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Enhancing Election Trust Through Technology Understanding: A Survey Experiment on Technical Education and Technology Readiness

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Abstract

Public confidence in election administration can be damaged by unsupported fraud claims, yet factual corrections often have limited effects. This survey experiment tested whether a brief, nonpartisan explanation of hashing and digital signatures changed technology readiness or confidence in election technology. A commercial online panel of 507 U.S. adults completed a pretest and post-test in September 2025; Qualtrics assigned 255 participants to a survey-only control condition and 252 to the technical-education condition. The primary analysis compared individual change scores between conditions. The intervention did not significantly improve election confidence (between-condition change difference = 0.09, unadjusted p = .105). It produced a small improvement in overall Technology Readiness Index scores (change difference = 0.15; approximately 95% CI [0.05, 0.25]; Holm-adjusted p = .018) and adjusted-significant gains in optimism and innovativeness. The insecurity contrast did not remain significant after correction for six outcomes. Because the study included no knowledge check, used a nonprobability sample, and showed an age imbalance across conditions, the findings support only a cautious conclusion: brief technical instruction may shift general readiness toward election technology, but this study does not show that it increases election confidence or that technical understanding caused the change.

Keywords: election trust, technology readiness, election security, technical education, hashing, digital signatures

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1. INTRODUCTION

Confidence in election administration is a consequential democratic attitude, but it is vulnerable to political messages and unsupported claims of fraud. Survey experiments show that exposure to unsubstantiated fraud allegations reduces perceived electoral integrity, especially among people for whom the allegation is politically congenial, and that conventional corrective messages may not fully repair the damage (Berlinski et al., 2023). Elite rhetoric can also weaken acceptance of democratic norms even when citizens receive no new evidence about actual election performance (Clayton et al., 2021).

Election confidence is shaped by more than technical facts. Voters respond to administrative experience, poll-worker performance, partisanship, and elite cues (Atkeson & Saunders, 2007; Hall et al., 2009). At the same time, modern election systems rely on technical mechanisms that are difficult for nonexperts to evaluate. Hashes can reveal whether a digital artifact has changed, and digital signatures can help authenticate its source and integrity. These mechanisms are not substitutes for paper records, audits, chain-of-custody controls, or transparent administration, but understandable explanations may reduce general unease about the technologies used in election processes.

The present study evaluates a brief educational intervention about hashing and digital signatures. The revision distinguishes two outcomes that the original manuscript treated too similarly: technology readiness, a broad disposition toward technology, and election confidence, a judgment about a specific institutional application. It also treats ideology descriptively, corrects the direction of the inhibitor subscales, and moderates all causal and practical claims to match the available evidence.

2. LITERATURE REVIEW AND RESEARCH QUESTIONS

2.1 Election Confidence and Corrective Messages

Research on election confidence consistently indicates that administrative quality and political context both matter. Local election administration and voter experience are associated with confidence judgments (Atkeson & Saunders, 2007), and interactions with poll workers can shape citizens' evaluations of election quality (Hall et al., 2009). More recent experimental evidence is especially sobering: unsupported voter-fraud claims reduce confidence, while corrective messages from mainstream sources do not necessarily reverse the loss (Berlinski et al., 2023). The implication is that one brief informational treatment should not be expected to overcome institutional, experiential, and partisan determinants of confidence.

2.2 Misinformation Correction and Educational Interventions

The broader correction literature finds that fact-checking usually improves factual accuracy, but effects vary by message, source, and audience and do not always carry over to durable attitudes or behavior (Ecker et al., 2022; Walter et al., 2020). Digital media literacy interventions can improve discernment between mainstream and false news (Guess et al., 2020), and large-scale reviews find little support for a general backfire effect (Nyhan et al., 2020; Wood & Porter, 2019). These findings justify testing education while cautioning against assuming that receiving information is equivalent to learning it or trusting the institution that uses the technology.

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v12 n6844

2.3 Technical Understanding, Technology Readiness, and the Study Gap

The Technology Readiness Index (TRI) measures a person's general propensity to embrace technology through two drivers - optimism and innovativeness - and two inhibitors - discomfort and insecurity (Parasuraman, 2000; Parasuraman & Colby, 2015). TRI is appropriate here because a technical explanation could change generalized comfort with technology even when it does not change a judgment about election integrity. Election confidence is therefore a distinct outcome, not a synonym for readiness. Election-security scholarship explains how cryptographic evidence can support verifiability (Bernhard et al., 2017), but the literature reviewed for this paper does not identify a randomized public-education test focused narrowly on hashing and digital signatures. That gap motivates the present experiment.

2.4 Research Questions

RQ1. Does brief technical instruction produce a larger pretest-to-post-test increase in overall TRI than a survey-only control condition?

RQ2. Which TRI subscales, if any, differ between conditions after adjustment for testing six outcomes?

RQ3. Does the intervention increase confidence in election technology relative to the control condition?

RQ4. What descriptive patterns, if any, appear across self-reported ideological groups? This question is exploratory and is not a test of ideological moderation.

3. METHOD

3.1 Design and Intervention

The study used a randomized pretest-post-test control-group design in Qualtrics. Participants were assigned with approximately equal probability to a control condition (pretest and post-test only) or an experimental condition (pretest, five-paragraph educational reading, and post-test). Both groups received the same outcome items at both measurement points. The treatment explained the purpose and limitations of hashing and digital signatures and described how those mechanisms can support evidence about software and data integrity. Appendix A provides the publication-ready intervention text corresponding to the five content blocks.

3.2 Recruitment, Eligibility, Randomization, and Data Quality

A commercial online panel provider recruited adult U.S. residents in September 2025. The panel was not a probability sample, no population weights were applied, and no claim of national representativeness is made. Qualtrics Survey Flow implemented the condition assignment. The archived analytic record retained responses marked Finished = True with Progress = 100%. Incomplete responses were excluded; no additional exclusions for speed, attention checks, or response-pattern quality were documented or applied. The final sample included 507 participants: 255 control and 252 experimental.

The archived conference materials did not include an institution-specific ethics determination, consent language, or protocol number; consequently, those details cannot be verified or reported here. A future preregistered replication will archive the ethics determination and consent materials together with recruitment-vendor specifications, quality-control rules, and analysis code.

3.3 Measures and Scoring

TRI was measured with 16 seven-point agreement items based on TRI 2.0 (1 = strongly disagree; 7 = strongly agree). Four items measured each of optimism, innovativeness, discomfort, and insecurity. Following the TRI framework, discomfort and insecurity were reverse-scored as 8 minus the original response before calculating readiness scores. Subscales were the mean of their four items, and overall TRI was the mean of the four subscale scores. Thus, every TRI result in this revision has one direction: higher values indicate greater readiness. Appendix B provides item-domain descriptors and the complete scoring rules.

ISSN: 2473-4901
v12 n6844

Election confidence was measured at pretest and post-test with one five-point item: "How confident are you that election technology can ensure a fair and secure voting process?" Higher values indicated greater confidence. The survey did not include a knowledge check; consequently, change in TRI cannot be attributed specifically to learning or technical understanding.

3.4 Analytic Strategy

The primary estimand was the between-condition difference in individual change scores (post-test minus pretest). This approach was selected because it directly represents whether participants changed more in the treatment condition and subtracts each participant's baseline score. Independent-samples t tests compared change scores, and paired t tests summarized change within each condition. Because six outcomes were tested, Holm-adjusted p values are reported for the between-condition family. Approximate 95% confidence intervals were reconstructed from the reported change differences and t statistics; the discomfort interval also uses the within-group standard error because the reported contrast rounded to 0.00.

Change-score analysis is transparent but may be less efficient than post-test analysis of covariance (ANCOVA), especially when baseline precision is high. The observed age imbalance also favors a baseline-adjusted and age-adjusted robustness model. A full ANCOVA or condition-by-time model requires the participant-level data and is deferred to a future full-length analysis. Accordingly, this conference paper treats the present estimates as preliminary and does not use the descriptive ideology pattern as evidence of moderation.

4. RESULTS

4.1 Sample Characteristics and Balance

Table 1 reports selected sample characteristics. The sample was older and more highly educated than the U.S. adult population, and the control condition included 13.3 percentage points more participants aged 65 or older than the experimental condition. This imbalance is substantively important because age may relate to both technology readiness and election attitudes. Gender composition was nearly identical across conditions. Party categories shown in the archived table are not exhaustive.

Characteristic	Control (N = 255)	Experiment (N = 252)	Total (N = 507)
Age: 65 or older	48.2%	34.9%	41.6%
Age: 35-64	38.4%	49.2%	43.8%
Age: 18-34	13.3%	15.5%	14.4%
Gender: female	51.4%	51.6%	51.5%
Education: bachelor's or higher	59.2%	53.2%	56.2%
Party: Democrat	18.0%	20.6%	19.3%
Party: Republican	12.5%	14.7%	13.6%
Party: Independent	17.6%	17.5%	17.5%

Table 1. Selected Demographic Characteristics of the Analytic Sample

4.2 Reliability and Primary Outcome Tests

Internal consistency was good to excellent for all TRI subscales (Table 2). In the experimental condition, overall TRI increased from 4.36 to 4.53 (mean change = 0.17, paired $p < .001$, standardized within-condition change $d = 0.15$). Election confidence did not increase: it changed from 4.25 to 4.23 in the experimental condition (mean change = -0.02, $p = .610$) and from 4.32 to 4.21 in the control condition (mean change = -0.11, $p = .004$). The between-condition election-confidence contrast was not statistically significant.

 ISSN: 2473-4901
v12 n6844

Subscale	Items	Cronbach's alpha	Interpretation
TRI optimism	1-4	.916	Excellent
TRI innovativeness	5-8	.876	Good
TRI discomfort	9-12	.852	Good
TRI insecurity	13-16	.899	Good

Table 2. Internal Reliability of Technology Readiness Subscales

Table 3 presents every control and experimental change score in the common readiness direction. After Holm adjustment, overall TRI, optimism, and innovativeness remained statistically significant. The insecurity contrast was positive after reverse-scoring but did not survive familywise adjustment (adjusted p = .126). Discomfort and election confidence did not differ between conditions. These results answer RQ1 with a small positive effect, RQ2 with adjusted evidence for two driver subscales but not the inhibitor subscales, and RQ3 with no evidence of increased election confidence.

Outcome	Control change	Experiment change	Difference	Approx. 95% CI	Raw p	Holm p
Election confidence	-0.11	-0.02	+0.09	[-0.02, 0.20]	.105	.210
TRI overall	+0.02	+0.17	+0.15	[0.05, 0.25]	.003	.018
TRI optimism	-0.05	+0.19	+0.24	[0.08, 0.40]	.003	.018
TRI innovativeness	-0.04	+0.19	+0.23	[0.08, 0.38]	.003	.018
TRI insecurity	+0.08	+0.24	+0.17	[0.01, 0.33]	.042	.126
TRI discomfort	+0.06	+0.06	0.00	[-0.18, 0.18]	.995	.995

Table 3. Between-Condition Comparisons of Pretest-to-Post-Test Change Scores
Note. Difference = experimental change minus control change. Discomfort and insecurity are reverse-scored; positive values indicate greater readiness. Confidence intervals are approximate reconstructions from rounded summary statistics. Holm p values adjust the six between-condition tests.

4.3 Exploratory Ideological Description

Within the experimental condition, mean TRI change varied non-monotonically across ideological categories: very liberal = 0.01, liberal = 0.31, slightly liberal = 0.21, moderate = 0.09, slightly conservative = 0.09, conservative = 0.33, and very conservative = 0.25. The archived summary did not include subgroup cell sizes, standard errors, or a condition-by-ideology interaction. The pattern is therefore descriptive only. It does not establish that conservative participants were more receptive to correction or that ideology moderated the intervention.

5. DISCUSSION

5.1 Interpretation and Practical Implications

The brief technical reading produced a small improvement in overall technology readiness relative to the control condition, with adjusted-significant contrasts for optimism and innovativeness. It did not increase confidence in election technology. The distinction matters: a participant can become somewhat more positive about technology in general without changing a judgment about whether election institutions and procedures are trustworthy. This result is consistent with research showing that election confidence reflects political cues and administrative experience as well as factual information.

The results offer limited support for technical education as one component of public communication, not as a standalone trust-restoration strategy. Election administrators and information-systems educators can explain hashing and digital signatures while emphasizing their limits and their relationship to paper records, audits, physical controls, and transparent procedures. The present evidence does not justify claiming that the intervention increased technical knowledge, reduced susceptibility to misinformation, or improved confidence.

ISSN: 2473-4901
v12 n6844

5.2 Limitations and Future Research

Several limitations constrain inference. First, the nonprobability panel was older and more highly educated than the U.S. adult population, no weights were used, and age was imbalanced across conditions. Second, the study measured election confidence with one item and did not measure actual knowledge, reading completion, long-term retention, or behavior. Third, the immediate post-test cannot establish durability. Fourth, the change-score analysis does not replace a participant-level ANCOVA or condition-by-time model, and the ideological summary lacks interaction tests and uncertainty estimates.

Future research should preregister the intervention and outcomes; archive the exact survey, randomization, ethics determination, exclusion rules, code, and deidentified data; include a knowledge check and multi-item confidence scale; and collect a delayed post-test. A full-length analysis should estimate baseline- and age-adjusted treatment effects, report robust confidence intervals, and test ideology interactions with adequate subgroup sizes. Comparing technical instruction with administrative transparency, audit education, and prebunking messages would also clarify which combinations affect knowledge, readiness, and confidence.

6. CONCLUSION

A five-paragraph explanation of hashing and digital signatures was associated with a small relative increase in technology readiness, especially its optimism and innovativeness dimensions, but it did not increase confidence in election technology. This conference study therefore supports a narrow conclusion: accessible technical education may influence general readiness, while confidence in elections likely requires broader evidence about administration, auditing, and institutional performance. Stronger claims await a preregistered replication with knowledge measures, balanced sampling, delayed outcomes, and participant-level adjusted models.

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v12 n6844

APPENDIX A

Educational Intervention

Election systems use several layers of evidence and control. No single technology can prove that an entire election was administered correctly. Technical tools can, however, help officials and observers detect whether particular digital files changed and verify who produced or approved them. These tools work best alongside paper records, physical security, chain-of-custody documentation, testing, and post-election audits.

A cryptographic hash converts digital information into a fixed-length value sometimes described as a digital fingerprint. If even a small part of the underlying file changes, a secure hash function produces a different value. Comparing a published hash with a newly calculated hash can therefore reveal that software, configuration files, or exported data are not identical to the version previously checked.

In election administration, hash comparisons can support evidence about software versions and stored records. A matching hash shows that two digital objects are the same at the time of comparison; it does not show that the original object was accurate, that a machine was configured correctly, or that procedures were followed. Human review and independent auditing remain necessary.

A digital signature uses a private key to sign digital information and a related public key to verify the signature. Successful verification provides evidence that the signed material came from the holder of the private key and was not altered after signing. Digital signatures can help authenticate software releases, reports, and transmitted records when keys are securely managed.

Hashing and digital signatures strengthen integrity and authentication, but they do not eliminate every threat. Compromised keys, incorrect source data, poor procedures, or insecure hardware can still create risk. Trustworthy elections therefore combine technical verification with voter-verifiable records, bipartisan observation, access controls, audits, clear public explanations, and transparent correction of errors.

APPENDIX B

Measurement Domains and Scoring Rules

1. Optimism
(Positive feelings about new voting technology)
1. I think voting technology can make voting easier and faster for everyone.
2. Voting technology could make elections more fair and open.
3. I believe voting technology can help people trust the results more.
4. New voting technology might help avoid mistakes in counting votes.

2. Innovativeness
(Being open to trying new voting technology)
1. I would like to try new ways to vote before everyone else.
2. I enjoy learning about online or other new voting methods.
3. I am okay with trying new ways to vote.
4. I think people should use updated voting technology in future elections.

3. Discomfort
(Feeling uneasy about using new voting technology)
1. I worry that voting technology might have problems on Election Day.
2. I think some people may find voting technology hard to use.
3. I am concerned that technology could cause more mistakes than paper voting.
4. It makes me nervous to rely on technology to count votes correctly.

4. Insecurity
(Worries about safety and privacy in voting technology)
1. I worry that my vote could be changed when using online or digital voting.
2. I am concerned that hackers could mess with election results if we use voting technology.

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v12 n6844

3. I feel nervous that my personal information isn’t safe with online voting.
4. I believe paper voting is safer than digital voting for keeping elections secure.