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Article

E-government based on sustainable digitalization: The case of the Chinese social sustainability marketing technologies paradigm

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Abstract: Amidst China's burgeoning population and rapid technological strides, this study explores how elderly citizens navigate and embrace electronic governance (e-governance) platforms. Addressing a crucial gap in knowledge, we delve into their limited digital fluency and its impact on e-governance adoption. Our meticulously crafted online survey, distributed via WeChat across significant cities (Beijing, Shanghai, Tianjin, Changsha), yielded 396 responses (384 analyzable). Utilizing Structural Equation Modeling (SEM), we unearthed key influencers of subjective norms, including perceived ease and usefulness, trust, supportive conditions, and past tech exposure. These norms, in turn, positively shape attitudes. Crucially, educational background emerges as a moderator, amplifying the positive link between attitudes and e-governance engagement intent. This underscores the necessity of an inclusive, customized e-governance approach, offering valuable policy insights and advocating for holistic solutions for older adults. Our research yields empirical and theoretical contributions, paving the way for actionable Social Sustainability Marketing Technologies in China, particularly championing digital inclusivity for seniors.

Keywords: e-government; marketing technologies; social sustainability marketing technologies paradigm; older adult e-government acceptance model (OAEAM); behavioural intention to use

1. Introduction

The idea of e-government has gained considerable attention in the past few decades. E-government alludes to the critical use of information and technology and is a correspondence innovation to "offer citizens and associations progressively helpful access to government information and services; and to give conveyance of government services to residents, business partners, and providers, and those working in the government sector" (Adjei-Bamfo et al., 2020; Gronlund, 2002; Turban et al., 2004). The e-government should serve the general public and must help people of all

ages. According to the US Bureau of Health and Human Services and the US Department of Commerce's International Population Report, the world's population is ageing at an astounding rate. Additionally, older people must be more responsive to new technologies and applications (Morris and Venkatesh, 2000). China, one of the world's most populous countries, is experiencing a notable demographic shift, particularly in the context of its ageing population. However, China is a developing country and a highly internet-using country. The study shows that 70% of people over 65 have begun using the Internet and typically use it daily. The digital divide in developing countries, including China, is closely linked to education, income, and age. The selection of China as the focal point of investigation is predicated upon the distinctive socio-cultural and technological milieu intrinsic to the nation. Within this context, a notable segment of the elderly demographic actively participates in Internet activities and engages with e-government services.

This demographic trend and high utilization rate among older people in China present a distinctive and dynamic setting for the study. By choosing China as the focal point, we aim to contribute valuable insights into the challenges and successes encountered in a rapidly evolving technological landscape, particularly concerning adopting e-government services among older adults. The intention is to shed light on the nuanced factors influencing technology adoption within this demographic, drawing attention to the potential barriers and facilitating elements unique to the Chinese context.

In the landscape of e-government services, where the online paradigm is deemed essential, understanding factors influencing citizen adoption arises due to a consensus on suboptimal e-uptake (Alneyadi et al., 2022). Acknowledging the centrality of adoption for effective e-government implementation, the study underscores the challenges arising from low adoption, hindering the realization of the full potential of e-government initiatives. Notably, the study addresses a research gap by focusing on the demand side of e-government, particularly in developing countries like Togo, where the uptake has been challenging despite early Internet access (Chen and Aklikokou, 2020). These perceptions create interest among scholars in studying e-government acceptance factors among the older population, an area of research that has received limited attention (Lee et al., 2011).

Among these research studies, (Renaud and Van Biljon, 2008) offer a senior technology acceptance and adoption model (STAM). The current research examines the effect of these adopted influences on older adults' adoption of e-government services, bridging the gap between policymakers and consumers in information technology (IT) awareness and needs. This research endeavours to furnish public organizations with strategic insights into enhancing the adoption of their e-services and delineating the pertinent demographics that warrant focused attention. The inquiry is guided by the following paramount research questions, seeking to investigate the factors influencing the efficient use and adoption of e-government services and understand how older adults in China effectively embrace government-to-consumer (G2C) services. What factors underlie the efficient use and adoption of e-government services? How do older adults in China effectively adopt and utilize e-government (government-to-consumer [G2C]) services? How can the findings of this study be extrapolated to support public sector agencies and policymakers in other developing

countries facing circumstances similar to China? To ascertain this research, the current study, integrating the Technology Acceptance Model (TAM) and the Senior Technology Acceptance and Adoption model (STAM), shed light on the recognition and Acceptance of technology among older adults. This study will provide the road map to shift the mindset of older adults to a better attitude towards IT acceptance and participation. At the same time, connecting the gap to the meaning of this issue contributes to an exciting research subject. Additionally, this study extended the view that differences exist in the explicit information provided to older adults about transitioning to e-government services and how administrative bodies can better support and encourage this specific target population.

The study aims to complete an interconnected system by applying market research insights to product creation activities around the acceptance variables by addressing this issue. The current literature provides a broad understanding of factors influencing e-government adoption but needs a nuanced exploration within the unique context of older adults in China. This study aims to address this gap by conducting a large-scale survey, delving into the intricate dynamics shaping this demographic's effective utilization of e-government services. Older adults' utilization patterns of e-government services in China must be more adequately explored. This study seeks to address this gap by empirically examining the validity of adoption factors identified in earlier research phases, contributing nuanced insights into the effective adoption and usage patterns of e-government services among this demographic. Despite the increasing importance of e-government services, there needs to be more research on the applicability of findings in diverse developing country contexts. This study aims to fill this gap by establishing a framework that applies market research insights to inform product creation activities related to acceptance variables, thereby contributing to a comprehensive and interconnected system. Existing research recognizes the relevance of technology acceptance models, but there needs to be a notable gap concerning their application to the unique context of older adults. By integrating TAM and STAM, this study aims to address this gap, offering a roadmap to reshape the mindset of older adults and foster a more positive attitude towards IT acceptance and participation. The literature needs an in-depth exploration of the differences in explicit information provided to older adults regarding transitioning to e-government services. This research aims to delve into this gap, giving nuanced insights into strategies that administrative bodies can employ to support and encourage older adults, ultimately promoting increased utilization of e-government services within this demographic. The study intends to explore further the difference in explicit information provided to older adults about how they can more easily transition to e-government services and how administrative bodies can better support and encourage this specific target population to promote the use of e-government services.

2. Literature review

Indirectly or implicitly, the idea of "governance" implies that whatever is desirable, it also means that it is a framework for managing common resources that can be employed to achieve many goals, including sustainability (especially from the point of view of social sustainability marketing technologies paradigm), effectiveness,

soundness, suitability, honesty, accountability, equity, gender balance, and even democracy (Schmitter, 2019). E-government is critical to modernizing government in the 21st century. Governments, businesses, and employees can interact better through technology such as e-government. Electronic governments take into account the "latest rules of the game" when it comes to this interaction (United Nations [UN] E-Government Survey) (Draheim and Butt, 2019). As a simple Internet-based tool, e-government is a way to increase public and business services (Solinthone and Rumyantseva, 2016; Gustova, 2017). Listed below are the four paths to consider. Through government-to-citizen communication channels, citizens can communicate, generate, receive, and disseminate information pertinent to relevant topics, such as state property management. As a result of these capabilities, public authorities are more transparent because they can monitor the safety of citizens, the financial process, and the local authorities.

Chen and Aklikokou (2020) present a comprehensive e-government adoption model designed to identify the determinants influencing citizens' Acceptance of e-government services in the specific context of Togo. This investigation explores the mediating roles of perceived usefulness and ease of use. The public and private sectors interact in government-to-business processes such as taxing, licensing, issuing certificates and licenses, registering and dissolving legal companies, and preparing and submitting reports (Hartanto et al., 2021). This type of contact uses IT to improve supply chain management and increase the nation's competitiveness in global markets. Public authorities and local governments can use interdepartmental electronic information management systems to increase capacity (Oliveira et al., 2020; Ahmad et al., 2019). These measures result in both economic and social savings for public entities. Further, government-to-employee pathways support payroll and pension plans, employee happiness, and workforce development. Open political communication is needed to engage and inform a more informed populace (Yildiz, 2007; Preacher and Hayes, 2008).

2.1. E-government services in China: Policy, process, and systems

In 2001, the Chinese government announced that 80% of metropolitan government agencies would be online by 2005. According to the 10th Five-Year Plan (2001–2005), Chinese Internet users should reach nearly 150 million by 2005 (Albesher and Stone, 2016). This objective may significantly impact the use of Internet technology in the public and private sectors (Fatima et al., 2023). Government competence and productivity could be boosted. The Internet economy fueled China's GDP and sustainable development (Ming et al., 2018). Alibaba's online economy had a value of 8000 billion RMB in 2014. Since 2010, China's Internet economy has grown five to seven times faster than its GDP, according to Marinina et al. (2022). WeChat, a mobile social networking platform with a large user base and expanding offerings, is the most influential app in China. WeChat launched public services in late 2014, bringing remarkable convenience to its users (Babar and Ahmed, 2023). Weibo and WeChat have integrated government e-services into their main platform features, from messaging to payments (Hou et al., 2020). Chinese government services use social networking applications to ensure citizens use government services despite concerns

about sharing personal information and outsourcing government services to private companies (Zhang et al., 2022). In 2018, UN research found that mobile devices experienced the most remarkable Internet expansion. There is significant potential for expansion. In addition, China has laid the foundation for expanding mobile internet. In 2018, 600 million individuals used Internet payments, an increase of 13% over 2017, according to the China Internet Network Information Center. E-government is also driving dynamic growth and the development of an electronic China.

More than 570 million people currently use the app (WeChat). Over 900 million people have benefited from our 30,000-government mini-programs. China has made significant progress in developing e-government over the past 20 years. Chinese citizens and government representatives can interact online through official websites. For instance, requests can be processed electronically without paper paperwork. Through electronic transactions, the Chinese government has improved efficiency for both agents and clients. A fully functioning e-government will save the state money and improve service. E-government has revolutionized the way Chinese citizens interact with their government. Now, the government can be contacted anytime without waiting in lines for paperwork or travelling. Since 1999, China's e-government has offered information and services via websites. These procedures apply to all levels of government. Over 85% of county governments, 100% of national and provisional governments, and 99.1% of city governments used e-government in 2015. Chinese municipalities increasingly offer smartphone apps. Many local governments also use big data for policy-making and e-government (Ahmad et al., 2022; Lu et al., 2018).

2.2. E-Government adoption among the older adult population of China

Information and communications technology (ICT) infrastructure capabilities can be learned in later life. The Social Sustainability Marketing Technologies paradigm significantly impacts older people's quality of life. Therefore, quality ICT training and help are necessary to promote internet productivity among older people (Hardill and Olphert, 2012). When older people are granted access to and mastery of ICT skills, it has been proven that it will become part of their everyday life. Our research shows that 70% of people over 65 have begun using the Internet and typically use it daily. The digital divide in developing countries, including China, is closely linked to education, income, and age. In total, 61% of internet non-users do not have a formal education, relative to 6% of internet non-users with credentials from higher education, according to data from a United Kingdom (UK) survey (Blank and Dutton, 2012). The same study indicates that an individual's income level is positively linked to internet usage and non-use. It correlates to a survey conducted 2009 by the Center for Work Research and the Age Action Organization for Middle-Aged and Older People with Return on Investment. The study found that, although the number of older people using ICT is increasing, many say they are not interested in learning ICT skills.

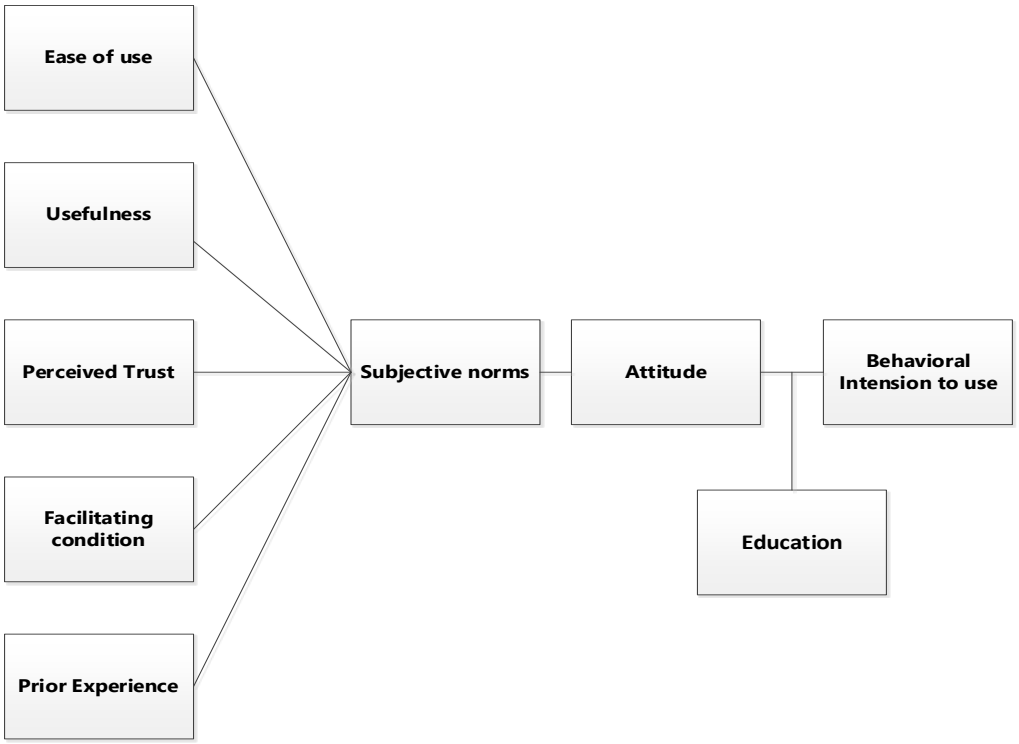

Figure 1. Conceptual framework of e-government services'. Adoption among older adults (including social sustainability marketing technologies paradigm).

Figure 1 depicts the conceptual framework for the adoption of e-government services by older adults, which includes the social sustainability marketing technology paradigm. This framework visualizes the important aspects and relationships under investigation in the study. It describes the different factors that influence older individuals' acceptance of e-government services, with a focus on the social sustainability marketing technology paradigm (Guner & Acarturk, 2020). The image serves as a reference for understanding the complex interaction of factors that influence older individuals' use of e-government services, and it will be used to inform the study's research and analysis (Harris & Rogers, 2023; Yu-Huei et al., 2019).

2.3. Conceptual framework

2.3.1. Perceived ease of use (PEOU)

Perceived ease of use (PEOU) measures whether the user imagines the target system as free of effort. A clear link is found between technology, its characteristics, and the user's experience (Davis, 1989). Furthermore, a connection exists between individual computer self-efficacy (Davis, 1989; Feng et al., 2015) and motivation (Yang, 2017).

Perceived ease of use (PEOU) has an essential influence on behavioural intention. However, this has less impact than perceived usefulness (PU) as the PEOU does not directly affect users' behavioural intentions. The effect on intention emerges through perceived usefulness (PU) (Hong et al., 2017). Therefore, the PEOU cannot be influenced when users do not perceive the new technology's benefits. The original five-point Likert scale developed has been used in many subsequent studies. This scale

has six items to estimate the PEOU, which were discovered to be valid and reliable in the PEOU estimation.

Hypothesis 1 (H1): Perceived ease of use positively impacts the subjective norms of adopting e-government services among older adults.

2.3.2. Perceived usefulness (PU)

Perceived usefulness is the degree to which people trust that a particular system will improve their performance. Several studies have shown that perceived usefulness (PU) strongly correlates with user acceptance. These include spreadsheet systems acceptance and word processing (Poquiz et al., 2023), predicting user intentions (Lin and Kim, 2016), telecommuting technology (Mills, 2016), and measuring the ability to use wireless and websites (Venkatesh and Ramesh, 2006). According to the TAM, perceived usefulness (PU) is a critical determinant of usage. As a primary determinant, perceived usefulness (PU) positively impacts users' convictions and intentions toward technology. In discussing the original technology acceptance model (TAM), the TAM highlights how external variables affect perceived usefulness (PU) (Nawaz et al., 2017). Other studies, including social impact (subjective norms, volunteerism, and image) and cognitive tools (job relevance, output quality, provability of results, and PEOU), are being collected as perceived usefulness (PU) structures. The results show that the importance of social impact and cognitive mechanisms in improving users' perceptions of technological usefulness explains about 60% of the difference.

Hypothesis 2 (H2): Perceived usefulness positively impacts the subjective norms of adopting e-government services among older adults.

2.3.3. Perceived trust (PT)

According to Alarcon et al. (2018), trust is characterized as the desired value on which the commitment of a person or community will rely. Two other significant facets of the efficiency of e-government services can be found within the perceived trust (PT): perceived protection and privacy (Khaleel and Hussain, 2023). Security and privacy are essential in establishing and enforcing high standards if a digital framework includes public users, such as e-government. Consumers need to feel safe when communicating with information systems (IS) and software to increase the extent of implementing and using these systems (Tolston et al., 2018). The protection and privacy of user information mean several things, including well-protected databases, maintaining the confidentiality of financial activity correspondence, ensuring that user information is not misused, and not exchanging it with another party without their consent and approval (Shareef et al., 2011). The alleged loss of privacy relates to the risk that data and knowledge submitted by persons to e-government programs may be misused or exchanged without authorization (Dugdale, 2018).

Hypothesis 3 (H3): Perceived trust positively impacts the subjective norms of adopting e-government services among older adults.

2.3.4. Facilitating conditions (FC)

Facilitating conditions (FC) can be defined as "the extent to which individuals perceive the organizational and technological infrastructure used by support systems" (Venkatesh et al., 2003). The basic assumption across these models is that all aspects of the technology and organizational environment are in place to reduce barriers to

technology use. The key to understanding this factor is that older adults have the time, money, and knowledge to adopt smartphones (Choudrie et al., 2020; Ahmed and Kabir, 2018). According to previous studies, constructing facilitating conditions leads to the Acceptance or adoption of mobile phones (Zhou et al., 2010). Other studies also combine the convenience factor in the acceptance of smartphone online applications in China (Lai et al., 2019); smartphone presentation acceptance in Singapore (Khan et al., 2020); intention to use smartphones in Bangkok (Pitchayadejanant, 2011); Chinese mobile banking (Zhou et al., 2010); mobile technology acceptance (Choudrie et al., 2020); and mobile device and services (Gordon and Hornbrook, 2018).

Hypothesis 4 (H4): Facilitating conditions positively impact the subjective norms of adopting e-government services among older adults.

2.3.5. Prior experience (PE)

Prior experience (PE) refers to the user's previous experience using online applications and services, including e-business and e-commerce services, online banking, online shopping, and online payment services (Bhattacherjee, 2000). Consider the situation of someone who has difficulty using individual facilities, such as placing an online order or transferring money online. In that case, they could encounter the same problems using e-government services. It would also limit the adoption and use of e-government services (Sun et al., 2008). On the other hand, if users are satisfied with and have no problems using online applications and services, this may positively impact their adoption and use of e-government services. Older people often find it challenging to understand new technologies if they are not in a position to recall relevant experiences. It is helpful to use an appropriate analogy to communicate with other systems with which they are familiar. For example, Price et al. (2014) consider older people's previous computer experience and related capabilities when designing graphical user interfaces (GUIs). Technical familiarity is a measure of expertise regarded as an essential factor for intuitive interaction (Blackler et al., 2010).

Hypothesis 5 (H5): Previous experience positively impacts the subjective norms of adopting e-government services among older adults.

2.3.6. Subjective norms (SN)

Studies have shown that society's influence significantly affects people's attitudes toward e-government services. The degree of personal awareness about the opinions of others that they should use the new system determines the degree of social impact. The perceived utility of electronic services and the intention to adopt e-government services are influenced by subjective norms (Kurfalı et al., 2017; Lee and Porumbescu, 2019). Social influence can also be mitigated by gender, with women more sensitive to other people's perspectives and age factors. Young citizens, especially, are more likely to imitate other people's behaviour.

In contrast, people with a lower level of education or less internet experience tend to be early followers of standards (Al-Gahtani et al., 2007; Venkatesh and Bala, 2008). According to previous discussions, as silver surfers (i.e., older people) embrace emerging technology, they are typically motivated by others, particularly near relatives, such as their families and good friends. Previous research relating to different innovations has often found the social influence of technology to be

significant. Examples of research using social impact include an analysis of 3G adoption in China (Chong et al., 2012), mobile coupons and mobile phone adoption among older adults (Chong et al., 2012), online apps on smartphones, and older Thai adults' perceptions of smartphone practice for e-health services (Boontarig et al., 2012).

Hypothesis 6 (H6): Subjective norms positively influence the attitude towards adopting e-government services among older adults.

2.3.7. Attitudes (ATT)

Attitudes (ATT) towards technology may also be related to more general aspects, such as personal preferences. Some older people have adopted other more sophisticated forms of technology (e.g., telephones), stating that computer technology seems less critical. They can accomplish similar tasks through telephones rather than computers (Roque and Boot, 2018). Older people have also reported spending time on hobbies that do not include technology (Guo et al., 2013). Such attitudes concerning technology are very influential in their final choices about whether or not to accept technology.

Interestingly, previous studies highlight that higher comfort levels and interest in computers have increased the use of computer products/services (Jeng and Tseng, 2018). The current study extends these findings by assessing the impact of people's attitudes towards technology, including their comfort and interest, with technology other than computers, such as mobile phones, global positioning system (GPS) navigation, Facebook, etc. The results of the current study also show that higher levels of comfort and interest are related to higher levels of technology adoption.

Hypothesis 7 (H7): Attitudes positively impact older adults' behavioural intention to use e-government services.

2.3.8. Moderating effects of education (EDU)

In the literature, many scholars have examined and tested the effects of individual characteristics or personality factors on technology acceptance. Although a few studies in technology acceptability covered education, the Unified Theory of Acceptance and Use of Technology (UTAUT) did not (El-Gayar and Moran, 2006). Behavioural purposes measure the influence on smartphone usage resulting from a person's choice to use a smartphone. This study suggests that older adults use e-government tools when the time is right and the environment is favourable (Donat et al., 2009). Education significantly impacts older people's access to digital technology, as they are 3.1 times more likely to possess personal computers (PCs) than people with low education. Education alone or other relevant factors may not support technology utilization (Niederhauser et al., 2018). Due to its correlation with the financial situation (as an associated factor) (Tezci, 2011), income, access to services (Adjei-Bamfo et al., 2020), and technology expertise, education cannot be considered a separate research component. According to Zmud's (Marengo et al., 2020) analysis of the research, people with better education will use Al-Gahtani (Al-Gahtani and King, 1999) into the impact of education on usage produced conflicting results. There was no significant finding in other educational research. Education will affect the association between attitudes toward behavioural intention to use (Jackson et al., 1997; Miller et al., 2006). It makes sense that education is a significant moderating influence. In the belief that

knowledge positively influences a user's attitude. Based on the above literature, the following hypothesis has been made.

Hypothesis 8 (H8): Education positively moderates the relationship between older adults' attitudes and behavioural intention to use e-government services.

3. Methodology

The study adopted a quantitative methodology. Its objectives were to investigate and explore the notable elements that influence older people's adoption and utilization of e-government services and approve the proposed structure by researching and testing hypothesized relationships between the proposed constructs. This study used purposive convenience sampling to collect data from diverse locations in China, including Beijing (China's capital city), Shanghai, Tianjin, and Changsha, China's metropolitan cities. For reliable data collection, the research mainly focused on education institutions, public banks, pension offices, community centres, old-age benefits offices, offices of non-governmental organizations (NGOs), and, with specific goals, educated respondents with prior experience with technology. Similarly, due to the ageing-related disabilities and accessibility options in mobile technology, social media networking tools (WeChat) were utilized to find potential respondents in the targeted areas. The study chose to gather data from various locations to enhance the reliability of the findings, improve the sample's representativeness, assist the generalizability of the results, and decrease the bias that could occur when using the purposive convenience sampling method (REF). Data were collected from respondents aged 50 and above. Before collecting data from respondents, a pilot study was conducted to confirm construct validity. According to (Bell, 2005), 50 responses were collected in pilot testing, which helped the researcher guarantee the instrument's construct validity (REF, REF). This study utilized rating scales to manage the inclusion of closed-ended questions. The adopted rankings had an odd number of five and seven, which seemed appropriate and convenient (Birmingham and Wilkinson, 2003). We sent 500 questionnaires after analyzing and thoroughly checking the questionnaire content. Only 396 were completed, with 384 suitable for consideration, enabling the researcher to examine and statistically analyze the collected data to formulate reliable findings.

3.1. Sampling and data collection process

The sample size in this study was 384 with a margin of error of 5% and a confidence level of 95%, "$n = z^2 \times (p)(1-p) \times c^2$". Survey questionnaires were designed to collect data from respondents who use WeChat as a social networking tool. The Chinese government recently reported that monthly active users (WeiXin in Chinese) had reached 1.082 billion, a considerable percentage of the Chinese population. In other words, WeChat was the most commonly used social media platform with the highest popularity in China during this study.

3.2. Demographics

As shown in **Table 1**, 73.1% of the total respondents (n = 384) were male, and 26.8% were female. One of this research's key challenges and complexities was

gathering data from female respondents for religious and cultural reasons. In the age range (**Table 1**), more than half of the respondents (29.9%) were aged between 50 and 55, with 20.8% aged from 56 to 60. In China, it is generally believed that their family members should authorize citizens over 60 to retire from government work. The marital status results showed that 7% of respondents were single, while 48.7% were married, 20.1% were widowed, 14.8% were divorced, and 9.4% were separated. The findings revealed that 2.9% of respondents who attended secondary school were 21%. Besides, 31.8% were diploma holders or had college qualifications, whereas 32.6% held a bachelor's degree. Only 12.2% of respondents had a Master's degree, while only 1.6% had doctoral degrees. 28.4% of respondents were from Beijing, 27.1% were from Shanghai, 25.5% were from Karachi, and 19% were from Changsha. Therefore, most respondents were from the Punjab province, China's largest province in terms of population. The respondent's employment status was an essential concern in adopting e-government services. The results indicated that 20.6% of respondents were pensioners, 4.4% were retired, 15.6% were currently full-time, 24.2% were part-time employed, 2.9% were unemployed, and 32.3% were self-employed. The overall mean household size was 6.25, indicating China's massive population, confirmed in other data showing China's high birth rate. In total, 2.3% of respondents had an annual income in the range of 0–80,000 China Yuan (CNY), while 18.5% were in the field of 81,000–140,000 CNY; 26.8% were in the range of 141,000–200,000 CNY; 18.2% were between 201,000 CNY and 260,000 CNY; while 20.1% had an income of more than 260,000 CNY, and 14.15% said that they did not know their annual income.

The proficiency in computer use indicated that 25.3% of respondents had a low-level ability to use a computer. In all, 37.8% of respondents had an average ability to use a computer, while only 12.2% indicated that they had an excellent knowledge of computer use. In total, 37% of respondents used the Internet daily, 37.25% used it several days a week, and 24.7% used it some days a month, whereas only 1% had never used the Internet. Among the respondents, about 83.1% were already used to the term "e-government," while 16.85% had not heard about e-government. Moreover, 89.3% were interested in learning more about e-government in the future, while 10.6% did not want to know about e-government. This level of interest indicated that e-government could benefit citizens with user-friendly services. When asked about respondents' e-government services, 91.6% responded that they had used them, while 8.2% had not used e-government services. According to this study, older Chinese adults are highly likely to use e-government services. The results indicated that 86.5% could use non-governmental online services, while only 13.4% could not use online services. **Table 1** shows that 86.5% of respondents used non-governmental online facilities for purchases, such as online banking, online shopping, and online payments. Around 13.4% of respondents indicated that they were not using these facilities. Analyzing the impact of previous use of these online services on e-government would be easier if we understood the form of online services provided by respondents. **Table 2** shows the standard deviations of demographic characteristics of respondents.

Table 1. Demographic characteristics of respondents.

		Percentage (%)
Gender	Male	73.1
	Female	26.8
Age	50–55	29.9
	56–60	20.8
	61–65	14.1
	Over 66	35.2
Marital status	Single	7.0
	Married	48.7
	Widowed	20.1
	Divorced	14.8
	Separated	9.4
Education	Primary or Secondary level	21.0
	Technical Diploma	31.8
	Bachelors	32.6
	Master's	12.2
	Doctoral (Ph.D.)	1.6
City of residence	Beijing	28.4
	Shanghai	27.1
	Changsha	25.5
	Tianjin	19.0
Employment status	Pensioners 50+	20.6
	Retired (under 65 years old)	4.4
	Currently employed full-time	15.6
	Currently employed part-time	24.2
	Unemployed	2.9
	Self-employed	32.3
Annual income (CNY)	0–80,000	2.3
	81,000–140,000	18.5
	141,000–200,000	26.8
	201,000–260,000	18.2
	More than 260,000	20.1
	I do not know	14.1
Proficiency in using computer	Low	25.3
	Average	37.8
	Good	24.7
	Excellent	12.2
Use the Internet	Every day	37.0
	Several days a week	37.2
	Several days a month	24.7
	Never use the Internet	1.0

Table 1. (*Continued*).

		Percentage (%)
Knowledge about e-government before participating	Yes	83.1
	No	16.8
Interested in learning more about e-government	Yes	89.3
	No	10.6
Online access to government services	Yes	91.6
	No	8.2
Online services offered by non-governmental organizations	Yes	86.5
	No	13.4

n = 384.

Table 2. Means and standard deviations of demographic characteristics of respondents.

Name of variable	Mean	Std. Deviation
Gender	1.1693	0.37548
Age	2.1380	1.05177
Marital status	2.7083	1.09989
Education	3.3698	1.06142
City of residence	2.3516	1.08580
Employment status	3.8125	1.86524
Annual income	3.7734	1.39122
Computer proficiency	2.2396	0.98876
Use of Internet	1.8984	0.80637

4. Analysis

Structural equation modelling (SEM) is an important instrument that uses exploratory factor analysis (EFA) and regression to evaluate the measurement and structural models simultaneously (Hair et al., 1998). In the current study, SEM was applied using AMOS v.24. Before testing the size and structural model through factor loading, EFA was performed to measure the factor loading of the constructs, employing Cronbach's alpha values and the Kaiser–Meyer–Olkin (KMO) test. The benchmark value of factor loadings was 0.5, while for Cronbach's alpha, the benchmark value was 0.6, with this value from the KMO test >0.5 (Anderson and Gerbing, 1988). **Table 3** shows that Cronbach's alpha, factor loadings, and KMO values for all constructs were more than 0.5. Hence, our results indicated that these measures were valid.

Table 3. Results of exploratory factor analysis (EFA).

Construct	Measuring Items	Item Code	Factor Loadings	KMO
Perceived ease of use (PEOU)	My experience with the e-government service website has been positive.	PEOU1	0.816	0.89***
	In terms of technology, it is easy to use.	PEOU2	0.724	
	Interacting with technology is often frustrating (R)	PEOU3	0.691	
	Interacting with the e-government website enables online feedback to the government when needed.	PEOU4	0.651	
Perceived usefulness (PU)	The e-government service website provides me with valuable service.	PU1	0.912	0.91***
	E-government websites make it easier to accomplish tasks than traditional government services.	PU2	0.868	
	Using e-government services enhances the quality of my work.	PU3	0.745	
	Using e-government services helps me be more productive.	PU4	0.701	
Perceived trust (PT)	I do not believe it is safe to deal with the government over the Internet (R).	PT1	0.842	0.87***
	I am concerned that my data may be used without my consent in e-government systems (R).	PT2	0.812	
	E-government systems would be reluctant to provide financial information (e.g., bank account information).	PT3	0.758	
	My hesitation would be if I were asked to provide personal information (address and income) through an e-government system.	PT4	0.714	
Facilitating conditions (FC)	I have the necessary resources to use the system.	FC1	0.795	0.84***
	I have enough internet experience to use online services.	FC2	0.752	
	The operating cost is sufficient to use my smartphone and the internet.	FC3	0.711	
	If I have trouble using an e-government service, I can get help from others.	FC4	0.685	
Prior experience (PE)	How would you rate your experience with e-government in general?	PE1	0.788	0.82***
	Will your previous experience with e-government affect how you use it in the future?	PE2	0.725	
	Do you have any experience using online services provided by non-government organizations?	PE3	0.713	
	Based on your experience using non-government online services, how will your willingness to use e-government services affect your decision?	PE4	0.682	

Table 3. (*Continued*).

Construct	Measuring Items	Item Code	Factor Loadings	KMO
Subjective norms (SN)	Do people I care about prefer e-government services?	SN1	0.925	0.87***
	If my friends used e-government services, I would do the same.	SN2	0.758	
	People's social status is enhanced by interacting with e-government online.	SN3	0.715	
	I use online government services because many people use them.	SN4	0.634	
Attitudes (ATT)	I feel comfortable with technology.	ATT1	0.925	0.85***
	I can succeed if I work hard to learn about technology.	ATT2	0.845	
	Technology will never replace the need for working human beings.	ATT3	0.762	
	Technology is dehumanizing (R).	ATT4	0.691	
behavioural intention to use (IU)	I intend to use e-government services if I have access to them.	IU1	0.872	0.88***
	To obtain information and services, I would use e-government.	IU2	0.843	
	Providing information to the e-government would be fine for me.	IU3	0.755	
	I intend to use the e-government information system in my next passport and national identity card applications.	IU4	0.715	

Note: *, **, *** at the 10%, 5%, and 1% significant levels, respectively.

4.1. Results and analysis

Following Anderson and Gerbing (1988), two systematic steps evaluated the results of the proposed model. Confirmatory factor analysis (CFA) was performed in the first phase to test the measurement model. In contrast, scores of the proposed model's fit indices were tested using the SEM structural model in the second phase. As the SEM technique helps validate research results, it is adopted by researchers from various disciplines. Researchers check scores for fitness indices, such as chi-square, Tucker-Lewis Index (TLI), Normative Fit Index (NFI), Comparative Fit Index, and root mean square error of approximation (RMSEA), to evaluate the fitness of the model. For example, the accepted chi-square rate should be between 2.0 and 5.0 based on the sample size (Hu and Bentler, 1999).

If the value of RMSEA is less than 0.07, this score indicates good fitness. By Arbuckle (2003), NFI and TLI scores are predicted to reach 0.90.

Model validity

Table 4 shows the results of the reliability measures of the SEM model indicated that the proposed model had reasonable validity. Furthermore, the eigenvalues of the second vectors were much lower for all items. These results suggest that the proposed SEM model is valid.

Table 4. Uni-dimensionality and reliability measures for SEM model.

Constructs	Manifest variables	Eigenvalue 1st	Eigenvalue 2nd
PEOU	4	3.10	0.44
PU	4	2.81	0.40
PT	4	2.32	0.39
FC	4	3.19	0.46
PE	4	2.99	0.26
SN	4	3.06	0.35
ATT	4	3.23	0.49
IU	4	3.41	0.36

ATT attitudes; IU Behavioral Intentions to Use; SN subjective norms; PEOU Perceived Ease of Use; PU Perceived Usefulness; FC Facilitating Conditions; EDU Education; PT Perceived Trust; PE Prior Experience.

4.2. Measurement model analysis

The proposed model showed a good fit according to the benchmarks mentioned above. The results of different model fitness criteria are provided in **Table 5**. The (Comparative Fit Index) CFI and Tucker-Lewis Index (TLI) values are reasonably high (0.96 and 0.93, respectively), showing the proposed structural model is suitable. The TLI value 0.93 is the parameter which define and assesse the fitness of a structural equation model. Furthermore, the importance of χ^2, RMSEA, and the standardized root mean square residual (SRMR) confirm that the proposed SEM model performed reasonably well in model fitness criteria.

Table 5. Fit indices for SEM model.

Criteria	Value
CFI	0.96
TLI	0.93
χ^2	52.23
RMSEA	0.05
SRMR	0.04

TLI: Tucker-Lewis Index, SRMR: Standardized Root Mean Square Residual, RMSEA: Root Mean Square Error of Approximation.

4.3. Means and standard deviations of study variables

The results for all variables' mean and standard deviations are shown in **Table 6**. A higher value for a variable indicates the significance of that variable. The findings revealed that the variable "facilitating conditions (FC)" has the highest means, showing that respondents' responses were trending toward this variable. The lowest standards were recorded for perceived trust (PT), suggesting respondents were scared to share their personal information with the government. Ease of use (EU) was also the next most important factor among the variables after facilitating conditions (FC).

Table 6. Means and standard deviations of study variables.

Variable	Mean	Standard Deviation
Education	2.91	2.01
Perceived ease of use (score ranges from 4–20)	16.10	3.40
Perceived usefulness (score ranges from 4–20)	15.90	3.22
Perceived trust (score ranges from 4–20)	13.35	3.09
Facilitating conditions (score ranges from 4–20)	16.89	2.59
Prior experience		
PE1 (score ranges from 1–3)	2.22	0.76
PE2 (score ranges from 1–3)	2.51	0.35
PE3 (score ranges from 1–3)	2.41	0.49
PE4 (score ranges from 1–3)	2.05	0.91
Subjective norms (score ranges from 4–20)	14.99	2.77
Attitudes (score ranges from 4–20)	15.11	3.01
Behavioural intention to use (score ranges from 4–20)	16.22	2.01

Notes: Ranges reflect the possible maximum and minimum scores according to the method of measurement; *$p < 0.05$, **$p < 0.01$.

4.4. Correlations

We calculated the bivariate correlations for all items in **Table 7**. The results indicated that all variables were positively correlated with subjective norms (SN), attitudes (ATT), and behavioural intention to use (IU), but overall, none of the values was alarming. Specific variables correlated with behavioural intention to use (IU). **Table 8** shows respondents who rated highly on IU were likely to rank higher on the perceived ease of use (PEOU) construct. Similarly, the facilitating conditions (FC) score was likely higher for respondents who rated highly on behavioural intention to use (IU). The relationship between subjective norms (SN) and IU was also positive, implying that respondents who rated highly on the SN variable were likely to have a higher behavioural intention to use e-government services.

Table 7. Correlations between latent variables (LVs).

LVs	EDU	PEOU	PU	PT	FC	PE	SN	ATT	IU
EDU	1.00								
PEOU	0.21*	1.00							
PU	0.11	0.23*	1.00						
PT	0.16	0.18	0.09	1.00					
FC	0.13	0.26*	0.13	0.06	1.00				
PE	0.19	0.15	0.11	0.12*	0.19	1.00			
SN	0.26	0.21*	0.13	0.22	0.30	0.17	1.00		
ATT	0.11	0.08	0.19	0.26	0.12	0.27	0.31	1.00	
IU	0.18	0.07	0.14**	0.19	0.28**	0.17	0.26*	0.15	1.00

ATT= Attitudes; IU= Behavioral intentions to Use; SN= Subjective norms; PEOU= Perceived ease of use; PU= Perceived usefulness; FC= Facilitating conditions; EDU= Education; PT= Perceived trust; PE= Prior experience.
Note: *, **, *** at the 10%, 5%, and 1% significant levels, respectively

4.5. Structural model analysis

The following results reflect the situation in developing countries: PU and ATT are positively correlated, while PU and PT have no dependency. The SN and ATT constructs are most highly correlated in this study. Cultural values and social setup are most influential for older adults, especially in adopting new e-services. PT and FC mainly influence the SN construct; both are positively correlated, while FC and PT have no significant correlation. The IU and FC constructs are also positively correlated, while ATT and PEOU have a negligible correlation, with PU and PT having this result.

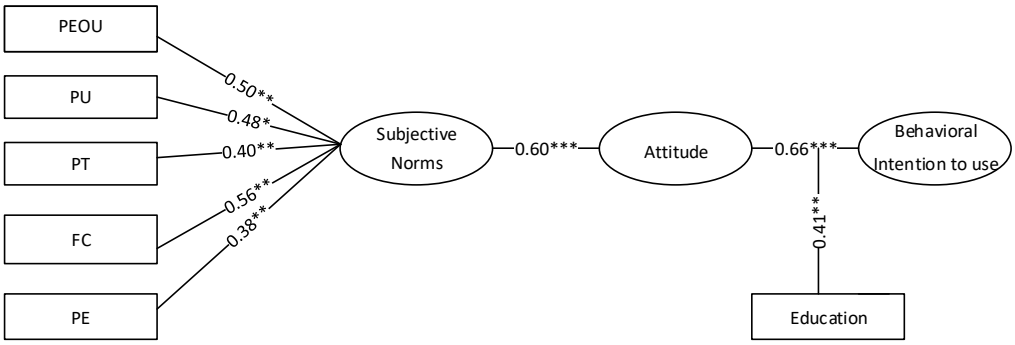

Figure 2. Path diagram for the proposed model.
Note: *, **, *** at the 10%, 5%, and 1% significant levels, respectively.

As expected, the direct effect of attitudes (ATT) on behavioural intentions to use (IU) e-government services is positive and significant ($\beta = 0.66$, $p < 0.001$). Similarly, a substantial direct effect was found between subjective norms (SN) and ATT ($\beta = 0.66$, $p < 0.001$). This result follows our expectations. However, we find that the effect of SN on IU is attenuated when mediated through the ATT variable. Therefore, the indirect effect between SN and IU has a value of 0.4 in **Table 8**. The direct impact of latent variables on subjective norms (SN) is as expected in the proposed model. As seen in **Figure 2**, significant direct effects were found between Perceived ease of use (PEOU) on subjective norms (SN) ($\beta = 0.5$, $p < 0.01$); perceived usefulness (PU) on subjective norms (SN) ($\beta = 0.48$, $p < 0.05$); perceived trust (PT) on subjective norms (SN) ($\beta = 0.40$, $p < 0.01$); facilitating conditions (FC) on subjective norms (SN) ($\beta = 0.56$, $p < 0.001$); and prior experience (PE) on subjective norms (SN) ($\beta = 0.38$, $p < 0.01$). However, the indirect effects of these variables on behavioural intentions to use (IU) e-government services were somewhat attenuated **Table 8**. Education (EDU) was tested as the moderator in the relationship between attitudes (ATT) and behavioural intention to use (IU). The results show that education (EDU) positively moderates this relationship ($\beta = 0.41$, $p < 0.01$). Respondents who were relatively more educated and rated highly on the ATT variable were likelier to use e-government services.

Table 8. Effect sizes in SEM model.

Relationship	Direct effect	Indirect effect	Total effect
ATT → IU	0.66	0.00	0.66
SN → IU	0.00	0.40	0.40
SN → ATT	0.60	0.00	0.60
PEOU → ATT	0.00	0.30	0.30
PEOU → SN	0.50	0.00	0.50
PEOU → IU	0.00	0.20	0.20
PU → SN	0.48	0.00	0.48
PU → ATT	0.00	0.29	0.29
PU → IU	0.00	0.19	0.19
PT → SN	0.40	0.00	0.40
PT → ATT	0.00	0.24	0.24
PT → IU	0.00	0.16	0.16
FC → SN	0.56	0.00	0.56
FC → ATT	0.00	0.34	0.34
FC → IU	0.00	0.22	0.22
PE → SN	0.38	0.00	0.38
PE → ATT	0.00	0.23	0.22
PE → IU	0.00	0.15	0.15

ATT= Attitudes; IU= Behavioral intentions to Use; SN= Subjective norms; PEOU= Perceived ease of use; PU= Perceived usefulness; FC= Facilitating conditions; EDU= Education; PT= Perceived trust; PE= Prior experience.

5. Discussion

This study first examined the impact of perceived ease of use (PEOU), perceived usefulness (PU), perceived trust (PT), facilitating conditions (FC), and prior experience (PE) on behavioural intention to use (IU). All variables have positive and significant relationships with the behavioural intention to use (IU), directly connecting all latent variables. The latent variables, PEOU, PU, PT, FC, and PE, positively correlate with subjective norms (SN). We expect SN to have a positive relationship with attitudes (ATT). Finally, we hope that behavioural intention to use (IU) is positively influenced by attitudes (ATT) and education (EDU), as this moderator has a significant moderating influence on the relationship between attitudes (ATT) and behavioural intention to use (IU). The findings revealed that the FC construct has the highest means, indicating that respondents responded to facilitating conditions (FC). The lowest means were recorded for perceived trust (PT), suggesting respondents were scared to share their personal information with the government. Perceived ease of use (PEOU) was also the most critical factor among the variables after facilitating conditions (FC).

The older adult population's proposed relationships of perceived trust (PT) and subjective norms (SN) with the adoption of e-government services were shown to be necessary. The Spearman's correlation coefficients showed that the data for both variables were normally distributed, as were the correlation levels between them. In contrast, there was a positive correlation between the two variables. It was consistent

with previous studies that reported a direct relationship between perceived trust (PT) and subjective norms (SN) (Ali and Mujahid, 2015; Venkatesh et al., 2012). However, other studies have shown that the construction of subjective norms (SN) is not sufficient to predict perceived trust (PT), which is of great significance in determining the use of these services (Venkatesh et al., 2012). However, subjective norms (SN) were not considered necessary in the older age groups, as seen from the results. On the other hand, perceived trust (PT) was a critical factor in adopting e-government services.

The facilitating conditions (FC) construct was added as a direct determinant for e-government services among the older age groups. The study findings have shown a direct and positive relationship between the values for facilitating conditions (FC) and subjective norms (SN). The results have shown that reducing conditions (FC) is an essential factor considered beneficial. Therefore, the easier it is to provide e-government facilities, the more valuable users think they are. This assumption comes from the original TAM (technology acceptance model). The findings are consistent with some previous studies (Siddique, 2016). Conversely, other studies have shown that subjective norms (SN) are not an essential determinant of prior experience (PE) (Ursavaş et al., 2019). Studies have also shown that the construction of convenience conditions is not enough to predict the discovery of intention, which is of great significance in determining the use of e-government services (Zahid et al., 2022).

Education is pivotal in assimilating knowledge, skills, values, beliefs, and habits. A noteworthy correlation emerged between the behavioural intention to use (IU) and the level of education (EDU). Prior research has consistently delved into the perspective that higher education correlates with increased technological proficiency, often utilizing education as a moderator and establishing its significant influence on technology acceptance. Building upon this foundation, the current study seeks to investigate the moderating impact of education on technology acceptance.

In the context of this study, educational attainment serves as a moderating variable, with a pronounced emphasis on its secondary position. The intricate relationship between education and the Unified Theory of Acceptance and Use of Technology (UTAUT) constructs has been explored in prior studies, revealing conflicting moderation effects. This research contributes fresh insights and references to elucidate the complex interplay between educational background and technology acceptance.

6. Conclusions and policy implications

In conclusion, this study significantly advances our understanding of information systems (IS) and interactive systems, specifically focusing on e-government services. Grounded in the well-regarded STAM, the developed research model, the Older Adult E-government Acceptance Model (OAEAM), emerges as a highly applicable framework, especially within the complex dynamics of older adults and ICT adoption, particularly in developing countries that share similar cultural and technological challenges. The meticulous examination of all variables, supported by robust statistical analysis, highlights the pivotal role of education as a critical factor in ICT adoption. This study uniquely positions education as a moderator, revealing significant values in its influence on attitudes (ATT) and behavioural intention to use (IU). The

implications of this finding extend to electronic service providers, government agencies, practitioners, and researchers engaged in e-government, providing valuable insights for crafting targeted interventions. The successful evaluation of China's older citizens' behavioural intentions to use e-government systems and services underscores the practical utility of the OAEAM model. Beyond its immediate context, the model can be extrapolated as a role model for assessing and enhancing e-government services across various public organizations. This opens avenues for improving the efficiency and effectiveness of e-government services and sets a precedent for similar studies in comparable sociocultural settings.

Furthermore, the study suggests promising avenues for future research, envisioning broader applications supporting the government's adoption of electronic services for citizens, mainly focusing on older adults in Chinese society. Implementing effective e-government services carries the potential to substantively enhance the quality of life for older adults, presenting tangible benefits in terms of time, cost, and resource savings. By heeding these comprehensive recommendations, stakeholders can navigate a clear pathway towards the successful and widespread implementation of effective e-government services in China and beyond.

6.1. Managerial and policy implications

In policy implications, this study endeavours to deliver a refined and targeted model crafted from the intricate findings that encapsulate the multifaceted dynamics of e-government services across diverse user groups—citizens, government staff, and users. The central objective is to present actionable insights for policymakers, directing attention to the nuanced practical implications of the research.

6.1.1. Managerial implication

First and foremost, the study identifies critical factors that significantly influence the adoption of e-government services across different age cohorts. These encompass education, perceived ease of use, usefulness, facilitating conditions, social culture, functional services/systems quality, accepted simplicity, and regulatory frameworks. This holistic understanding enables policymakers to tailor interventions addressing diverse demographic groups' needs and concerns. It underscores the imperative of fostering an accessible, user-friendly environment that aligns with citizens' perceptions and cultural nuances while emphasising the importance of regulatory frameworks in shaping the adoption landscape.

Furthermore, the study delves into the realm of civil servants, illuminating the multifaceted factors shaping their engagement with e-government services. The identified factors span gender, education, income (annual salary), perceived health, popular culture, knowledge, service/system work efficiency, ease, usability, confidence, rules, and policies. Policymakers can leverage this detailed breakdown to inform strategies for enhancing the utilization of e-government services among civil servants. For instance, understanding the impact of income and education on engagement can guide targeted initiatives aimed at specific demographic groups within the civil service.

6.1.2. Practical implication

In practical terms, the revised model from this study becomes a powerful tool for practitioners. Electronic service companies, government departments, and researchers can leverage this model to gain a nuanced understanding of the factors influencing technology adoption among older consumers. The model provides a roadmap for developing tailored interventions and strategies to enhance the accessibility and usability of e-government services. Shifting the focus to theoretical contributions, this study is a beacon of innovation by expanding upon established models like UTAUT and TAM. Creating the Older Adult E-government Acceptance Model (OAEAM) represents a significant theoretical advancement. By incorporating elements such as education, prior experience, and UTAUT components, the OAEAM captures the intricate dynamics of technology adoption among older Chinese adults. This theoretical refinement contributes to academic discourse and holds immense practical value. Policymakers and stakeholders gain insights into the specific elements that influence technology adoption, enabling them to tailor initiatives that resonate with the unique needs of older demographics.

Moreover, the study updates the UTAUT model by revealing that facilitating conditions (FC) positively influence effort expectancy (EE). This finding, consistent with research from United Arab Emirates (UAE) scholars, underscores the universality of specific factors influencing technology adoption across diverse cultural contexts. Including various mediators and moderators in the proposed model, especially the role of education as a moderator between attitude and behavioural intention, enriches our understanding of the intricate relationship dynamics shaping the adoption of e-government services. This study contributes to academic scholarship and is a pragmatic guide for policymakers and stakeholders navigating the evolving landscape of e-government adoption. It provides a comprehensive understanding of the factors at play, offering a roadmap for developing and implementing effective e-government services tailored to the needs of diverse user groups.

6.2. Limitations of the study

In acknowledging the limitations of this study, it is paramount to offer a more comprehensive perspective, particularly concerning the methodology, sample size, scope, and the exclusion of certain variables. This enhanced discussion aims to provide a well-rounded understanding of the study's constraints. One notable limitation lies in the exclusive examination of e-government websites. While these platforms represent the most widely utilized channels for online services, it is crucial to recognize that citizens' engagement extends beyond websites to encompass diverse mediums such as Weibo, apps, and others. Although the study sheds light on the adoption of e-government websites, there is a broader landscape that future research could explore. Academics, practitioners, researchers, and policymakers could benefit from delving into citizens' utilization of alternative channels for e-government services in China. This acknowledgement emphasizes the need for future studies to broaden their scope, encompassing a more comprehensive array of digital interfaces and platforms.

Another limitation stems from the constrained sample used in testing the model, which focuses specifically on older Chinese citizen users. While this targeted approach

enhances parsimony and participant engagement, it limits the generalizability of findings. Expanding sample sizes becomes imperative to augment the robustness of future research. This expansion should include a more extensive demographic representation and account for regional diversity, spanning urban and rural areas and cultural variations or comparisons across different countries. A broader, more diverse sample would afford a more nuanced and representative understanding of e-government adoption dynamics. Lastly, the study is confined to examining user adoption within the Government-to-Citizen (G2C) context. While this focus aligns with the prevalent use of e-government services, it disregards the broader landscape of the government's adoption of information technology, especially in sectors like milk production and other industries subject to governmental regulations. Future research endeavours should broaden the scope to explore the government's integration of digital technologies across diverse sectors. This expansion would yield valuable insights into the broader implications of information technology adoption in various governmental functions and industries. In summary, while acknowledged, this study's limitations prompt avenues for future research to enhance the depth and breadth of inquiry. Expanding beyond the confines of e-government websites, diversifying sample sizes, and broadening the focus to encompass the government's utilization of information technology in various sectors contribute to a more comprehensive understanding of the complexities surrounding e-government adoption.

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