

## The Impacts of the Digital Divide on Citizens' Intentions to Use Internet Voting

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**Abstract** – Internet voting is increasingly used by governments and corporations as a means for individuals to cast their votes. However, not everyone has access to and is comfortable with the use of technology. This digital divide is composed of the access divide and the skills divide. This study explores the impact of the digital divide on Internet voting (I-voting). We propose a model of the effects of the digital divide on I-voting, which suggests that age, income, education and frequency of Internet use have an impact on I-voting utilization. Online and paper-based surveys were administered to a large sample of citizens of varied backgrounds to test the model. The results of multiple linear regressions indicate that age, income, and Internet use (representing the access and skills divide) have a significant impact on Internet voting. Education was not found to be significant. These findings indicate that, like other e-government services, I-voting is subject to the barriers associated with the digital divide, and this digital divide introduces several challenges to government agencies.

**Keywords:** *Internet voting, digital divide, technology adoption, e-services, access divide, skills divide*

### I. INTRODUCTION

This paper explores the impact of the digital divide on Internet voting [1]. Voting is an important democratic right, and voter turnout is vital to the health of all democracies. A key element of a democracy is the continuing responsiveness of the government to the preferences of its citizens. Turnout rates in U.S. presidential elections (which are the most popular in that country) vary between 50 and 60 percent, with winners never receiving more than 60 percent of the turnout. Hence, presidents are selected by the votes of 25 to 30 percent of the electorate [2]. In fact, the United States ranks at the bottom, or just above last place, in voter involvement when compared to other democratic nations [3]. Research suggests Internet voting could increase voter participation [4]. Internet voting, or I-voting, is defined as “an election system that uses encryption to allow a voter to transmit his or her secure and secret ballot over the Internet [5, p. 2].” Researchers suggest that I-voting has the potential to increase “turnout” among individuals between

the ages of 18-25 since they have experience in surfing the Internet and like the idea of using the latest technology [6]. Morris [7] agrees that the Internet has the potential to mobilize the otherwise disenfranchised voters under the age of thirty-five.

I-voting would be an ideal option for many citizens. Done [4] argues that one of the most important social impacts of Internet voting is the effect it could have on voter participation. A survey conducted at the University of Arizona suggests that 62 percent of the unregistered voting age population would register to vote on the Internet. The survey results also suggest that Internet voting would increase voter participation by about 42 percent while conserving costly resources. These increases would be realized across all sex, age, ethnicity, and education groups [4].

Many countries have conducted research on or experimented with Internet voting [8]. In the Netherlands, 62% of the people with access to the Internet would prefer to vote online [9]. In New Zealand, a taskforce concluded that Internet technology might boost the number of voters, speed the count, and reduce costs. In Japan, the Center for Political Public Relations experimented with poll site Internet voting in the 2001 gubernatorial election in Hiroshima. In 2005, Estonia was the first country to offer Internet-voting as an option nationwide for mayors and city councilors [10].

In the United States, the 2000 Arizona Democratic primary offered the first binding Internet election for public office [4, 11, 12]. In 2008, Okaloosa County in Florida allowed hundreds of military personnel in Germany, Japan and the United Kingdom to cast their votes in the presidential election [13]. Despite the gradual implementation of I-voting and its potential to increase participation, some citizens may not benefit from this innovation due to the digital divide.

The paper explores the relationship between the digital divide and I-voting. Whereas one can argue that I-voting offers simply another electronic service, voting is a fundamental right in democratic societies, available to all

citizens, irrespective of their income, education or social status (within legal limits).

The paper is organized as follows. First, we discuss the issues of the digital divide to provide background for the development of the research model and the hypotheses. The methodology section describes the research conducted. The next section presents the results and their implications for research and practice.

## II. THE ISSUE OF THE DIGITAL DIVIDE

As governments worldwide begin to implement more technology-based voting systems, in particular Internet voting, concerns about the potential impacts of the digital divide continue to grow. The digital divide refers to the distinction between the information haves and have-nots; the gap between the computer literate and the computer illiterate. Researchers have been interested in the digital divide from a variety of perspectives, including a demographic view [14-16], a global view divide [17], an urban view [18, 19], and a psychosocial view of the digital divide [20].

The digital divide is composed of two major barriers: access to technology and comfort with technology [21]. Both of these barriers may play a role in limiting the use and convenience of Internet voting. Not surprisingly, researchers have found that demographically, citizens who use the Internet for political purposes differ from the rest of the population, particularly in terms of income and education [22]. It could be because education and income increase the likelihood of openness toward Internet voting [4]; it could also be due to the digital divide barriers of access and skills. We discuss each of these digital divide barriers before presenting the research model in the remainder of this section.

### A. The Access Divide

The access divide refers to factors that may limit an individual's access to technology that can be used, in this case for Internet voting. Prior research has identified ethnicity, income, age and education as significant predictors of access to technology [23, 24]. A more recent study finds that income, education and age significantly impact who is willing to use e-government services such as electronic tax filing or license renewals [21]. This is not surprising since other researchers have found that approximately 78 percent of households with income between \$50,000 and \$75,000 had Internet access compared to only 40 percent of those with household incomes between \$20,000 and \$25,000. Others find that young citizens (18-24) and their parents (45-54) report the highest levels of home Internet access, reaching better than 61 percent [25]. Research also shows that more younger Americans have an Internet connection than older Americans [6]. Thomas and Streib [24] suggest that among Internet users, ethnicity and education are important predictors of government Web sites utilization, with white

and better educated users more likely to be uses such sites [24]. Interestingly, gender differences in access and use of computers has narrowed over the years, with recent research suggesting that it does not impact use of e-government services [21]. This is consistent with findings from the Pew Internet Project report, which suggests that although men and women have different attitudes toward technology, the surge in the number of women online has eliminated some of the disparity in access between genders [26].

### B. The Skills Divide

In addition to Internet access, comfort with Internet technology is also a major element of the digital divide. The skills divide refers to a disparity in skills necessary to effectively interact with online systems [23]. Other researchers call this the second order digital divide [27]. Mossenburg, Tolbert, and Stansbury [23] identify two components of this skill divide: technical competence and information literacy [23]. Technical competencies are "the skills needed to operate hardware and software, such as typing, using a mouse, and giving instructions to the computer to sort records a certain way". Information literacy is "the ability to recognize when information can solve a problem or fill a need and to effectively employ information resources." Researchers have found that the old, less-educated, poor and minority individuals (African Americans and Latinos) were more likely to need computer assistance (such as help using the mouse and keyboard, using e-mail, or using word processing and spreadsheet programs), although recent studies show some of the differences disappearing after a year or two of use [28]. It is also possible that as new user interfaces such as multi-touch screens and touch screens become more popular, skills require to use the computers will become less of an issue. Nevertheless, comprehension of the navigation, applications, and resulting information will still be required for completing digital tasks.

In this study, we use frequency of Internet use in general as a proxy measure of technical competence and information literacy. The use of this proxy is consistent with Belanger and Carter [29]. Citizens who use the Internet frequently should possess a level of technical and information literacy.

### C. The Research Model

In summary, differentials in age, income, education, and Internet usage, seem to create a digital divide that should affect which individuals will choose to use Internet voting as a means of performing their constitutional right. Figure 1 summarizes the access and skills divide factors that are expected to affect one's intention to use I-voting.

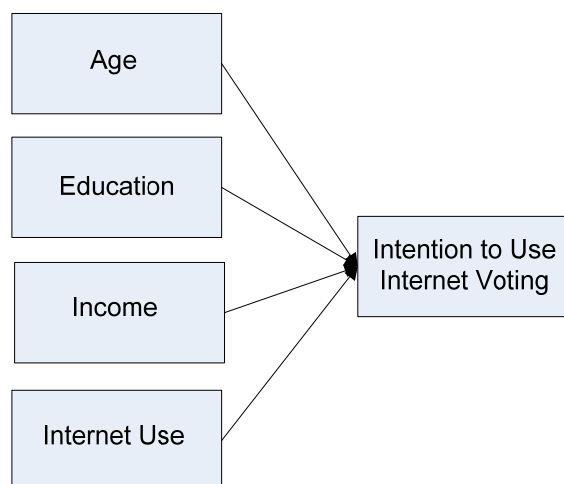


Figure 1. I-Voting Digital Divide Factors

As depicted in the model, there are four hypothesized relationships:

*H1: Age will have a negative impact on intention to use Internet Voting.*

As discussed before, a larger number of younger adults tend to have Internet access than older citizens. Since Internet access is a condition for I-voting, it can therefore be expected that there is negative relationship between age and I-voting intentions. Furthermore, since younger adults also tend to have more computer skills than older adults do, it further reinforces the negative relationship between age and I-voting intentions.

*H2: Education will have a positive impact on intention to use Internet Voting.*

Education is closely linked in two ways to the relationship between the digital divide and I-voting intentions. First, individuals with higher education tend to have more computer and Internet skills, as previously discussed. As a result, it is expected that education has a positive relationship with I-voting intentions. Of note, education can also impact I-voting intentions through the higher income that highly educated individuals tend to have. For the sake of parsimony and simplicity, our model does not test the potential mediating effect of income between education and I-voting intentions. Nevertheless, this potential relationship would also involve a positive link between education and I-voting intentions.

*H3: Income will have a positive impact on intention to use Internet Voting.*

As prior research suggests, individuals with higher income tend to have more access to the Internet (and other

technologies). They also tend to have more education, and potentially computer skills. As a result, it is expected that income is positively related to I-voting intentions.

*H4: Experience using the Internet will have a positive impact on intention to use Internet Voting.*

Because individuals who have used the Internet for a longer period of time are expected to be familiar with the terminology, tools, and features of the Internet, it is expected that their skills will easily translate to the use of the Internet for voting. As a result, we expect that Internet experience is positively related to I-voting intentions. We discuss in the next section the methodology used to test the research model and hypotheses.

### III. METHODOLOGY

#### A. Overview

To identify the salient I-voting divide factors, we surveyed a diverse pool of citizens. Both online and paper-based versions of the resulting instrument were administered to participants. There were various sources of data collection for each version. The paper version of the survey was administered to members of a church choir, students in a religious seminary class, attendees of a symphony concert, and employees in a county agency. The online version was posted on a local website, disseminated through a graduate student listserv at a university, and sent to the listserv of a community fitness group. 372 surveys were used for data analysis: 133 paper responses and 239 online responses.

An independent samples t-test was used to identify any differences between online and paper responses. Since the two groups did not exhibit differences for the dependent variable - intention to use an I-voting system - a combined sample was used in the data analyses.

#### B. Instrument Items

Each I-voting divide factor was measured using categorical data on the survey instrument, except for age, which was measured by respondent writing their actual age. Five age categories were then used to classify the data: 18-24 years, 25-29 years, 30-44 years, 45-54 years, and 55 years and older. Education was measured using four categories (Grade school/some high school, High-school Diploma (or equivalence), Some college: no degree, and College degree/post graduate). Income was measured using seven categories (Less than US\$20,000, US\$20,000 - US\$34,999, US\$35,000 - US\$49,999, US\$50,000 - US\$74,999, US\$75,000 - US\$99,999, US\$100,000 - US\$149,999, and US\$150,000 and above). Internet usage was measured using four categories representing the number of years a citizen has been using the Internet (0-3 years; 3-6 years; 6-9 years; 10 years or more). Finally intentions to use I-voting (USE) was measured using four items adapted from a study of e-government [29], which

used a seven-point Likert-type scale (from strongly disagree to strongly agree).

C. Sample Demographics

Regarding sample demographics, the age range of participants is 18 to 75 years with an average of 33 years (see Table 1). Most participants (78%) have a college degree, and the reported income range is well distributed. Forty-four (44) percent of the sample makes US\$50,000 or more a year.

TABLE 1. AGE DISTRIBUTION

Age Category	Frequency	Percent	Cumulative %
18-24 years	92	24.7	24.7
25-29 years	71	19.1	43.8
30-44 years	104	28.0	71.8
45-54 years	57	15.3	87.1
55 years and older	48	12.9	100

In addition to the demographics mentioned above, general information about the participants was collected. The sample was 63% female. A majority of the subjects were Caucasian (64%). African-Americans accounted for 26% of the sample and Hispanic, Asian and Native Americans accounted for seven percent of the sample. The remaining three percent of the subjects did not report ethnicity. In terms of access to and experience with the Internet, most participants reported high levels, with the exception of having used e-government services, where only 70% of respondents indicated having done so, as can be seen in Table 2.

TABLE 2. INTERNET AND WEB EXPERIENCE. PERCENTAGE OF RESPONDENTS WHO...

...have access to the Web at home	91%
...used the Web to make a purchase	90%
...had used the Web to complete a government transaction.	70%
...voted in the 2004 presidential election	82%

IV. RESULTS

Multiple regression analysis was used for hypothesis testing. Prior to testing the hypotheses, assumptions of multivariate normal distribution, independence of errors, and equality of variance were tested. The USE variable was slightly skewed with a mean of 4.78. Pearson correlation coefficients revealed low correlations among variables, except for age and income with a correlation of 0.48. Variance inflation factors (VIF) confirmed that multicollinearity was not a concern with this data set (VIF range from 1.11 to 1.29). Outlier influential observations were identified with leverage and studentized residuals. This analysis indicated that thirteen data points were considered outliers. They were removed for data analysis. There were no violations of the other assumptions.

A. Model Testing

The regression analysis results in a model with an F-value of 9.344, resulting in a p-value of  $p < 0.0001$ , which indicates that at least one of the coefficients corresponding to an independent variable is not equal to zero. The r-square value was 9.5 %, indicating that digital divide factors identified in this research account for nine and a half percent of the variance in intentions to use I-voting. This is important because this is the variance explained on top of what typical adoption factors from theories such as the Technology Acceptance Model (TAM) or the Unified Theory of Acceptance and Use of Technology (UTAUT) should account for.

B. Hypothesis Testing

Since the model is significant, the individual beta coefficient t-tests can be used to identify which digital divide factors are significant. Table 3 shows the results of the hypothesis testing analyses.

TABLE 3. HYPOTHESIS TESTING RESULTS

Hypothesis	Beta	P-value	Support?
H1: Age → I-voting Intentions	-0.271	<0.0001	Yes
H2: Education → I-voting Intentions	0.056	0.301	No
H3: Income → I-voting Intentions	0.211	<0.001	Yes
H4: Internet Usage → I-voting Intentions	0.142	0.008	Yes

Results from Table 3 indicate that age, income, and Internet usage are significant predictors of I-voting intentions. Figure 2 shows the significant results, which are further describes and discussed in the next section.

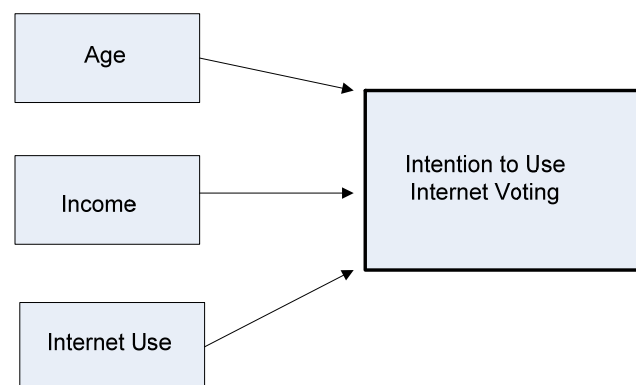


Figure 2. I-Voting Significant Factors

V. DISCUSSION

This study explored how the digital divide impacts citizens' intentions to use Internet voting. The overall result of the study is that there is indeed an impact of the digital divide. More specifically, the levels of income, the age of citizens, and their level of Internet use impact their intentions to use I-voting.

Before we discuss the results and their implications in this section, we need to acknowledge some limitations to the study. One of the primary limitations was the sample's lack of variance in education. The participants in this study are highly educated. Seventy-eight percent have a college degree. Future studies should test a sample with more variance in education. Lyons and Alexander [30] found that education beyond high-school increases the likelihood of voting by almost 15%. Alvarez and Hall [6] found that individuals who have attended college are approximately two times more likely to vote than individuals without a high school education. These findings illustrate the importance of obtaining responses from people with diverse educational backgrounds. The demographic characteristics of this sample may account for education not having a significant impact in this study. Future studies should seek to collect data from individuals with diverse educational backgrounds; an ideal sample could include those who have a high school diploma and those who do not.

An additional limitation of the sample is the lack of variance in ethnicity with only a few Asian, native American, or Hispanic respondents. As such, the sample is not truly representative of the American population in general. However, to avoid any potential lack of representativeness issues, we did not include or test ethnicity as a digital divide factor.

#### A. Significant Results: Age, Income, and Internet Use

The results of the regression analysis indicate that age, income, and Internet usage are significant elements of the I-voting divide. Younger citizens, individuals with higher income levels, and individuals with more experience using the Internet are more likely to use Internet voting. These findings indicate that, like other e-government services, I-voting is also subject to the barriers associated with the digital divide. In other words, both the access divide (impacted by income and age) and the skills divide (impacted by age and Internet usage) affect I-voting intentions.

As hypothesized, age has a negative relationship with I-voting intentions. In general, this means that younger individuals are more likely to vote using the Internet. There are several potential reasons for this. First, they may have more readily access to the Internet via school, their parents' computers and networks, or even friends' networks. Older citizens are not only less likely to have access to the Internet, but also less likely to possess the computer skills necessary to take advantage of Internet voting. In a post hoc analysis, we show the means of I-voting intentions across age categories in Table 4. To eliminate potential bias, we only used observations from registered voters for this analysis. As can be seen from the table, there is a steady decline in I-voting intentions means as age increases.

TABLE 4. I-VOTING INTENTIONS BY AGE FOR REGISTERED VOTERS

Age Category	n	I-voting means	I-voting St. Dev.
18-24 years	80	5.22	1.65
25-29 years	55	5.16	1.78
30-44 years	98	5.11	1.68
45-54 years	57	4.38	1.96
55 years and older	47	4.29	2.20
	325	4.90	1.85

Since one of the arguments often heard is that I-voting could increase voter participation among younger adults, we identified registered voters who voted on the 2004 United States Presidential election by age category in Table 5.

TABLE 5. LAST PRESIDENTIAL ELECTION VOTING BEHAVIOR BY AGE FOR REGISTERED VOTERS

Age Category	n	Voted	Did not vote	% Did not vote
18-24 years	80	65	15	18.8 %
25-29 years	52	48	4	7.7 %
30-44 years	91	88	3	3.3%
45-54 years	56	55	3	5.4%
55 years and older	46	45	1	0.1%
	325	299	26	8.0%

As can be seen, the results are extremely revealing in that the younger adults are by far less likely to have voted in the last election. Even taking out a portion of the respondents who were not old enough to vote in the last election, there remains a large portion of these younger adults who did not vote. Yet, these same younger adults state they would use the Internet to vote. It is possible, therefore, that I-voting would indeed increase voter participation among younger adults.

Income is positively related to intentions to use I-voting. Citizens with higher income levels are more likely to have access to the technology necessary to take advantage of Internet voting. While the regression analysis identifies a general relationship between these constructs, a closer look at the distribution of I-voting use intentions per income category, presented in Table 6, reveals a more complex situation.

TABLE 6. I-VOTING INTENTIONS BY INCOME LEVELS

Income Category	n	I-voting means	I-voting St. Dev.
Less than US\$20,000	89	4.91	1.79
US\$20,000 - US\$34,999	63	4.55	1.97
US\$35,000 - US\$49,999	53	4.51	1.88
US\$50,000 - US\$74,999	62	5.25	1.86
US\$75,000 - US\$99,999	51	5.35	1.62
US\$100,000 - US\$149,999	31	5.05	1.89
US\$150,000 and above	10	4.95	1.26
	359	4.92	1.84

As can be seen from the data in the table, it is true that lower income individuals show fewer intentions to vote using the Internet than higher income levels, except that the relationship does not seem to be linearly constant across categories of income. There are several possible explanations. First, our income categories are probably too granular, with the effects of the digital divide finding its way into lower than US\$ 50,000 versus higher than US\$50,000. There also appears to be a lower intention to vote using the Internet when income levels are in the very high (greater than US\$150,000) category. It is possible that there is a bell shape (curvilinear) relationship between income and I-voting intentions. It is also possible that these results are simply due to the unequal distribution of responses in our sample. Future research should further explore these possibilities.

Finally, experience using the Internet has a positive impact on intentions to use I-voting. Regular use of the Internet translates into an affinity towards Internet voting. These findings support prior suggestions that I-voting will be more appealing to citizens who use the Internet regularly [31]. In the literature review, we discussed how experience using the Internet is one factor that may reduce the skills divide. However, since voting is such an important civil act, we believe that prior e-government usage might also be an important predictor of intentions to use I-voting. This would be consistent with prior findings in e-commerce where Schaup and Carter [32] found that prior use of an e-commerce or e-government service is positively related to intention to use an I-voting system. To verify this possibility, we ran a post hoc analysis on the effects of e-government usage, of which two measures were available in our dataset, on intentions to use I-voting. One of these variables is whether individuals have used a government website to collect information (EgovInfo), and the other is whether an individual has used a government website to conduct a transaction (EgovTrans). While the EgovInfo variable proved to be non significant, the prior use of a government website to conduct a transaction (EgovTrans) was highly significant with a p value of 0.003. In this study, 70 percent of the sample has completed a government transaction online and 90% has purchased a product or service online. Participants in this study have adopted e-service initiatives in both the public and private sector. As suggested by the literature, citizens who have adopted other e-services are more likely to adopt I-voting.

Even with these results, it is possible that online voting will introduce unique concerns, even among frequent Internet users. Future studies should explore the impact of concepts such as Internet trust and Internet self-efficacy on I-voting acceptance. Future studies should also explore the impact of technology adoption variables on intention to use Internet voting. Perhaps, constructs such as compatibility and social influence would have a significant impact on I-voting intentions.

### *B. Factors Not Affecting I-voting Use Intentions*

Interestingly, education did not have a significant impact on one's intention to use an Internet voting system. This finding could be a result of our sample, which did not have a large variance in education. Seventy eight percent of our survey respondents have a college degree. This percentage is far greater than the population at large. Future studies should continue to explore the effects of education on the digital divide.

### *C. Implications for I-voting Diffusion*

As municipalities begin to make I-voting a viable option for civic participation it is imperative that whole sectors of the population are not "left behind." This digital divide introduces several challenges to government agencies: 1) the sectors in danger of exclusion are already disenfranchised and 2) as long as there is a divide, the government will need to maintain traditional voting methods in addition to Internet options. Older, lower income citizens will need an advocate to ensure that they are not disregarded as I-voting initiatives become more commonplace. The existence of this divide means that I-voting should be used as an accompaniment to, not a replacement of, existing voting procedures.

Government agencies need to discover ways to make online services more appealing to older citizens. The results of this study indicate that younger voters are more inclined to use Internet voting than older citizens. Perhaps government agencies could work with community and/or non-profit organizations designed to help senior citizens, such as the American Association for Retired Persons (AARP) ([www.aarp.org](http://www.aarp.org)), to increase adoption among older users. As senior citizens often become increasingly less mobile, having an easy way to cast their vote could improve the level of participation of this group of citizens in the democratic process.

As I-voting becomes more popular, municipalities also need to make I-voting options available to low-income citizens that may not have Internet access at home. For instance, the government may be able to make voting kiosks available in public places such as libraries, supermarkets and post offices to increase citizens' access to this innovation.

Can I-voting lead to more individuals actually voting? It is unclear that I-voting alone can achieve this, but a post hoc analysis of our data shows at least a potential for this to happen. We compared the individuals who voted in the 2004 presidential elections with those who did not on their intentions to use I-voting if this technology was available to them. Surprisingly, non-voters (59 individuals) exhibited a higher mean for I-voting intentions (5.31) than voters (300 individuals; 4.85). An independent samples t-test reveals that this difference is significant only at the 0.10 level ( $p = 0.06$ ). While this not a highly significant test, it does suggest that future research should explore more in-depth the perspectives of non-voters. A potential avenue to

do this would be through interviews of non-voters on the topic. Alternatively, researchers could conduct experimental studies where non-voters would be presented with an Internet voting option.

#### D. Social Impact of Increased Voter Participation

The impact of I-voting on political participation cannot be fully ascertained until Internet voting actually becomes a common option for voting in major elections. Recent studies suggest that its diffusion is steadily approaching. Researchers at the Georgia Tech Research Institute (GTRI) predict that kiosk I-voting will be available at post offices, malls, and automated teller machines. By 2012, they predict that some states, especially Oregon, which only uses mail-in ballots, will be the first to adopt Internet voting [33]. In light of the potential for Internet voting to increase voter participation, it is important to consider the potential impact of increased voter turnout on the nation's political system.

Given the current disparities in Internet access and literacy, agencies should be aware of the potential emergence of a democratic digital divide [23]. A democratic digital divide occurs when advancements in technology increase political inequality. This inequality results from the unequal distribution of political power among population groups. Future studies should explore the existence and implications of a democratic digital divide. Will certain groups reap the benefits of Internet voting at the expense of others? As technology transforms the voting process, will socio-economic status persist as a discriminating factor, or will other factors such as political motivation become more salient?

#### E. Personal Impact on the Act of Voting

In this study, participants were receptive to Internet voting; the mean of intention to use was 4.79 on a seven point scale (for all 359 valid responses), where seven represents the highest level of acceptance for I-voting. In light of this notable adoption potential, it is important to consider the impact of Internet voting on the voting experience.

Some opponents are critical of Internet voting because it deviates from traditional voting methods. Critics of I-voting argue that it will contaminate and eventually replace the most fundamental form of citizen participation in the democratic process. It may result in the loss of an important civic ritual: citizens going to the polls. Coleman [34] writes "reducing a vote to a mere key stroke of a personal computer may diminish, not heighten, the significance of the act. At a minimum, voters who bother to actually go to the polls tend to be people who are motivated enough to learn about issues. The solution to a lack of commitment of voters is not to reduce the necessary commitment needed to vote (p. 2)."

Some critics even argue that I-voting would make elections less of a community event, which might create a

gap between citizens and government, thereby decreasing participation. In light of the diverse predictions regarding the impact of Internet voting on the democratic process it will be interesting to explore its actual implications as this innovation is diffused throughout society.

#### F. Personal Impact on the Act of Voting

In addition to societal and personal implications, there are also technical implications affiliated with the use of Internet technology to cast a vote. In addition to increasing voter participation, I-voting can also potentially increase the accuracy with which votes are cast. I-voting may increase both the number of ballots that are submitted, and it may also increase the accuracy of the ballots submitted. Tomz and Van Houwelling [35] conclude that the use of appropriate voting technologies can greatly decrease the number of invalid ballots. Internet voting could be one such technology.

#### G. Additional Research

One important digital divide factor mentioned in prior literature that may impact intentions to use I-voting is ethnicity. As explained before, we did not include ethnicity in our model because we could not obtain sufficient variance in ethnicity levels to conduct proper analyses. However, we provide in Tables 7 and 8 descriptive data on I-voting intentions and voting behaviors per ethnic category for registered voters.

TABLE 7. I-VOTING INTENTIONS BY ETHNICITY FOR REGISTERED VOTERS

Ethnicity Category	n	I-voting means	I-voting St. Dev.
Caucasian	218	4.92	1.85
African-Americans	98	4.72	1.88
Hispanic	6	5.29	1.56
Asian	4	6.63	0.75
Native Americans	3	6.08	1.59
Other/ Not reported	8	5.00	1.62
	325	4.90	1.85

TABLE 8. LAST PRESIDENTIAL ELECTION VOTING BEHAVIOR BY ETHNICITY FOR REGISTERED VOTERS

Ethnicity Category	n	Voted	Did not vote
Caucasian	210	192	18
African-Americans	96	93	3
Hispanic	6	5	1
Asian	4	1	3
Native Americans	3	2	1
Not reported/Other	6	6	0
	325	299	26

As can be seen from the tables, there might be some important impact of ethnicity on I-voting intentions. As such, we believe that future research should seek samples with a wider variety of ethnicities to conduct statistical analyses on the impact of ethnicity on I-voting intentions.

Future studies should also explore the impact of concepts such as Internet trust and Internet self-efficacy on I-voting acceptance. Conversely, future studies of adoption of technologies should include relevant digital divide variables that may have an effect in technology acceptance.

An additional avenue for future research is to expand the digital divide model by exploring additional factors that can impact the intentions to use I-voting. While we included the digital divide factors that are most often found to impact use in electronic services contexts, it is possible that additional factors could be of importance.

Finally, as previously stated, future research would benefit from finding a sample of respondents that is more representative of the current population of the United States of America in order to have conclusions that are more representative [36].

## VI. CONCLUSION

The combination of I-voting and the digital divide provides a solid foundation for research on the new areas of e-democracy, civic mindedness and civil society. This paper enhances the Internet adoption literature and emphasizes its relevance to the developing research on e-participation. This study identifies prominent demographic predictors of I-voting intention. Using only digital divide factors (demographics), the proposed model explains 9.5% of the variance in intention. Considering their significance, these variables should be used to enhance the explanatory power of future e-services models that explore technology adoption using established theories such as diffusion of innovation [37] and technology acceptance [38]. The factors identified here can serve as a foundation for future studies of the digital divide and I-voting adoption

As local, state, and national governments begin to experiment with Internet voting, now is the time to identify the characteristics that distinguish potential I-voters from non-I-voters. This study identifies digital divide factors that affect one's intention to use an I-voting system. Governments should find ways to reduce the digital divide issues related to income (by providing more inexpensive access) and Internet experience (by providing community training and access to technology), and find ways to minimize the effects of the age-based digital divide.

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