveness, which can guide more targeted

interventions for digital literacy and e-government initiatives. Also, future research could investigate the role of social capital in shaping the adoption and perception of e-government services. This will offer insights into societal dynamics in the digital era. Finally, considering the ever-evolving technological landscape, future research should explore how emerging technologies such as artificial intelligence and virtual reality impact the e-government-trust relationship in the context of citizens' digital literacy. This will inform more effective and inclusive e-government strategies, preparing for fast-changing innovations in the public sector.

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