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The impact of usability on e-government usage in the Peruvian context

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Abstract

Governments usually face various challenges in supplying public services to their citizens, such as limited infrastructure and human resources. Investment in technology can support and improve the provision of these services; however, the success of projects of this kind depends on their adoption by citizens. Hence, it is imperative to consider a user-centered design when implementing these technology-based solutions. Literature suggests that usability might be important in this type of design, and thus, the present study aims to determine whether usability can influence citizens' intention to use these online services. Specifically, this study aims to support the effect of usability on the success of e-Government portals in Peru with empirical evidence. To achieve this goal, an online survey was distributed to citizens across urban areas. Participants were randomly provided with one of our three selected government websites, and they were required to complete an information query. They were then asked to answer a set of questions regarding their experience. A pilot test was conducted, and its results showed that usability effectively drives satisfaction, which in turn impacts on usage intention. Based on these findings, implications are discussed.

Keywords: e-Government, usability, satisfaction, portal design

Introduction

Public services are an essential part of the functioning of modern contemporary states and nations. Whereas the free market can supply goods and services for most market needs, the modern state remains at its core as a centralized supplier of protection and justice. Furthermore, it could be argued that an efficient public system is essential for the socio-economic development of a country: "access to quality services, such as education, healthcare, transportation, and justice, is essential to connect people and businesses with opportunities to achieve higher-paid jobs, better living standards and longer, more fulfilling lives" (OECD, 2015, p. 27). However, various contextual issues, such as societal requirements, demographic changes, a lack of competencies, economic pressure, income inequality, and uneven service access, all provide challenges to the public sector. Indeed, nations' inability to offer public services is attributable not only to a lack of funding but also to governance difficulties that differ depending on each context (Lopes & Dhaou, 2018). This is problematic since the provision is constrained by several infrastructural factors that exacerbate the gap for those with few resources.

To overcome some of these problems, governments have heavily invested in information and communication technology (ICT) projects. One case is "FRIENDS," a development project in Kerala, South India. It consisted of centers that offer one-stop, front-end, ICT-enabled payment counter facilities for citizens to make all kind of government payments (Kiran, 2002). This project, for instance, solved the problems from the traditional administrative government process caused by paper transactions,

discoordination, and bureaucracy (Kiran, 2002). However, there is also extensive literature regarding the multiple failed experiences of government contracts for software and infrastructure (Lerner, 2020; Maddison & Thesis, 2014; Marchewka, 2010). Generally, literature traces the responsibility of these failures back to an insufficient involvement of all stakeholders. On the one hand, ICT integration and usage are carried out within governmental administration and operations, and on the other, they are carried out in connection with people and the business environment (Aniela, 2019). Governments' interest in ICTs to improve public services has grown in recent decades due to rapid acceptance and use of the internet. Across the countries from the Organization for Economic Co-Operation and Development (OECD), for example, the number of fixed-broadband subscriptions has notably increased. According to OECD data, fixed-line broadband subscribers increased to 387 million in December 2016, up from 372 million the previous year, resulting in a penetration rate of 30.1 percent (OECD, 2017).

E-Government is defined as the use of ICTs to offer government services to individuals and companies in a more effective and efficient way (United Nations, 2020a). One of the most important proponents of this concept is e-Estonia, also known as the Republic of Estonia. Estonia was the pioneer in government digitalization and digital services. Indeed, in 2017, The New Yorker published an article in which they named Estonia as the "Digital Republic." It has a population of 1.3 million citizens, at least 90% of whom use the internet regularly (e-Estonia, 2021). In addition, most Estonians are registered in the digital national registration services and are active users of public digital services offered by the government (e-Estonia, 2021). This fact has had a significant impact on the economic development of the country and is reflected in the gross domestic product (GDP) as annual savings of public budget and aggregated increasing production of e-Businesses (e-Estonia, 2020).

The United Nations has an index that measures the status of e-Government development of its member states. The e-Government Development Index (EGDI) assesses countries' performance based on the capability to deliver digital public services, the infrastructure required to do so, and the capacity of the citizens to operate them. In 2020, Peru ranked 71 out of 193 and was positioned in the High EGDI category (United Nations, 2021). Peru's EGDI score of 0.7083 is higher than both the world average of 0.5988 and the Americas region average of 0.6341. In addition, it is marginally higher than the South America sub-region average of 0.6827 (United Nations, 2021). However, it is behind the sub-region leader Uruguay with a score of 0.8500, the regional leader USA with a score of 0.9297, and the world leader Denmark with a score of 0.9758 (United Nations, 2020b). Despite this index value, completing a procedure in the Peruvian public sector takes an average of 8.6 hours, only 15% of procedures can be started online, just 4% can be finished digitally, and only 29% can be completed in a single interaction (OECD, 2019). Peru is in penultimate place in Latin America based on these numbers. This would indicate that Peru is currently facing underuse of its digital public infrastructure despite having strong potential to develop effective e-Government services.

In this era, society expects that the government can provide customized and responsive public services in the same way that the private sector does. Indeed, the digital era and a user-centered strategy may improve citizens' end-to-end public service experiences (OECD, 2019). In designing policy and delivering services, the government must embrace a 'citizen first' mindset (Mittal, 2020). The Price Waterhouse Cooper (2019) report explores possible approaches to building services models that are citizen-centric. One of the key concepts in the report is that of designing 'citizen-friendly government interfaces.' It means that intuitive interfaces for government portals that are relevant, user-friendly, safe, and accessible to all users is one of the most important components in offering citizen-centric services. There is a substantial literature that describes the best practices for the design of such solutions (Fath-Allah, Cheikhi, Al-Qutaish, & Idri, 2014; Maheshwari, Kumar, & Kumar, 2008). However, as this kind of development is highly context-dependent there is no guarantee that these best practices might impact citizen use of these services in the Peruvian context. The objective of this research project is to provide empirical evidence to support the impact of usability on the successful use of digital public services on e-Government portals in Peru.

Literature review

Previous research has presented various factors that may impact the use of e-Government services. For example, Nielsen (2017) established that e-Estonia success was caused by a formal e-Governance model. That is, in order to be able to introduce online services, the government needs a model to ensure their correct development. This is representative of the scope of prior studies about the supply side of e-Government. Other authors focused on user perceptions of digital services. For example, Alomari et al. (2014) identified key demographic and psychological factors that characterize the current way of approaching public digital services in Jordan. Chacon et al. (2021), on the other hand, focused on social values; they claimed that the perceived value of environmental sustainability might be a main driver for using digital services.

Another research stream focused on user characteristics and their perceptions of the Web. For example, Mercy et al. (2020) used Likert-based variables to measure the preferences and perceptions related to Web e-Government portals. Aladwani (2013) studied the role of attitudes and perceived satisfaction along with other variables to explain the real adoption of government digital services.

In terms of e-Government design, some studies focused on best practices. Fath-Allah et al. (2014) and Maheshwari et al. (2008), for example, referred to important attributes reflected on both the front end and the back end of e-Government services. The main contribution of these studies is the synthesis of the findings of prior related studies into unified frameworks. However, there is no empirical assessment of the importance of such best practices and their impact on the use of e- Government services.

Rocha et al. (2014) claimed that end-user needs and characteristics had not been taken into account in the development of e-Government services. In this line, Bataineh et al. (2017) took a pragmatic approach by using eye-tracking technology to get objective results to judge Dubai's government portal usability and design. Their study concluded that usability and design issues may affect user performance and satisfaction. Further, Kuzma et al. (2011) use the Web Content Accessibility Guidelines 1.0 (WCAG) with the EvalAccess 2.0 to assess the usability of government sites for people with disabilities. However, there are no studies that used usability evaluation methods to assess the usage of these platforms.

Based on the above discussion, our study seeks to fill the following gaps: 1) there are no empirical studies on the best practices for e-Government design, and 2) lack of empirical studies on the impact of technological characteristics on e-Government usage. Accordingly, the objective of this research project is to assess the impact of usability on the use of e-Government portals in Peru.

Theoretical framework

Acceptability and usability

A user interface (UI) refers to the aesthetic elements with which humans interact when using a system (Babich, 2019). The acceptability of a system is a combination of social acceptability and practical acceptability (J. Nielsen et al., 1993b). For practical acceptability, the usefulness factor is essential because it assesses the system's ability to achieve a desired goal (J. Nielsen et al., 1993b). Now, in terms of usefulness, the system should be both useful and usable (Grudin, 1992). On the one hand, utility (i.e., a useful system) refers to the functionality of the system, that is, the system can do what is needed (J. Nielsen et al., 1993b). On the other hand, usability (i.e., a usable system) refers to how well individuals can use the system's functionalities (J. Nielsen et al., 1993b).

In Figure 1, we can see a graphical representation of the acceptability model proposed by J. Nielsen et al. (1993b). Usability is associated with five general attributes: learnability (i.e., easy to learn), efficiency (i.e., efficient to use), memorability (i.e., easy to remember), errors (i.e., few errors), and satisfaction (i.e., subjectively pleasing) (J. Nielsen et al., 1993b).

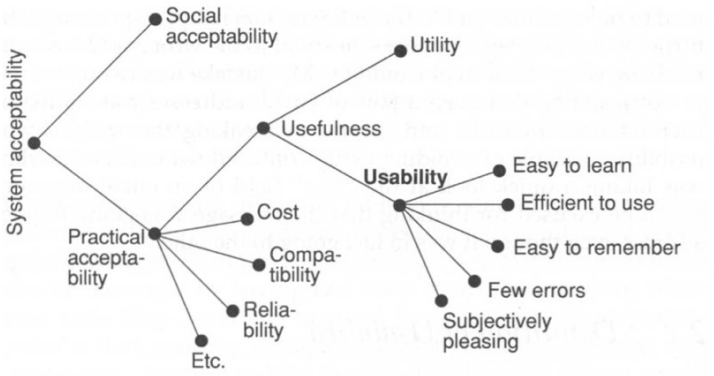

Figure 1. Acceptability model from J. Nielsen et al. (1993b)

In the context of contemporary e-Government portal development, it is important to focus on current best practices. In general, a back-end development focuses on the system's associated operations, while a front-end development focuses on the system's interface. Therefore, this study posits that the back end is more likely to be related to utility, whereas the front end is associated with usability. Furthermore, Maheshwari et al. (2008) highlighted usability as one of the essential front-end attributes.

Usability and satisfaction for e-government adoption

Previous research shows that a high degree of usability can boost the use of e-Government digital services by improving user performance as well as user satisfaction with these portals (Huang & Benyoucef, 2014). The adoption and usage of e-government services are inextricably linked to their usability (Verdegem & Verleye, 2009). Therefore, the better the usability of e-Government portals, the more effective will their usage be (Huang & Benyoucef, 2014). Failure to ensure usability, on the other hand, reduces user engagement (Huang & Benyoucef, 2014). Indeed, users' discontent rises when they are unable to access and use services due to usability issues (Anthopoulos, Siozos, & Tsoukalas, 2007). In those cases, users may be hesitant to return to an e-Government website or even promote it to others if they are dissatisfied (Huang & Benyoucef, 2014).

Heuristic evaluation

Lyzara et al. (2019) conducted an extensive literature review and analyzed the advantages and challenges of usability evaluation methods in the e-Government context; heuristic evaluation is one of those. As part of an iterative design process, heuristic evaluation is a usability engineering method for finding and fixing usability flaws in UI design (J. Nielsen, 1994b). Considering that the five dimensions seen in Figure 1 are abstract attributes, the present study will use a heuristic evaluation based on perceptions of these attributes, as prior literature suggests (J. Nielsen et al., 1993a). Lyzara et al. (2019) recognize heuristic evaluation as quick, easy, and cost-efficient. Even though it is frequently referred to as expert inspection, the heuristic assessment may be used effectively by both experts and beginners (Cristina, Garcia, Maciel, & Pinto, 2005). Huan and Benyoucef (2014) designed a method to measure usability through heuristics (see Table 1).

Table 1. Heuristics for usability (J. Nielsen, 1994a)

Usability dimensions	Explanation
Visibility of system status (VSS)	The system should always keep users up to date on what is going on by providing relevant feedback in a timely manner.
Match between system and the real world (MSRW)	The system should be able to communicate with the user in their own language. Follow real-world standards to present information in a logical and natural arrangement.
User control and freedom (UCF)	Users frequently choose system functions by accident, requiring the presence of a clearly visible "emergency escape" that allows them to depart the undesirable state without having to go through a lengthy dialogue.
Consistency and standards (CS)	Users should not have to wonder whether different words, situations, or actions mean the same thing.
Error prevention (EP)	A thoughtful design that avoids a problem from happening in the first place is much better than nice error messages.
Recognition rather than recall (RRR)	Objects, actions, and options should all be visible. The user should not have to recall information from one dialogue segment to the next.
Flexibility and efficiency of use (FEU)	Accelerators may frequently speed up expert user interactions, allowing the system to accommodate to both new and experienced users.
Aesthetic and minimalist design (AMD)	Information that is useless or is used rarely should not be included in dialogues. Every additional piece of information in a conversation competes with the relevant pieces of information, lowering their relative exposure.
Help users recognize, diagnose, and recover from errors (HURDRE)	Error messages should be written in plain language, clearly state the problem, and offer a helpful remedy.
Help and documentation (HD)	Although it is preferable if the system can be operated without documentation, assistance and documentation may be required.

Research model

This study aims to determine the impact of usability on user satisfaction, in order to determine whether usability can drive e-Government services adoption in Peru. Figure 2 shows the proposed framework that was adapted from Huang and Benyoucef (2014), J. Nielsen (1993a), and Verdegem and Verleye (2009), to determine the relationship between usability and satisfaction, and their impact on citizen use of e-Government services. Usability consists of J. Nielsen (1994a)'s heuristics, as seen in Table 2. The statements supporting the proposed relationships are as follows:

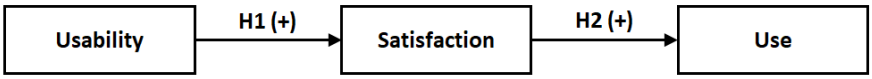

Figure 2. Proposed research model

- Users can determine the consequences of prior interactions and plan their next movements when they are aware of the current system state. Predictable encounters build trust in the system as well as the entity (J. Nielsen, 1994a). Thus, this study expects that the visibility of system status will have a positive impact on satisfaction.
- It is simpler for users to learn and remember how to use an interface when the controls match real-world norms and correlate to desired results (J. Nielsen, 1994a). This characteristic helps to create a natural-feeling experience (J. Nielsen, 1994a). Thus, this study expects that the match between the system and the real world will have a positive impact on satisfaction.

- It promotes a sense of independence and confidence when people may easily back out of a process or undo an activity (J. Nielsen, 1994a). Users may utilize exits to stay in control of the system and avoid being stranded and irritated (J. Nielsen, 1994a). Thus, this study expects that user control and freedom will have a positive impact on satisfaction.
- Users' expectations are determined by their previous experiences with other products (J. Nielsen, 1994a). Failure to maintain consistency may raise the cognitive burden of users by requiring them to acquire new information (J. Nielsen, 1994a). Thus, this study expects that consistency and standards will have a positive impact on satisfaction.
- Slips and mistakes are two forms of errors. Inattention causes slips, which are unintentional errors that cause frustration (J. Nielsen, 1994a). Mistakes, on the other hand, are deliberate errors caused by a misalignment of the users' mental model and the design (J. Nielsen, 1994a). Thus, this study expects that error prevention will have a positive impact on satisfaction.
- Humans have a limited capacity for short-term memory (J. Nielsen, 1994a). Users' cognitive work is reduced when they utilize interfaces that facilitate recognition (J. Nielsen, 1994a). Thus, this study expects that recognition rather than recall will have a positive impact on satisfaction.
- Flexible procedures can be conducted in a variety of ways, allowing people to choose the manner that best suits them (J. Nielsen, 1994a). Thus, this study expects that the system's flexibility and efficiency will have a positive impact on satisfaction.
- Ensuring that the content and visual design remain simple is essential. It is necessary to ascertain that the interface's visual aspects serve the users' key objectives (J. Nielsen, 1994a). Thus, this study expects that an aesthetic and minimalist design will have a positive impact on satisfaction.
- Visual treatments for error messages should also be used to assist people to notice and recognize them (J. Nielsen, 1994a). Thus, this study expects that helping users to recognize, diagnose, and recover from errors will have a positive impact on satisfaction.
- Assistance and documentation content should be simple to find, and relevant to complete users' goals. Keeping it short and providing a list of specific actions that must be taken is compulsory (J. Nielsen, 1994a). Thus, this study expects that help and documentation will have a positive impact on satisfaction.

Based on the above discussion, the present study hypothesizes:

H1: e-Government portal usability has a positive relationship with satisfaction.

H2: Satisfaction with the government portal has a positive relationship with e-Government use.

Methodology

Measurement instrument

In this study, a quantitative approach is used to understand the impact of usability and satisfaction on the use of e-Government services in Peru. A survey was used for data collection. The questionnaire was divided into five sections. Section A randomly presented one of the three selected government websites to respondents and asked them to complete an information query. Then, the questions in section B were related to the usability dimensions. The questions in section C were about satisfaction, and in section D the questions were about the respondents' intention to use e-Government services. Finally, section E gathered respondents' demographics such as gender, age, IT usage experience, and public services usage frequency.

Each usability dimension was measured with three items adapted from Yusoh and Matayong (2017) and Turhangil, Erenler, (2018), satisfaction was measured with one item adapted from Oghuma et al. (2015), and use was measured with four items adapted from Ramos-de-Luna et al. (2016). All items were measured using a five-point Likert scale.

Data collection

This study mostly targeted adult citizens from urban areas in Peru who are current users of Peruvian public services. Data were collected between October and November 2021 via SurveyMonkey. Respondents were contacted via social media and other online platforms. A total of 68 completed responses were collected over three weeks. The sample was composed of a higher number of females (61.8%) than males (38.2%), while the range age with the largest frequency was from 21 to 29 years old. The demographic profiles of respondents are listed in Table 2.

Table 2. Sample demographics

Respondents	n = 68	
	Frequency	Percentage (%)
Gender		
Male	26	38.2
Female	42	61.8
Age		
18-20	7	10.3
21-29	22	32.4
30-39	6	8.8
40-49	12	17.6
50-59	15	22.1
60+	6	8.8
Experience using digital services		
Very inexperienced	0	0
Inexperienced	3	4.4
Neither experienced, nor inexperienced	11	16.2
Experienced	42	61.8
Very experienced	12	17.6
Frequency of access to public services		
At least once a week	13	19.1
At least once every 15 days	9	13.2
At least once a month	15	22.1
At least once every 3 months	11	16.2
At least once every 6 months	8	11.8
At least once every 12 months	12	17.6

Data analysis

For data analysis, the present study first assessed the reliability and validity of the instrument through a confirmatory factor analysis. After the validation of the survey, a principal component analysis (PCA) was used to reduce the variables measuring usability to just one measure. In the case of use, the average of the four items was used as a single measure of this variable. Finally, after the reduction process, a linear regression analysis was used to assess the impact of usability on satisfaction, and of satisfaction on use.

Results

Analysis of reliability and validity

The validity of the measurement model was established using construct reliability, convergent validity, and discriminant validity. To assess reliability and convergent validity, we used item reliability, internal consistency, and average variance extracted (AVE). Item reliability was assessed by examining each item's

loading on its corresponding latent variable. We found all item loadings were greater than the criterion of 0.7 (see Table 3) suggested by Barclay et al. (1995). Internal consistency (reliability) was assessed by examining the composite reliability and Cronbach's alpha values, which ranged from 0.834 to 0.959 and from 0.811 to 0.9570, respectively (see Table 3). Both composite reliability and Cronbach's alpha values were greater than the recommended value of 0.7 (Nunnally, 1978). We also found all AVE values were greater than the criterion of 0.5 (see Table 3) suggested by Hu et al. (2004). These results indicate that our measurement model is reliable and internally consistent.

Table 3. Constructs' reliability and convergent validity

Construct	Item	Loading	α	CR	AVE
Visibility of system status (VSS)	VSS1	0.846	0.811	0.887	0.724
	VSS2	0.834			
	VSS3	0.872			
Match between system and the real world (MSRW)	MSRW1	0.923	0.874	0.921	0.796
	MSRW2	0.838			
	MSRW3	0.914			
User control and freedom (UCF)	UCF1	0.880	0.874	0.922	0.798
	UCF2	0.904			
	UCF3	0.896			
Consistency and standards (CS)	CS1	0.808	0.821	0.893	0.736
	CS2	0.892			
	CS3	0.873			
Error prevention (EP)	EP1	0.884	0.900	0.938	0.834
	EP2	0.941			
	EP3	0.913			
Recognition rather than recall (RRR)	RRR1	0.802	0.819	0.893	0.736
	RRR2	0.922			
	RRR3	0.845			
Flexibility and efficiency of use (FEU)	FEU1	0.894	0.863	0.916	0.785
	FEU2	0.849			
	FEU3	0.914			
Aesthetic and minimalist design (AMD)	AMD1	0.794	0.721	0.834	0.627
	AMD2	0.730			
	AMD3	0.846			
Help users recognize, diagnose, and recover from errors (HURDRE)	HURDRE1	0.901	0.815	0.891	0.734
	HURDRE2	0.906			
	HURDRE3	0.755			
Help and documentation (HD)	HD1	0.888	0.867	0.916	0.785
	HD2	0.915			
	HD3	0.854			
Use (ADP)	ADP1	0.920	0.959	0.970	0.889
	ADP2	0.957			
	ADP3	0.946			
	ADP4	0.948			

Note: α = Cronbach's alpha; CR = Composite reliability; AVE = Average variance extracted; Satisfaction was excluded because it only has 1 item

Principal component analysis (PCA)

A general value for each usability-related latent variable was calculated as the average of its three items. PCA was run on the ten resulting variables in this study's sample. The suitability of PCA was assessed prior to analysis. Bartlett's test of sphericity was statistically significant ($p = 0.000$), indicating that PCA is

feasible (Leech, Barrett, & Morgan, 2013). PCA revealed two components that had eigenvalues greater than one and which explained 62.471%, and 10.275% of the total variance, respectively. However, we decided to include the third component that represents 6.596% of the total variance, although its eigenvalue is lower than one. Our decision was based on the fact that it is important to retain more variance but at the same time keep the simplicity of the output. Accordingly, by retaining three components instead of two, simplicity is not compromised, and in contrast, the captured variance increases to 80% of the original data.

The first component captures visibility of system status (VSS), match between the system and the real world (MSRW), error prevention (EP), consistency and standards (CS), user control and freedom (UCF), and recognition rather than recall (RRR). As for the second component, it captures the feature of helping users to recognize, diagnose, and recover from errors (HURDRE), help and documentation (HD), and flexibility and efficiency of use (FEU). Lastly, the third component captures aesthetic and minimalist design (AMD). Finally, a usability index was developed as a weighted average of these three components by using the variances of the component as weights.

Linear regression

Impact of usability on satisfaction

In this case, the independent variable was usability and the dependent variable was user satisfaction with the e-Government portal. In addition, demographics were used as control variables. The dataset was assessed to check whether the requirements for linear regression are met. First, the value of the Durbin-Watson test is close to 2 (2.325), which suggests that there is no correlation between errors (Laerd Statistics, 2015). Second, the absence of multicollinearity was guaranteed by checking that VIF values were under the threshold of 5 (Laerd Statistics, 2015) – the highest VIF value was 1.233 for IT usage experience. In the case of the homoscedasticity requirement (i.e., the variance of the errors is constant), the normal distribution of the errors, and the linear relationship between the independent variable and the dependent variable were all assessed by visual inspection (omitted for brevity), suggesting these requirements are met.

Considering that all linear regression requirements are met, the results (see Table 4) show that usability has a significant positive effect on satisfaction ($\beta = 0.454$, $p < 0.01$), while the effect of the control variables was not significant. Finally, the proposed model explains 30.3% of the variance in the dependent variable. These results provide evidence that supports H1.

Table 4. Linear regression results

Coefficients	Dependent variable: Satisfaction (H1)	Dependent variable: Use (H2)
Independent variables		
Usability	0.454** (VIF = 1.161)	N/A
Satisfaction	N/A	0.356** (VIF = 1.120)
Control variables		
Gender	0.098^{ns} (VIF = 1.055)	0.100^{ns} (VIF = 1.070)
Age	-0.010^{ns} (VIF = 1.085)	0.042^{ns} (VIF = 1.114)
IT usage experience	-0.028^{ns} (VIF = 1.233)	0.162^{ns} (VIF = 1.138)
Public services usage frequency	-0.092* (VIF = 1.061)	0.056^{ns} (VIF = 1.113)
Explained variance		
R2	30.3%	15.9%

* p-value < 0.05, ** p-value < 0.01, ns = Non-significant, N/A = Not applicable

Impact of satisfaction on use

In this case, the independent variable was satisfaction and the dependent variable was the future intention of using the e-Government portal. In addition, demographics were used as control variables. The dataset was assessed to check whether the requirements for linear regression are met. First, the value of the Durbin-Watson test is close to 2 (2.216), which suggests that there is no correlation between errors (Laerd Statistics, 2015). Second, the absence of multicollinearity was guaranteed by checking that VIF values were under the threshold of 5 (Laerd Statistics, 2015) – the highest VIF value was 1.138 for IT usage experience. In the case of the homoscedasticity requirement (i.e., the variance of the errors is constant), the normal distribution of the errors, and the linear relationship between the independent variable and the dependent variable were all assessed by visual inspection (omitted for brevity), suggesting these requirements are met.

Considering that all linear regression requirements are met, the results (see Table 4) show that satisfaction has a significant positive effect on the dependent variable ($\beta = 0.356$, $p = 0.006$), while the effect of the control variables was not significant. Finally, the proposed model explains 15.9% of the variance in the dependent variable. These results provide evidence that supports H2.

Discussion and implications

Access to public services is crucial for the proper functioning of modern states. With the development of ICTs, the opportunities to provide access to these services to a larger proportion of the population has increased, especially in developing countries. However, the success of these initiatives lies in their adoption by citizens. Hence, the importance of a proper user-centered design brings the concept of usability to the fore, although there is not empirical evidence of its role in e-Government adoption. The objective of this study is to determine whether usability of government portals might play an important role in citizens' decisions to use these digital services or not. Accordingly, this study proposes a research model to assess the impact of usability on satisfaction, and indirectly on usage continuance intention. The results provide empirical evidence that support the positive effect of usability on e-Government use, supporting the two associated hypotheses.

Theoretical implications

The literature review section suggests that there are no studies that provide empirical evidence for the influence of usability design on the e-Government field. Accordingly, the present study contributes to filling this gap by conducting an empirical study to determine the existence of a positive impact of these design best practices on users' satisfaction and consequent future intention to use e-Government services.

Practical implications

Although this study embraces usability as an index, it is important to consider all the dimensions of usability when implementing e-Government projects in Peru. This preliminary validation of the importance of usability design on the acceptance and use of e-Government services opens future research streams. For instance, governments may use larger samples to assess the independent effect of each of the usability dimensions. By doing so, governments may prioritize these dimensions based on which variables have a larger impact. For instance, managers may focus mainly on the first component of PCA, which is the component capturing the maximum variance of the dataset. This component may be labeled as ease of use considering the variables it captures. The second component in order of priority should be addressed next. This second component may be labeled as ease of learning. Finally, the third component may be labeled as minimalism, and may be the last feature to be addressed by managers.

This initial prioritization is important because of companies' time and budget constraints. Thus, even though it is usually a requirement for government contracts to work under the traditional waterfall model,

it may be better to use an incremental development strategy to address usability step by step. In this context, it may be interesting to use agile frameworks for the associated projects.

Limitations and future studies

This study presents some limitations. Firstly, sample size is small, and thus, future studies may collect larger sample sizes to validate these findings. Futures studies may use this larger sample size to conduct additional analysis with other techniques such as structural equation modelling, and include tests such as moderation and mediation effects to improve our understanding of usability.

Secondly, the collected sample is exclusively about the Peruvian context, so future research may include other countries to further increase the external validity of these findings. Finally, in line with the previous subsections, future studies may conduct a study to determine the individual impact of usability dimensions, and prioritize them to understand the causal chain for each one.

References

Aladwani, A. M. (2013). A contingency model of citizens' attitudes toward e-Government use. *Electronic Government*, *10*(1), 68–85.

Alomari, M. K., Sandhu, K., & Woods, P. (2014). Exploring citizen perceptions of barriers to e-government adoption in a developing country. *Transforming Government: People, Process and Policy*, *8*(1), 131–150.

Aniela, B. (2019). The use of digital public services by romanians, in light of the digital single market. In *Annals of "Constantin Brancusi" University of Targu-Jiu*. Retrieved from http://www.itu.int/en/ITU-D/Statistics/Pages/definitions/regions.aspx.html

Anthopoulos, L. G., Siozos, P., & Tsoukalas, I. A. (2007). Applying participatory design and collaboration in digital public services for discovering and re-designing e-Government services. *Government Information Quarterly*, *24*(2), 353–376.

Babich, N. (2019). *UI vs. UX Design: The Similarities & Differences*. Retrieved from https://xd.adobe.com/ideas/process/ui-design/ui-vs-ux-design-understanding-similarities-and-differences/.

Barclay, D. W., Higgins, C. A., & Thompson, R. (1995). The partial least squares approach to causal modeling: Personal computer adoption and use as illustration. *Technology Studies*, *2*, 285–309.

Bataineh, E., Mourad, B. Al, & Kammoun, F. (2017). Usability analysis on Dubai e-government portal using eye tracking methodology. In *2017 Computing Conference*, London.

Cristina, A., Garcia, B., Maciel, C., & Pinto, F. B. (2005). A Quality Inspection Method to Evaluate E-Government Sites. In *International Conference on Electronic Government*, Berlin.

e-Estonia. (2020). *E-Estonia guide*. Retrieved from https://e-estonia.com/wp-content/uploads/eestonia-guide-2018.pdf.

e-Estonia. (2021). *E-Estonia facts*. Retrieved from https://e-estonia.com/facts-and-figures/.

Fath-Allah, A., Cheikhi, L., Al-Qutaish, R. E., & Idri, A. (2014). E-government portals best practices: A comprehensive survey. *Electronic Government*, *11*(1–2), 101–132.

Grudin, J. (1992). Utility and usability: research issues and development contexts. *Interacting with Computers UOL*, *4*, 209–217.

Hu, X., Lin, Z., Whinston, A. B., & Zhang, H. (2004). Hope or hype: On the viability of escrow services as trusted third parties in online auction environments. *Information Systems Research*, *15*(3), 236–249.

Huang, Z., & Benyoucef, M. (2014). Usability and credibility of e-government websites. *Government Information Quarterly*, *31*(4), 584–595.

Kiran, G. R. (2002). *eGovernment for Development - Case Studies: Front-End First: Citizen Payment at FRIENDS Centres in Kerala*. Retrieved from http://www.egov4dev.org/success/case/friends.shtml

Kuzma, J., Rahim, W. A., Mohd, W., Muhammad, I., Suhami, R., & Semsudin, S. S. (2011). Assessing the Usability and Accessibility of Malaysia E-Government Website. *American Journal of Economics and Business Administration*, *3*(1), 40–46.

Laerd Statistics. (2015). *Simple linear regression using SPSS Statistics*.

Leech, N., Barrett, K., & Morgan, G. A. (2013). *SPSS for Intermediate Statistics*. Retrieved from https://doi.org/10.4324/9781410616739

Lerner, M. (2020). *Government tech projects fail by default. It doesn't have to be this way.* Belfer Center for Science and International Affairs.

Lopes, N. V., & Dhaou, S. Ben. (2018). Public Service Delivery Framework. In *11th International Conference on Theory and Practice of Electronic Governance*, Irland.

Lyzara, R., Purwandari, B., Zulfikar, M. F., Santoso, H. B., & Solichah, I. (2019). E-Government Usability Evaluation: Insights from A Systematic Literature Review. *ACM International Conference Proceeding Series*, 249–253.

Maddison, A., & Thesis, P. (2014). The impact of critical success factors on government IT projects: A case study of the Defence Information Infrastructure Programme. Retrieved from https://dspace.lib.cranfield.ac.uk/handle/1826/8766.

Maheshwari, B., Kumar, V., & Kumar, U. (2008). *E-Government Portal Effectiveness: Managerial Considerations for Design and Development*. Retrieved from https://www.academia.edu/3498277/E_government_portal_effectiveness_managerial_considerations_for_design_and_development.

Marchewka, J. T. (2010). The FBI Virtual Case File: A Case Study. *Communications of the IIMA*, *10*(2).

Mittal, P. (2020). Impact of Digital Capabilities and Technology Skills on Effectiveness of Government in Public Services. In *2020 International Conference on Data Analytics for Business and Industry: Way Towards a Sustainable Economy (ICDABI)*, 1–5.

Nielsen, J. (1994a). *10 Usability Heuristics for User Interface Design*.

Nielsen, J. (1994b). *How to Conduct a Heuristic Evaluation*.

Nielsen, J., Kaufmann, M., Diego, S., Francisco, S., York, N., London, B., & Tokyo, S. (1993a). Usability Heuristics. *Usability Engineering*, 115–148.

Nielsen, J., Kaufmann, M., Diego, S., Francisco, S., York, N., London, B., & Tokyo, S. (1993b). What Is Usability? *Usability Engineering*, 23–48.

Nielsen, M. M. (2017). eGovernance and Online Service Delivery in Estonia. In *18th Annual International Conference on Digital Government Research*, 300–309.

Nunnally, J. C. (1978). *Psychometric Theory*. New York, NY: McGraw-Hill.

OECD. (2015). *Policy Shaping and Policy Making: the Governance of Inclusive Growth Background Report*.

OECD. (2017). *Digital Economy Outlook 2017*. https://doi.org/10.1787/9789264276284-en

OECD. (2019). *Digital Government in Peru*. https://doi.org/10.1787/0c1eb85b-en

Oghuma, A. P., Chang, Y., Libaque-Saenz, C. F., Park, M.-C., & Rho, J. J. (2015). Benefit-confirmation model for post-adoption behavior of mobile instant messaging applications: A comparative analysis of KakaoTalk and Joyn in Korea. *Telecommunications Policy*, *39*(8), 658–677.

Pérez Chacón, S. R., Rodriguez Vilchez, J. L., Cabrera Berrios, J. A., Raymundo Ibañez, C. A., & Mauricio, D. S. (2021). Increasing e-government adoption by emphasizing environmental sustainability: An extended case study in Peru. *Transforming Government: People, Process and Policy*, *15*(4), 550–565.

PricewaterhouseCoopers. (2019). Digital Public Sector in CEE. Retrieved from https://www.pwc.com/c1/en/future-of-government-cee/digital-public-sector-cee.html

Ramos-de-Luna, I., Montoro-Ríos, F., & Liébana-Cabanillas, F. (2016). Determinants of the intention to use NFC technology as a payment system: An acceptance model approach. *Information Systems and E-Business Management*, *14*(2), 293–314.

Rocha, M. A. M., Sandoval, C. A. M., Bautista, J. S. A., & Ramírez, H. L. (2014). Developing a Usability Study for Mexican Government Sites. In *5th Mexican Conference on Human-Computer Interaction - MexIHC '14*, 1–6.

Samuel, M., Doctor, G., Christian, P., & Baradi, M. (2020). Drivers and barriers to e-government adoption in Indian cities. *Journal of Urban Management*, *9*(4), 408–417.

Turhangil Erenler, H. H. (2018). International journal of organizational Leadership Heuristic Evaluation of E-Learning. *International Journal of Organizational Leadership*, *7*, 195–210.

United Nations. (2020a). *E-government*. Retrieved from https://publicadministration.un.org/egovkb/en-us/About/UNeGovDD-Framework

United Nations. (2020b). *E-Government Survey 2020 Digital Government in the Decade of Action for Sustainable Development With addendum on COVID-19 Response*.

United Nations. (2021). *EGOVKB | United Nations > Data > Country Information*. Retrieved from https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/133-Peru

Verdegem, P., & Verleye, G. (2009). User-centered E-Government in practice: A comprehensive model for measuring user satisfaction. *Government Information Quarterly*, *26*(3), 487–497.

Yusoh, S., & Matayong, S. (2017). *Heuristic Evaluation of Online Satisfaction Survey System for Public Healthcare Service: Applying Analytical Hierarchical Process*.