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Research Article

E-Voting Adoption Instrument: Enhancing Validity Through Cognitive Interviews

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Abstract:

Digital governance has been transformed with the development of electronic voting (e-voting) which offers prospective advantages to the electoral process, making it more transparent, efficient, and accessible. Although the significance of e-voting has been recognized worldwide, developing countries seem to struggle with its adoption due to numerous factors, primarily the dearth of questionnaire pre-testing methods for ensuring the reliability and validity of the collected data. The current study thus conducts cognitive interviews for the purpose of pre-testing a proposed instrument for measuring the adoption of e-voting amongst prospective voters. The interview participants were selected via purposive sampling which enables the researcher to identify and resolve any vagueness, misinterpretations, and culturally immaterial items in the questionnaire. It was discovered that cognitive interviews are valuable for revealing the participants' thinking process and enhancing comprehension of the questionnaire items. The instrument's clarity and relevance were enhanced via adjustments according to the participant feedbacks, hence boosting its construct validity. The practical significance of solid pre-testing methods is underlined in this study, especially in the examination of technology adoption. This study's refinement of the survey design improves the robustness of e-voting adoption assessment tools, thus aiding policymakers and stakeholders in making informed decisions. These are key towards nurturing voters' trust and perceived usability of e-voting systems, particularly in the distinct sociocultural setting of developing nations.

1. Introduction

As a key initiative of electronic government (e-government), electronic voting (e-voting) offers the capacity for improving the political process, making it more transparent, efficient, and participative [1]. E-voting refers to the process of casting votes via the partial or complete usage of information technology [2]. Similar to any e-government initiative, e-voting has the potential to transform the electoral landscape by changing how citizens participate in politics and democratic procedures [1]. E-voting is projected to improve the democratic process by making it more efficient, accessible, and accurate compared to the conventional paper-oriented approach [3][4]. As a consequence, democratic institutions can be reinvigorated and civic trust reinforced.

While developed countries have pioneered in the e-voting endeavors, tweaking these systems to match their own sociocultural contexts [4]. However, when it comes to adopting these systems in a region like the Middle East that is mostly developing countries, this needs a deeper understanding with regards to their particular context and sensitivities [5]. In fact, although the e-voting systems are based on computer technologies and therefore follow some shared principles of technology adoption [6],

it is also influenced by societal factors alongside trust-related concerns [7].

The limited research on e-voting adoption in developing countries impedes a thorough understanding of the readiness of these countries to embrace e-voting systems across various elections [8], highlighting the pressing need for more comprehensive research and investigations [9].

Questionnaire design poses a significant challenge as respondents often misinterpret questions, a common observation in the existing literature [10]. One effective strategy to proactively address this issue is the pre-testing of questionnaires, a practice widely advocated in research of Ikart [11]. A pre-test can confirm the clarity of the questions and that they are aligned with the research objectives. Additionally, sampling errors can be reduced, response rates boosted, and the actual functionality of the new measures ensured [12][13]. Therefore, questionnaire pre-testing is a fundamental component of the research procedure.

Among the most common issues with surveys include the misinterpretation of the questions, the unwillingness or incapability of the respondents to provide responses, and excessively lengthy questions. All these are attributable to the number of questions, the sequencing of the questions, or the language and style employed [14][15]. There are three general approaches for validating a research instrument namely via expert validation, pilot testing, and cognitive interview which is the focus of this paper.

Cognitive interviews can help enhance a research instrument's validity, most notably surveys and questionnaires. In this approach, the researchers observe the respondents' engagement with the research instrument, analyzing their thought processes to gain insight into how they interpret the questions, access information, and frame their answers. By doing so, possible biases, uncertainties, or other problems that would render the collected data inaccurate and unreliable could be identified and subsequently resolved. To illustrate, cognitive interviews can demonstrate how certain questions could be misconstrued thus resulting in unwanted answers, or the inability of the response options to properly capture the intended range of responses. The ability to mitigate such issues would enhance the quality of the collected data and boost the validity of the findings.

Cognitive interviews have also been indicated to improve the validity of research instruments [16]. In healthcare research, Wright et al. [17] examined the role of cognitive interviews in improving patient-reported outcome measures (PROMs). They discovered the value of this approach in identifying and resolving the vague wording of questions, limitations of response options, as well as recall biases, resulting in the generation of high-quality patient-reported data.

Hadler [18] investigated the impact of the questions' order on the validity of responses in their study on cross-cultural web probing. They discovered that the way questions are ordered can profoundly shape the interpretation and responses of participants to survey questions, which can create biases that ultimately threaten the quality of the data. By studying the response to the questions, and by probing what respondents meant by their answers, the research drew attention to how careful design and the sequencing of survey questions can help to reduce or eliminate such biases.

This current study primarily sets out to establish a robust and reliable instrument for measuring the adoption of e-voting by potential voters. This entails the creation of a questionnaire which can capture the main determinants of e-voting adoption, like the variables in UTAUT and personalized ones such as trust and perceived security. A comprehensive and accurate instrument is crucial towards yielding valid and practical understandings regarding e-voting adoption, especially in the context of developing countries [19].

Towards this end, this study employs a systematic pre-testing method, focusing on cognitive interviews which are used for identifying and addressing possible issues in the survey instrument including vague wordings, misconceptions, or culturally inappropriate questions. The reflective process in the pre-test is meant to improve the questionnaire's clarity, relevance, and reliability [20] [21][22]. It guarantees the instrument's effective measurement of the constructs, this boosting its validity and usability in other contexts [23].

Cognitive interviews are valuable in this instance as they help uncover the respondents' perception and processing of the questions, providing in-depth understanding that the conventional pilot testing could not offer. This method emphasizes the need to understand respondent behavior and cognition in designing a survey instrument, most notably in the context of technology adoption [24] [25]. With the usage of cognitive interviews, this study enriches the methodological precision of e-voting research on top of setting a model of advanced pre-testing methods in comparable areas.

2. Related Work

E-voting is essentially crucial for the sharing of views and ideas. This technology is applicable across a range of sectors; however, it must prioritize accuracy, security and transparency. Adoption of e-

voting systems in developing countries still at its infancy [8][9][6]. Despite the potential benefits thereof, e-voting adoption has been unsuccessful in many parts of the world [26][8] due to controversial and not fully explored reasons, ultimately reverting to traditional paper ballots for instance in the United States, Belgium, Canada, Japan, Mexico, France, Peru, Australia Costa Rica, Finland, Guatemala, The United Kingdom, Ireland, Italy, Kazakhstan, Netherlands, Germany, Paraguay, Norway, and Switzerland [27].

Adopting and using e-voting technologies in major elections remain largely problematic regardless of where they are implemented. This has motivated a number of survey-based empirical studies on determining important factors for e-voting system adoption based on existing technology adoption models. For instance, attempts to explain e-voting adoption have, for instance, utilized the Technology Acceptance Model (TAM) where perceived usefulness and ease of use are central constructs influencing e-voting adoption [28]. However, other empirical studies point to a trust perception [25], as well as security and privacy concerns also affect voter acceptance [29][30].

Likewise, the Unified Theory of Acceptance and Use Technology (UTAUT) has been used to determine how performance expectancy, effort expectancy social influence and enabling conditions affect adopting e-voting [24]. However, differences in cultural and social contexts also exist which further add to the complexities of adoption as evidenced by divergent adoption studies outcomes across different regions around the globe [27][31].

Also, researches from different parts have used several theoretical models other than UTAUT and TAM to explore e-voting adoption. In the developing countries, the case in point is a study by [9] that used Belanger and Carter's model to investigate the impact of digital divide on e-voting adoption in Jordan, concluding internet usage as one key determinant. Agbesi [32] applied the Diffusion of Innovations (DOI) theory in Ghana to discuss political parties' attitudes with a focus on trust concerns.

Even though considerable research has been conducted in this aspect, there remains substantial uncertainty surrounding the determinants of e-voting adoption from a voter perspective. Factors have been explored using different theories and models by researchers, with the absence of a complete unified conceptual modelling framework resulting in various interpretational perspectives on this technology [8]. These differences demonstrate the necessity for more inclusive and context-specific research that subsequently enables a better understanding of, and solution-finding to address actual complexities e-voting adoption entails. Once again, this fragmented approach underscores the need for more coherent and integrated research that ties together the different aspects related to e-voting adoption in developing countries like Iraq [8][6].

Questionnaire design poses a significant challenge as respondents often misinterpret questions, a common observation in the existing literature [33][10]. One effective strategy to proactively address this issue is the pretesting of questionnaires, a practice widely advocated in research of Ikart[11]. Pre-testing enables the evaluation of the questions' comprehensibility and their alignment with the research objectives. It also reduces sampling errors, improves response rates, and facilitates the assessment of the new measures' real-world functionality [12][13]. Hence, the pre-testing of a questionnaire is deemed as highly crucial in the research process.

Cognitive interviews are preliminary assessments of the survey items [34]. They reveal the participants' perception and interpretation of the questions and subsequently their responses. This method is crucial for identifying issues with the questionnaire's instructions, measurement of the items, as well as explication of the responses [35].

Moreover, cognitive interviews entail respondents who are representative of the target population. They are carried out to improve the questionnaire comprising candidate items. Other than that, this method helps in uncovering additional concerns regarding questionnaire design, organization, and instructions [36]. Cognitive interviews usually entail face-to-face interviews whereby the respondents provide their viewpoints in responding to the survey questions. Verbal probing, think-aloud, paraphrasing, confidence ratings, and card sorting techniques may be utilized during the course of such interviews [37][38]. In the next sections, details of the cognitive interviews for validating the research questionnaire are presented.

3. Research Methodology

Various research approaches, methods, and techniques can be employed in the design of a research study. However, the selection of the specific research methodology is determined by the research objectives and the contextual factors surrounding the study [39]. The following subsections outline the key steps involved in conducting this study.

A. Research Design

This study employs the cognitive interview method for pre-testing the e-voting adoption instrument, assuring the clarity, relevance, and cultural-appropriateness of the questions. Samples are derived

from the target population; the interviews serve to identify issues which could hinder the participants' comprehension of the questions or their ability to answer them. Based on the feedbacks and responses, the instrument is refined to improve its construct validity and ability to capture the exact determinants of e-voting adoption. This iterative process not only strengthens the survey's design but also enhances its applicability in diverse settings.

B. Sample Selection

For the purposes of pretesting, a purposive sample of six participants, three males and three females, representing a range in age, gender, and ethnicity, was chosen. This group of participants only involve in the cognitive pretesting phase but will not be involved in the actual data collection for the study; participants' information is shown in Table 1. Five to ten participants are normally chosen to participate in the pretesting process [40][41]. Prior to the interview, the participants received the questionnaire link via the WhatsApp app.

Participants ranged in age from 17 to 27 years (M = 23, SD = 3 years) representing the targeted respondents of the research as recommended sample approach to cognitive interviewing [21].

Table 1. *Indicates the Participants' demographic data.*

Participants	Gender	Age	Educational Level
P1	Female	18	Bachelor Student
P2	Female	27	Master Student
P3	Female	25	Bachelor Student
P4	Male	21	Bachelor Student
P5	Male	22	Institute Student
P6	Male	26	PhD Student

C. Data Collection

Within cognitive interviews, two types of questions are commonly employed: Think-Aloud queries and Probing Questions. In this study, both techniques are used to elicit participants' overall impressions and responses to specific sections of the questionnaire. Using the think-aloud technique, respondents are prompted with the question, "Tell me about your thoughts". Willis [42] argued that the think-aloud technique introduces less interviewer bias than the probing method, as respondents express their thoughts independently of what they perceive as relevant to the interviewer. However, it's worth noting that the think-aloud technique can be more demanding for participants, unless they possess prior knowledge of the subject matter and can articulate their thoughts clearly, as highlighted by Mathews et al. [43]. In line with Willis [44] and Jolles et al. [45], interviewers are encouraged to have participants practice responding to the types of questions they will encounter during the interview. This warm-up activity, has been adopted by various cognitive interviewers, as documented in studies such as Garner[46], Haggar et al [47], Barale et al.[48], and Mathews et al.[48]. In this study, we also implemented Willis' recommended warm-up exercise which involved the following prompt: "Picture in your mind your classroom. How many windows are there? As you count up the windows, tell me what you are thinking about and seeing."

Participants exhibited varying degrees of capacity to articulate their thoughts in response to this exercise. For instance, Participant 4 (P4) provided a detailed response, saying, "I'm starting with Lab2 room. It's my favorite lab. It contains different high-performance computers with high-resolution monitors. There is a smartboard that the professor uses during the lectures. There are two doors, one for the students and the other is used by the professor, and there are three equal-sized windows with electric curtains" and so on. In contrast, Participant 1 (P1) simply stated, "Three, yes, there are three windows," and struggled to elaborate on her thought process despite attempts to prompt further information. During the practice exercise, some participants raised questions such as, "Do double windows count as one or two? Do doors count as one or two?" These inquiries provided an opportunity to clarify that this was the type of thinking-aloud about thoughts and responses we expected during the interview.

D. Instrument Details

The cost-effectiveness of questionnaires for data collection purposes renders the popularity of the research instrument [49]. Questionnaire development entails vigilant attention on construct selection, the measurement scales, the phrasing of items and the contents, format for the responses, as well as tactical question planning [50]. The process starts with the research question design, followed by the field work execution, and the measurement reliability assessment. The constructs and questions to be measured must be carefully determined. Saunders et al. [51] assert the critically of each question. There are three key steps involved in the design process namely:

- Deciding on the questions.
- The process of determining the type and phrasing of each item's question.
- Developing the question sequence and precisely designing the overall structure of the questionnaire.

For this particular study, the original UTAUT framework was adapted to align with the study's focus on e-voting adoption. This adaptation involved the use of appropriate terminology and paraphrasing

tailored to the context of e-voting including the additional constructs. Resultantly, the questionnaire had 8 constructs in total. The operational definition of each construct has been defined in Table 2.

Table 2. *Description of the model's constructs*

Construct	Brief Description	Source
Performance Expectancy	The degree to which the citizen believes that the use of the e-voting system is beneficial and will help in achieving gains in the elections, especially in the accuracy of polling and the efficiency and speed of vote counting.	[24], [52], [53]
Effort Expectancy	It is the extent to which a voter believes that the use of the e-voting system in the election would be easy, less challenged and doesn't need much effort.	[24], [54], [55]
Social Influence	It is the extent to which the perceptions and opinions of friends, family, peers and important personalities do impact the citizens' views toward the use of the e-voting system.	[24], [56], [54], [55]
Facilitating Condition	The degree to which a voter believes that an organizational and technical infrastructure exists to support the use of the e-voting system.	[24], [57], [56], [54]
Perceived Security	The degree to which the voter perceives that the e-voting system has the capacity to keep the votes secrete, private and secure.	[58], [52], [59]
Trust in Technology	The degree to which the voter believes that the e-voting system is effective and efficient and has the capacity to perform as expected in terms of reliability, credibility, safety, and integrity.	[58], [59][60], [59] , [54]
Trust In Government	The degree to which the voter believes the government has the required capacity and commitment as well as the technological know-how to execute the e-voting system in the absence of his/her control over the government's performance.	[60], [54]
Political Trust	The degree to which the voter believes the politicians, political institutions and authorities are performing in accordance with the normative expectations held by the public.	[61],[61], [62]
Behavioural Intention to Use	It is the extent to which an individual has formulated conscious intentions and plans to use or not to use the e-voting system for voting in elections.	[24], [52], [57], [59]

Once the constructs have been identified, the measurement items or indicators for gauging each construct were specified, either via selection or custom-development for a specific measurement purpose. All the items within the same scale should be able to measure the latent variable they are meant to measure [63]. In short, the content of each item must properly embody its respective construct, as emphasized by Spoto et al. [64].

Additionally, supplementary questions were incorporated to comprehensively cover the constructs outlined in the proposed e-voting model, refer to Table 3.

Table 3. *Survey questions used in the study*

Questions	To test
I would find the e-voting system is useful for election.	Performance Expectancy
Using e-voting system enables to get the election results more quickly.	
Using the e-voting system makes it easier to cast vote.	
If I have access to e-voting system, I will be more likely to vote.	
Using e-voting system enables me to vote more quickly than the paper-based voting.	
I find the process of interacting with the e-voting system to be clear and easy to understand.	Effort Expectancy
It would be easy for me to cast my vote using e-voting system in election.	
I would prefer to vote using e-voting system compared to traditional voting methods.	
I would find e-voting system to be flexible to interact with	
Learning to use the deployed e-voting system is easy for me.	

Most people who are important to me think that I should cast my vote using e-voting system.	Social Influence
Most people who are important to me would want me to use e-voting system to cast my vote.	
People whose opinions I value would prefer me to use e-voting system to cast my vote.	
Using e-voting system to vote enhances my status in the society	
My professors actively support my use of e-voting system.	
In general, the Government has supported the use of e-voting system in election.	
I have the knowledge and the ability to make use of e-voting system.	Facilitating Conditions
The election commission support will be available to help with technical problems related to e-voting system.	
I am sure that the necessary assistance (e.g., instructions, Guidelines and FAQs) is available for using this e-voting system.	
A specific person (or group) is available for assistance with system difficulties at the election centers.	
I believe the e-voting system keeps my vote secured from being manipulated.	Perceived Security
The e-voting system has adequate security features.	
I believe the e-voting system keeps the secrecy of my vote.	
The security policy of the e-voting system is clearly stated by the election commission.	
The e-voting is trustworthy	Trust in Technology
The e-voting system has enough safeguards to make me feel comfortable to use it.	
I feel confident that technological advances in the e-voting system make it a robust.	
I feel confident that the technological advances in the e-voting system make it able detect fraud and information theft.	
I believe the e-voting system is trustworthy to tally and count votes in an efficient manner.	
The election commission takes full responsibility for any type of insecurity	
The e-voting system is more reliable than the paper-work system.	
The election commission staff possess the necessary skills and expertise to operate the e-voting system effectively and as expected.	Trust in Government
The election commission can be trusted to carry out the election using e-voting system faithfully.	
I trust the election commission keeps my best interests in mind.	
The election commission departments have the ability to meet most voters' needs during the election day.	
In general, I think the election commission is trustworthy.	
I intend to use the e-voting system to cast my vote in the upcoming election.	Behavioral Intention
I predict to use the e-voting system to cast my vote in the upcoming election.	
I plan to use the e-voting system to cast my vote in the upcoming election.	

E. Analysis Techniques

The cognitive interview data analysis systematically identifies clarity, relevance, and usability issues in the instrument. The participants' interview responses and verbal feedback are transcribed and analyzed to identify cases of misinterpretations, vague wordings, or culturally irrelevant questions. inappropriate items. Thematic analysis, among other techniques, is used to classify and interpret the identified issues, specifically recurring themes which indicate possible errors in the design of the questions [42][45].

Subsequently, the issues are mapped against the corresponding survey items, followed by the proper amendments. To illustrate, a recurringly misconstrued question or one that repeatedly prompts unreliable interpretations would be rephrased or substituted. By performing this process iteratively, refinements to the instrument would be done according to the respondents' actual behaviors and feedback, thus improving the instrument's validity and reliability prior to being used in the actual data collection.

4. Findings and Discussion

This study is qualitative in nature. Its data entails all the interviews' audio recordings, written documentation of the responses as presented in the interview guide, and written field notes of the interviews. By listening to the audio recordings, reading the written responses, and documenting the field notes for each item, the researcher was able to

identify significant issues prevalent throughout the interviews. The impressions derived for each interview question were coded to indicate the respondents' understanding or misinterpretation of the item, or the insufficiency of the response choices. Identification of specific issues or suggestion of certain changes makes for a straightforward data analysis. The contrary occurs when the responses are vague.

Additionally, the interviewer also asked spur-of-the-moment probing questions. To illustrate, two participants were confused about the notion of "Vote Secrecy" and asked for its definition. In the ensuing interviews, some respondents asked about the meaning of the term 'Government' as stated in the questionnaire, to which the interviewer explicated it to mean as the Election Committee and subsequently agreed to state it clearly in the Introduction.

Questions about the Arabic translation were also prompted, such as the participants' preferences for some construct names and technical terms. To illustrate, we described the term "voting" using 'الادلاء', to which three of the respondents proposed "التصويت"?" as a better option. Some respondents highlighted the ambiguity of the term "اعتزم" and that it is already obsolete. One of the respondents, an Arabic literature Master's student, proposed the usage of Arabic vowels in the questionnaire to improve understanding as some of the actual respondents may not be proficient in the Arabic language.

Among the items for the Social Influence construct are "Most people who are important to me would want me to use e-voting system to cast my vote" and "Is it OK to ask people about others' influence on their behavior in your culture?" The interview session concluded with questions regarding the participants' general perception of the questionnaire's comprehensibility, ease of use, and length.

Ultimately, all significant issues were identified, followed by decisions to either retain, omit, or amend the relevant items, format, or instructions. According to Willis [42], amendments may be undertaken after one interview or after accruing enough proof about similar issues as identified by the respondents. In this paper, both methods were utilized. In instances where one respondent's identification of an issue may be opposed by the other respondents (e.g., three respondents proposed for the removal of English construct names and retention of the Arabic ones in the questionnaire), revisions were made prior to further testing. When no noteworthy issues were identified, the interviews proceeded up until more respondents identified a problematic item.

Finally, the questionnaire items were modified based on the notes taken, the participants' recommendations, and the issues faced by the participants with certain items during the cognitive interview.

5. Implications for Research and Practice

Improving the reliability and validity of e-voting adoption studies has significant implications for both academic research and practical implementation. A robust and well-validated instrument ensures that the findings accurately reflect the factors influencing voters' decisions. Ultimately, policymakers and stakeholders would have practical insights on how to mitigate possible challenges related to e-voting design and adoption.

A reliable instrument would be able to lessen measurement errors, leading to the accurate determination of correlations and patterns. The refinement of survey tools via techniques such as cognitive interviews enables researchers to improve the reliability and precision of e-voting adoption inquiries, thus boosting confidence in the findings and suggestions for policymaking and system development.

6. Limitations and Future Research

Despite the usage of rigorous approaches for ensuring the research instrument's validity and reliability, certain limitations do exist and need to be recognized. Firstly, cognitive interviews are typically constrained in sample size, thus hindering full insight of the target population's diversity. The researcher might have missed certain context-specific issues or nuances, especially in bigger populations or those with high heterogeneity. The findings are also reliant on the respondents' varied levels of inclination and capacity to express their thought processes while being interviewed.

Future studies may expand the pre-testing scope to incorporate a more wide-ranging and diversified sample, which ensures the instrument's robustness across various cultural and demographic groups. The incorporation of innovative methodologies like psychometric modelling and mixed-method approaches can further refine and validate the instrument. Technologies like online cognitive interviews or eye-tracking tools could also elucidate the behavior of respondents. Finally, the instrument's long-run performance in various electoral settings could be measured by longitudinal studies which offer in-depth understanding about e-voting adoption trends, thus facilitating the development of reliable measuring instruments in this domain.

7. Conclusion

The significance of reliable and valid instruments for assessing e-voting adoption is highlighted in this study, with a focus on the primary UTAUT determinants and other relevant factors. Using the pre-testing method of cognitive interviews, this study identifies and addresses potential problems inherent in the questionnaire, including vagueness and cultural irrelevance, to ensure the effectiveness of the instrument in capturing the desired constructs. The refinement process, performed iteratively, improves the validity and reliability of the instrument on top of setting a methodological standard for future research in this domain. These are valuable contributions for emerging nations in particular, as their distinct technology adoption challenges can only be understood and addressed using robust instruments.

Cognitive interviews crucially contribute to the advancement of e-voting adoption research by providing a deeper insight of the respondents' perception and interpretation of the survey questions. This method bridges the theoretical and practical gap between the constructs and their actual applicability, thus improving the instrument's accuracy and contextual relevance. This study underscores the prospective usage of cognitive interviews for improving data quality and reliability, thus boosting confidence in the conclusions drawn by studies in this field. In due course, this methodological development would enrich academic research on top of providing practitioners and policymakers with practical tools for driving the global execution of e-voting systems in a more effective manner.

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