Online-Journals.org

iJIM International Journal of Interactive Mobile Technologies

iJIM | eISSN: 1865-7923 | Vol. 19 No. 20 (2025) | OPEN ACCESS

https://doi.org/10.3991/ijim.v19i20.58485

PAPER

Analysis of Usage Barriers of Interactive Mobile Devices among the Elderly Based on the Technology Acceptance Model

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ABSTRACT

This paper aims to analyze the problems and barriers faced by the elderly when using interactive mobile devices in order to propose practical solutions. Based on the technology acceptance model (TAM), this study takes perceived usefulness (PU), perceived ease of use (PEOU), and usage intention as core latent variables; and extends the latent variables to include new technology anxiety (NTA), operational complexity (OCP), physiological function limitations (PFL), aging-friendly design (AFD), quality of intergenerational support (ISQ), and demand matching. The research objects are elderly people over 60 years old. Data are collected through questionnaires, and structural equation modeling (SEM) is used to quantitatively analyze the impact intensity of various barrier factors. The final results show that PU and PEOU jointly affect usage intention, determining the elderly's acceptance of interactive mobile devices; meanwhile, PEOU determines PU. The conclusions of this paper provide empirical evidence for the aging-friendly transformation and intervention measures of interactive mobile devices.

KEYWORDS

technology acceptance model (TAM), elderly group, interactive mobile devices, structural equation modeling (SEM), usage barrier analysis

1 INTRODUCTION

The global population is aging at an accelerating rate. According to the *World Population Prospects 2022*, a report released by the United Nations, the number of people aged 60 and above worldwide will exceed 2.1 billion by 2050, accounting for 22% of the total population [1]. Against this backdrop, the rapid development of information technology has made interactive mobile devices such as smartphones and tablets deeply integrated into all aspects of modern life, becoming core tools for accessing information, online consumption, and social interaction. However, the elderly generally face numerous challenges when using these digital devices,

Yue, X., Huang, Z., Zhan, Y., Wang, F., Efendiev, R. (2025). Analysis of Usage Barriers of Interactive Mobile Devices among the Elderly Based on the Technology Acceptance Model. *International Journal of Interactive Mobile Technologies (iJIM)*, 19(20), pp. 19–30. https://doi.org/10.3991/ijim.v19i20.58485

Article submitted 2025-06-01. Revision uploaded 2025-08-28. Final acceptance 2025-09-02.

including issues such as overly small interface sizes, cumbersome operational processes, obscure function descriptions, and inconvenient interaction methods. These problems essentially block the effective connection between the elderly and the information age. Many elderly individuals experience anxiety due to their inability to proficiently use mainstream tools such as Alipay for payments or WeChat for socializing, which causes significant inconvenience in their daily lives [2].

The traditional technology acceptance model (TAM) explains users' intention to use (IU) through perceived usefulness (PU) and perceived ease of use (PEOU). However, when applied to the study of barriers faced by the elderly in using interactive mobile devices, TAM exhibits obvious limitations due to the unique physiological, psychological, and social environmental characteristics of the elderly. Therefore, this paper introduces extended variables—including new technology anxiety (NTA), operational complexity (OCP), physiological function limitations (PFL), aging-friendly design (AFD), quality of intergenerational support (ISQ), and demand matching degree (DMD)—into the TAM framework to construct a model of usage barriers for interactive mobile devices among the elderly. This effectively addresses the lack of attention to "non-capability-based barriers" in traditional research [3].

Through empirical analysis, this paper aims to provide practical guidance for formulating targeted aging-friendly policies, optimizing product layouts for enterprises, and offering precise services for families. It is also hoped that society as a whole will work together to bridge the digital divide for the elderly, enhance their ability to integrate into society, and enable them to enjoy a happy old age [4].

2 LITERATURE REVIEW AND RESEARCH HYPOTHESES

Currently, research on users' technology adoption behavior primarily employs TAM, using core variables PU and PEOU to verify IU. These variables can also be applied to study the mechanism of action and hindering factors in the context of the elderly's use of interactive mobile devices.

2.1 Research on relationships between core latent variables

The core logic of TAM lies in the correlation between PU and PEOU: if users perceive a product as easy to operate, they tend to use it [5]. For the elderly, the more convenient the operation of a smartphone, the more they prefer to use it. In other words, PEOU strengthens the sense of need satisfaction by lowering the threshold for use [6].

Thus, H1 is proposed: The elderly's PEOU of interactive mobile devices positively affects their perceived usefulness.

Due to declining learning abilities, elderly users often struggle with complex interfaces. Therefore, simplified interface designs and clear operational processes can significantly enhance their willingness to use smart devices. Consequently, PEOU directly promotes IU by reducing psychological burdens [7].

Thus, H2 is proposed: The elderly's PEOU of interactive mobile devices positively affects their intention to use.

The positive effect of PU on IU has been supported by numerous empirical studies. For the elderly, IU significantly increases when they recognize that mobile devices can help them conveniently access medical information or easily contact family members [8].

Thus, H3 is proposed: The elderly's PU of interactive mobile devices positively affects their intention to use.

2.2 Research on relationships between extended latent variables and core variables

New technology anxiety is a unique psychological barrier among the elderly. Fear and uncertainty toward new technologies directly inhibit IU; most elderly respondents avoid using mobile payments for fear of "not using them properly" [9].

Thus, H4 is proposed: NTA negatively affects IU.

Redundant technical functions and OCP reduce users' PEOU. The elderly have lower tolerance for OCP; designs such as multi-step verification and nested menus on smartphones will decrease their PEOU [10].

Thus, H5 is proposed: OCP negatively affects PEOU.

Common PFL among the elderly, such as vision loss and reduced finger flexibility, directly reduces operational convenience. In particular, devices with overly small screen fonts or dense touch buttons significantly lower the elderly's PEOU [11].

Thus, H6 is proposed: PFL negatively affects PEOU.

Aging-friendly design that aligns with the physiological characteristics of the elderly—such as large fonts and voice assistance—can directly optimize the operational experience. According to a report by the International Telecommunication Union (ITU), devices equipped with aging-friendly features can increase the elderly's PEOU by over 40% [12].

Thus, H7 is proposed: AFD positively affects PEOU.

Quality of intergenerational support significantly strengthens PU. If the elderly receive patient guidance from their children to perform operations such as online registration or video calls, they will recognize the importance of mobile devices [13].

Thus, H8 is proposed: ISQ positively affects PU.

Demand matching degree is a core source of PU. The elderly's core needs focus on areas such as health management and emotional communication. If mobile application developers create new functions tailored to these needs, the elderly's evaluation of PU will be greatly enhanced [14].

Thus, H9 is proposed: DMD positively affects PU.

In summary, existing TAM research has initially revealed the interactions between variables. Based on previous scholars' findings, this paper constructs an integrated model to more accurately identify the barriers faced by the elderly in using interactive mobile devices.

3 RESEARCH METHODS

3.1 Structural equation modeling

Structural equation modeling operates based on the measurement model and the structural model, aiming to profoundly reveal the complex direct and indirect influence relationships among multiple dependent variables [15].

The measurement model is used to describe the relationship between latent variables and observed variables.

Its mathematical expressions are as follows:

$$\text{For exogenous latent variables: } x = \Lambda_x \xi + \delta \tag{1}$$

For endogenous latent variables: $y = \Lambda_y \eta + \varepsilon$ (2)

Where x and y are observed variables, ξ and η are latent variables, Λ is the factor loading, and δ and ε are measurement errors.

The structural model describes the causal relationships between latent variables.

Its mathematical expression is: $\eta = B\eta + \Gamma\xi + \zeta$ (3)

Where η is an endogenous latent variable, ξ is an exogenous latent variable, B is the coefficient of the relationship between endogenous latent variables, Γ is the coefficient of the influence of exogenous latent variables on endogenous latent variables, and ζ is the error of the structural equation.

The structural path diagram of this study is shown in Figure 1.

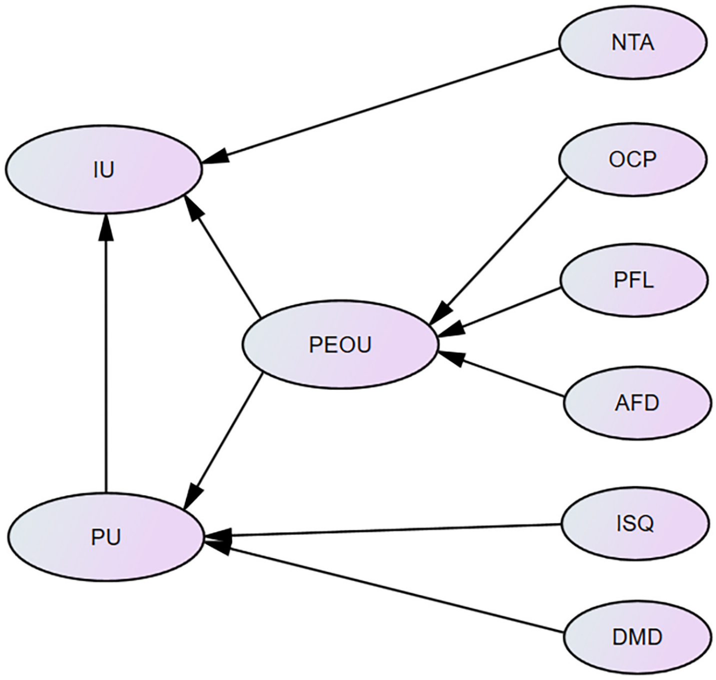

Fig. 1. Structural path diagram

3.2 Questionnaire design

The questionnaire consists of four parts. The first part covers the basic information of the respondents; the second part focuses on the three core variables of PU, PEOU, and IU, as shown in Table 1; the third part involves the six extended latent variables of NTA, OCP, PFL, AFD, ISQ, and DMD, as shown in Table 2; and the fourth part includes 2 open-ended questions. A 5-point Likert scale is used for scoring in Tables 1 and 2.

Before distributing the questionnaire, 10 elderly people were invited to pre-test it. They were asked questions such as "Can you understand the questions?" and "Do you find it troublesome?" The content of the questionnaire was revised based on the feedback from the elderly. Finally, it was reviewed and confirmed by two experts to ensure that the questionnaire content not only covers all variables but also conforms to the colloquial habits of the elderly. The final questionnaire design is as follows.

Table 1. Design of the questionnaire for core latent variables

Category	Questions	1 = Strongly Disagree, 5 = Strongly Agree
PU	Operating these devices can save me time on errands (e.g., no need to wait in line to pay fees) (PU1)	
	These devices allow me to contact family/friends conveniently (PU2)	
	For me, these devices have many practical functions (PU3)	
PEOU	I think the functions on the devices (such as sending messages via WeChat) are easy to learn (PEOU1)	
	There are not many operation steps, and I can finish things quickly (e.g., online registration) (PEOU2)	
	I can operate these devices even without help from others (PEOU3)	
IU	I am willing to spend time learning these new functions (IU1)	
	I will use these functions frequently in the future (IU2)	
	If there are new functions suitable for me, I am willing to try them actively (IU3)	

Table 2. Design of the questionnaire for extended latent variables

Category	Questions	1 = Strongly Disagree, 5 = Strongly Agree
NTA	I worry that operational errors will cause the functions to not work properly (NTA1)	
	I don't understand some new technical terms (such as Bluetooth, WIFI, hotspot) (NTA2)	
	I don't understand the relationship between WeChat Wallet and cash (e.g., worrying that "the money in WeChat Wallet is unsafe") (NTA3)	
OCP	The device interface is too complicated (e.g., too small fonts, functions are incomprehensible, not in line with the elderly's way of thinking) (OCP1)	
	There are too many operation steps, and I can't remember them (can't find the location of functions, can't remember passwords) (OCP2)	
	I can't distinguish whether the pop-up information is a normal prompt or an advertisement (OCP3)	
	APP interfaces are often upgraded; I just got familiar with the old version, but the new version has changed (OCP4)	
PFL	My eyes are presbyopic, and I can't see the text on the screen clearly (PFL1)	
	My fingers are not flexible enough, and I often click the wrong position (PFL2)	
AFD	If the device has large fonts and voice operation, I will find it more useful (AFD1)	
	I hope these devices have a "simple mode" (only retaining core functions) (AFD2)	
ISQ	Family members will take the initiative to teach me to use new functions (such as WeChat video) and tell me their uses (ISQ1)	
	When I encounter problems I can't solve, my family will help me in time (ISQ2)	
DMD	The mobile devices basically have the functions I need (such as registration, contacting family) (DMD1)	
	These devices can help me solve practical difficulties in life (such as buying vegetables, checking the weather) (DMD2)	

Open-ended questions:

- What is the biggest difficulty you encounter when using mobile devices?
- What kind of design or assistance do you think would make you more willing to use these mobile devices.

3.3 Data collection

This study includes 24 observed variables. Theoretically, the sample size should be 5–10 times the number of observed variables, so collecting 120–240 valid questionnaires meets the requirement.

From August 13 to 16, 2025, a random sampling method was adopted, and a total of 208 questionnaires were collected online nationwide. After excluding invalid questionnaires due to short response time, incorrect filling, etc., 186 valid questionnaires were obtained, with an effective rate of 89.4%, which meets the sample size requirement.

4 RESEARCH RESULTS

4.1 Descriptive analysis

The results of the descriptive analysis are shown in Table 3. The majority of elderly users of interactive mobile devices are aged 60–65. Since the average life expectancy of Chinese people is 78 years, the mortality rate of elderly people over 66 gradually increases, and some of them do not use smartphones at all. A relatively high proportion of the elderly have an education level of junior high school or below, which is due to the low popularity of education in the past, resulting in generally low educational attainment. A large number of respondents use smartphones frequently, as non-smartphones are basically unavailable in the market now. The main uses of mobile phones are contacting family, reading news, or watching videos, focusing on social interaction and entertainment.

Table 3. Results of descriptive analysis

Category	Questions	Options	Frequency	Percentage
Basic Information	Age	60–65 years old	107	57.7%
		66–70 years old	32	17.3%
		71–75 years old	27	14.4%
		Over 76 years old	20	10.6%
	Educational level	Primary school or below	64	34.6%
		Junior high school	52	27.9%
		Senior high school/technical secondary school	36	19.2%
		Junior college or above	34	18.3%
	Have you used a smartphone before?	Never used	14	7.7%
		Occasionally used	47	25%
		Frequently used	125	67.3%
	What do you usually use smart devices for? (Multiple choices)	Contacting family	166	89.4%
		Watching news/videos	147	78.9%
		Online shopping/paying fees	61	32.7%
		Health management (measuring blood pressure, registering for medical services)	32	17.3%
		Others	18	9.6%

The answers to the open-ended questions can be mainly summarized in the following aspects: First, in terms of operation and interface: simplicity, ease of operation, large fonts, voice prompts, voice control, friendly prompts, and guided steps are the main demands. Second, in terms of interfering factors: too many advertisements, accidental clicks on advertisements, and fancy functions are the main troubles. Third, in terms of safety and experience: the main safety concerns are fear of misoperation, being charged fees due to accidental clicks on advertisements, false information, and worry about fraud. Fourth, in terms of adaptation needs: there is a hope for a version specifically designed for the elderly.

4.2 Reliability analysis

As can be seen from the reliability analysis in Table 4, the Cronbach's α coefficients are all greater than 0.7, and the overall coefficient of the questionnaire is 0.881, indicating that the internal consistency of the scale is relatively high.

Table 4. Reliability analysis

Dimension	Number of Items	Sample Size	Cronbach's α Coefficients
PU	3	186	0.788
PEOU	3	186	0.866
IU	3	186	0.946
NTA	3	186	0.829
OCP	4	186	0.926
PFL	2	186	0.873
AFD	2	186	0.956
ISQ	2	186	0.918
DMD	2	186	0.832
Overall	24	186	0.881

4.3 Validity analysis

As shown in Table 5, the KMO value is 0.82, which is greater than 0.7; the P value of the Bartlett's test of sphericity is less than 0.05, indicating that there is a strong correlation between the observed variables.

Table 5. KMO test and Bartlett's test

Bartlett's test of sphericity	KMO value	0.820
	Chi-square	4051.992
	Degrees of freedom	276
	P level	0.000

4.4 Results of SEM analysis

As shown in Table 5, the KMO value is 0.82, which is greater than 0.7; the P value of the Bartlett's test of sphericity is less than 0.05, indicating that there is a strong correlation between the observed variables.

The results of the SEM analysis are shown in Figure 2.

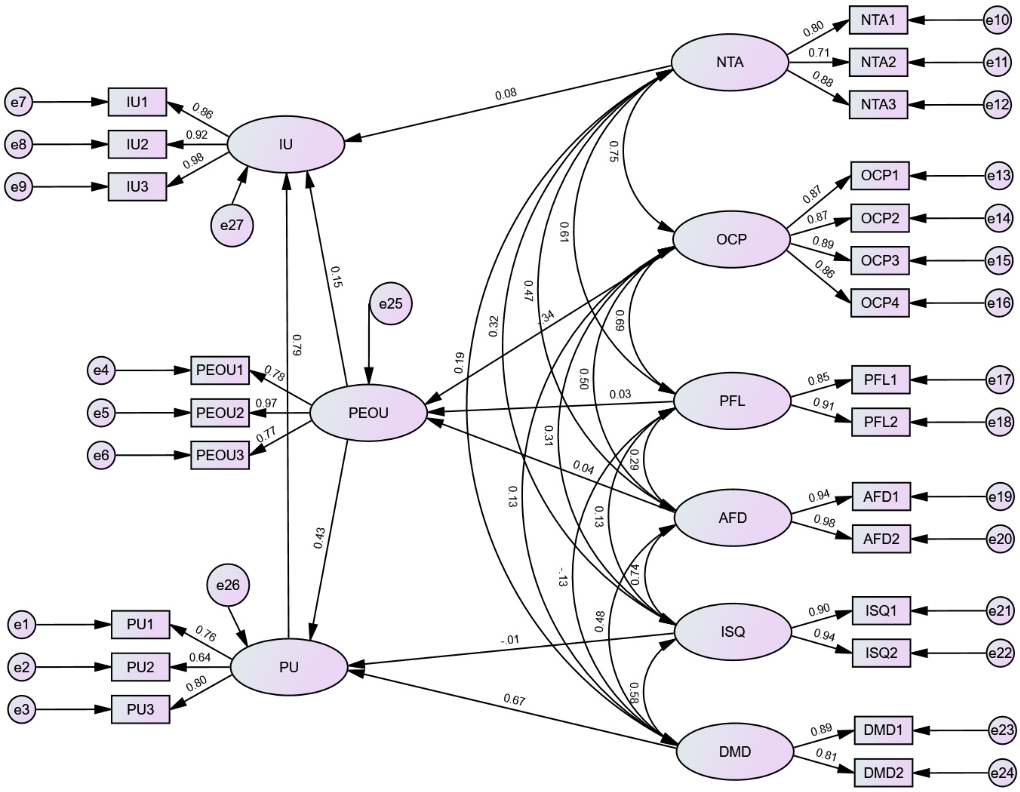

Fig. 2. Results of SEM analysis

The SEM fitting indices are shown in Table 6. The chi-square degree of freedom ratio (χ^2/df) is 3.094, which is less than 5, indicating an ideal fit; other indices such as RMSEA, GFI, IFI, TLI, and CFI are very close to the judgment standard values, suggesting that the model fit is acceptable.

Table 6. SEM fitting indices

Common Indicators	Judgment Criteria	Values
χ^2/df	< 5	3.094
RMSEA	< 0.10	0.106
GFI	> 0.8	0.776
IFI	> 0.8	0.881
TLI	> 0.8	0.855
CFI	> 0.8	0.880

5 CONCLUSIONS AND DISCUSSION

5.1 Conclusions

In this paper, through model fitting and calculation using data analysis software, if the P-value is <0.05, it indicates that the path passes the significance test, i.e., the hypothesis is valid; otherwise, the hypothesis is invalid (refer to Table 7).

Table 7. Path result analysis

Path	Standardized Path Coefficient	S.E.	C.R.	P	Hypothesis Test
PEOU→PU	0.431	0.068	5.858	***	H1 Accepted
PEOU→IU	0.152	0.056	2.502	0.012*	H2 Accepted
PU→IU	0.789	0.087	9.179	***	H3 Accepted
NTA→IU	0.078	0.054	1.492	0.136	H4 Rejected
OCP→PEOU	–0.338	0.136	–2.612	0.009**	H5 Accepted
PFL→PEOU	0.034	0.120	0.290	0.772	H6 Rejected
AFD→PEOU	0.043	0.104	0.490	0.624	H7 Rejected
ISQ→PU	–0.007	0.092	–0.082	0.934	H8 Rejected
DMD→PU	0.670	0.108	6.549	***	H9 Accepted

Notes: *p < 0.05; **p < 0.01; ***p < 0.001.

The results of the SEM path coefficient analysis show that among the path relationships related to the use of mobile devices by the elderly group, some paths have passed the significance test.

5.2 Discussion

This structural equation model analysis focuses on the impact of multiple key factors on the IU of elderly users and their interrelationships in the context of AFD. The results show that PEOU has a significant positive impact on PU (P < 0.001), indicating that elderly users' perception of PEOU of the product will significantly enhance their perception of PU of the product. PEOU also has a significant positive impact on IU (P = 0.012), but its impact is relatively small. In contrast, PU has a very significant impact on IU (P < 0.001), which is the strongest driving factor for promoting elderly users' IU.

The impact of NTA on IU is not significant (P = 0.136), indicating that in this study, NT has a weak impact on elderly users' intention to use.

Operational complexity has a significant negative impact on PEOU (P = 0.009), indicating that when elderly users perceive the operation of the product or system as complex, it will significantly reduce their PEOU. However, the impacts of PFL and AFD on PEOU are not significant (P = 0.772 and P = 0.624), which may mean that the aging-friendly functions in the current market have the problem of formalization, resulting in the weak direct impact of these factors on perceived ease of use.

The impact of ISQ on PU is not significant (P = 0.934), which may indicate that in this study, ISQ has a limited direct impact on elderly users' PU. DMD has a more significant impact on PU ($P < 0.001$), indicating that when product functions are highly matched with the needs of elderly users, they will more strongly perceive the PU of the product.

Overall, DMD and PEOU have the most significant impacts on elderly users' PU, and PU further strongly promotes their intention to use.

5.3 Suggestions

Give priority to strengthening the core driving role of PU. Since PU has the most significant impact on IU, it is necessary to take improving elderly users' perception of PU of the product as the core goal.

Demand matching degree has a significant impact on PU. Therefore, accurate research should be conducted to clarify the core needs of elderly users, such as health monitoring, convenient communication, and intelligent life assistance, and develop functional modules accordingly to ensure that product functions are highly consistent with needs. For example, add functions such as medication reminders and automatic recording of basic physical examination data in health-related apps.

Continuously optimize the basic support of PEOU. Perceived ease of use not only directly affects IU but also has a significant positive effect on PU. Therefore, it is necessary to focus on reducing the operational threshold and improving the convenience of use.

Operational complexity has a significant negative impact on PEOU, so the product operation process should be simplified and unnecessary steps should be reduced. For example, set an "elderly mode" in smart devices, enlarge the interface font, simplify the operation buttons, place commonly used functions on the home page, and avoid multi-level menu nesting.

Although the direct impacts of AFD and PFL on PEOU are not significant in this study, their potential value cannot be ignored. It is suggested that the design of mobile devices should consider the physiological characteristics of elderly users, such as optimizing screen brightness and contrast to address vision degradation, designing larger touch areas for reduced finger flexibility, and indirectly improving PEOU through detailed optimizations.

Reasonably respond to the potential impacts of other factors. Although the impact of NTA on IU is not significant, it is still necessary to alleviate elderly users' sense of strangeness and anxiety about new technologies through popular science publicity and experience activities.

The direct impact of ISQ on PU is not significant, but its indirect effect path can be explored. For example, encourage family members to enhance elderly users' trust in the product through intergenerational guidance and help, thereby indirectly improving their perception of PU of the product.

Establish a dynamic optimization mechanism. Regularly collect feedback from elderly users, understand new problems encountered during operation, and promptly iterate and update product functions to ensure that the product always meets the needs and usage habits of elderly users.

It is hoped that through the above multi-dimensional measures, the perception of PU and PEOU of the product by elderly users can be systematically improved, thereby effectively enhancing their IU and promoting aging-friendly products to better serve the elderly group.

6 REFERENCES

[1] United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects 2022*, 2022. https://population.un.org/wpp/

[2] J. Zhou, P.-L. P. Rau, and G. Salvendy, "Older adults' use of smart phones: An investigation of the factors influencing the acceptance of new functions," *Behaviour & Information Technology*, vol. 33, no. 6, pp. 552–560, 2014. https://doi.org/10.1080/0144929X.2013.780637

[3] K. Chen and A. H. S. Chan, "Gerontechnology acceptance by elderly Hong Kong Chinese: A senior technology acceptance model (STAM)," *Ergonomics*, vol. 57, no. 5, pp. 635–652, 2014. https://doi.org/10.1080/00140139.2014.895855

[4] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Quarterly*, vol. 13, no. 3, pp. 319–340, 1989. https://doi.org/10.2307/249008

[5] K. Renaud and J. van Biljon, "Predicting technology acceptance and adoption by the elderly: A qualitative study," in *Proceedings of the 2008 Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists*, 2008, pp. 210–219. https://doi.org/10.1145/1456659.1456684

[6] L. Wang, X. Li, and G. Zhao, "Research on the influencing factors of the smartphone use behavior intention of the elderly group," *Information Science*, vol. 38, no. 10, pp. 83–89, 2020.

[7] J. Cabero and C. Llorente, "La adopción de las tecnologías por las personas mayores: Aportaciones desde el modelo TAM (Technology Acceptance Model)," *Publicaciones*, vol. 50, no. 1, pp. 141–157, 2020. https://doi.org/10.30827/publicaciones.v50i1.8521

[8] V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, "User acceptance of information technology: Toward a unified view," *MIS Quarterly*, vol. 27, no. 3, pp. 425–478, 2003. https://doi.org/10.2307/30036540

[9] M. L. Meuter, A. L. Ostrom, R. I. Roundtree, and M. J. Bitner, "Self-service technologies: Understanding customer satisfaction with technology-based service encounters," *Journal of Marketing*, vol. 69, no. 4, pp. 50–64, 2005. https://doi.org/10.1509/jmkg.64.3.50.18024

[10] J. Liu and H. H. Zhang, "Research on the influencing factors of the mobile internet use behavior of the elderly group – An empirical analysis based on the technology acceptance model," *Journal of News Research*, vol. 10, no. 14, pp. 34–35, 2019.

[11] N. Charness, W. R. Boot, C. L. Kelley, E. A. Bosman, and M. Mottram, "Word processing training and retraining: Effects of adult age, experience, and interface," *Psychology and Aging*, vol. 16, no. 1, pp. 110–127, 2001. https://doi.org/10.1037/0882-7974.16.1.110

[12] International Telecommunication Union, *Ageing Society: Technology Considerations of the Ageing Population – Technical Report (ITU-T Technology Watch Report)*, 2020. https://www.itu.int/

[13] H. Li, L. Wang, and G. Zhao, "The impact of intergenerational support on the use of smartphones by the elderly," *Research on Aging*, vol. 8, no. 9, pp. 34–45, 2020.

[14] F. D. Davis, R. P. Bagozzi, and P. R. Warshaw, "Extrinsic and intrinsic motivation to use computers in the workplace," *Journal of Applied Social Psychology*, vol. 22, no. 14, pp. 1111–1132, 1992. https://doi.org/10.1111/j.1559-1816.1992.tb00945.x

[15] X. Yue, R. Wang, U. Comite, Y. Li, and L. Hao, "The driving effect of interactive mobile technology on digital economy based on PLS-SEM," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 19, no. 17, pp. 151–161, 2025. https://doi.org/10.3991/ijim.v19i17.57563

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