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How Does Digital Inclusion Shape Aging Attitudes:An Empirical Study Based on CLASS2023

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Abstract: In the era of population aging and digitization, whether and how digital integration can affect the aging attitude of the elderly is an important issue in the study of active aging. This study uses CLASS2023 data to systematically examine the impact of digital inclusion on the attitudes of the elderly towards aging. The study found that : First, digital integration has a significant positive impact on the aging attitude of the elderly. Both digital access and digital skills play an active role, and the marginal effect of digital access is greater. Second, community participation plays a partial mediating role between digital integration and aging attitudes ; third, the impact of digital integration has significant group heterogeneity, which has a significant effect on women, non-agricultural household registration and middle-aged and elderly people, but not on men, agricultural household registration and elderly people. The above findings reveal the structural inequality in the distribution of digital dividends and provide an empirical basis for formulating precise digital inclusion policies for the elderly.

Keywords: Digital Integration; Aging Attitude ; Community Participation

1. Introduction

In the context of population aging and the digital process, how to promote the active aging of the elderly has become a topic of widespread concern in the community. According to the seventh national census data, by 2020, China 's population aged 60 and over has exceeded 260 million, accounting for 18.70% of the total population, and the process of population aging is still accelerating (National Bureau of Statistics, 2021)[1].

Aging attitude, that is, the individual 's subjective cognition of the aging process, is an important constructive indicator that affects the health of the elderly and directly affects their quality of life (Laidlaw et al., 2007)[2]. Positive aging attitude not only helps the elderly to maintain a high subjective well-being, but also promotes their health behavior and social participation, thus delaying functional decline and improving the quality of life. On the contrary, negative aging attitudes may accelerate social withdrawal and psychological aging, forming a harmful self-fulfilling prophecy. Therefore, it is of great theoretical and practical significance to explore what factors can shape or improve the aging attitude of the elderly. From the perspective of technology acceptance model, the adoption of digital technology by the elderly is affected by both perceived usefulness and perceived ease of use (Brown & Venkatesh, 2005)[3]. However, the internal mechanism of how digital inclusion affects aging attitudes has not been fully revealed, especially the mediating role of community participation still lacks systematic research.

Based on this, this study uses CLASS2023 data to systematically examine the impact of digital inclusion on the aging attitude of the elderly and its mechanism, aiming to answer the following questions : First, does digital inclusion have a significant impact on the aging attitude of the elderly ? Second, does community participation play a mediating role between digital inclusion and aging attitudes ? Third, is the impact of digital inclusion heterogeneous among older adults of different genders, household types, and age groups ? By answering the above questions, this study will provide an empirical basis for understanding the active aging in the digital age and provide a reference for formulating policies to promote the digital integration of the elderly.

2. Literature Review and Research Hypotheses

2.1 Determinants of Aging Attitudes

From the perspective of social capital theory, aging attitude is not an isolated psychological

product, but a comprehensive evaluation embedded in the network of individual social relations. The empirical research of He Siyu and Wei Kenan (2021) based on CLASS2014 data shows that both cognitive social capital and structural social capital have a significant impact on the aging attitude of the elderly, and the role of cognitive social capital is greater than that of structural social capital, revealing the dual path of social capital affecting aging cognition through trust construction and network expansion[4]. In addition, aging attitude is not only restricted by pre-social factors, but also affects the subsequent development results as a key psychological mechanism. Ning et al. (2024) found that aging attitude plays a mediating role between Internet use and cognitive health of the elderly, indicating that positive aging attitude can activate individual psychological resources and promote the maintenance of cognitive function[5]. The above research suggests that aging attitude is not only shaped by external social factors such as social capital, but also affects subsequent health as an intermediary variable, and has a theoretical position in the gerontology research chain.

2.2 Digital Inclusion and Aging Attitudes: Empirical Evidence

International literature has accumulated increasingly rich empirical evidence on the relationship between digital inclusion and aging attitudes. Based on social cognitive theory, Zhang et al. (2025) found that the improvement of digital literacy can significantly inhibit the negative aging attitude of the elderly. This effect is significantly heterogeneous in urban and rural areas, income and age dimensions, and urban, high-income and young elderly groups benefit more[6]. Using a random intercept cross-lagged panel model, Wang et al. (2026) used the panel data of 6690 elderly people from the Health and Retirement Study (HRS) in the United States to find that Internet use promotes positive aging cognition, and positive aging cognition in turn promotes more Internet use[7]. This finding reveals the dynamics and complexity of the relationship between digital inclusion and aging attitude, and also provides a theoretical basis for endogenous discussion. Liu et al. (2025) further pointed out that Internet use may not only strengthen the psychological gain of positive social support, but also aggravate the damage of negative social relations to aging attitudes, indicating that the effect of digital inclusion is highly dependent on the quality of social relations embedded in individuals[8]. At the international comparative level, Luo et al. (2025) based on cross-country data from 23 countries confirmed a significant positive correlation between Internet use and mental health of adults aged 50 and over, providing cross-cultural external validity evidence for the psychological gain of digital inclusion[9]. Based on this, this paper proposes research hypothesis 1.

H1: Digital inclusion has a significant positive effect on older adults' aging attitudes.

2.3 the Mediating Role of Community Participation

Community participation serves as a key mechanism linking digital technology use and psychological well-being, and its mediating effect has received preliminary empirical support. Wang et al. (2026), based on CLASS2023 data, found a significant positive association between digital inclusion and social participation, and social participation was in turn positively associated with older adults' mental health, indicating that digital inclusion indirectly promotes active aging by expanding social participation[7]. Liu et al. (2025), using data from the 2021 China Social Survey and focusing on rural middle - aged and older adults, further verified the partial mediating role of community participation between instrumental digital adaptation and subjective well - being, showing that even in rural areas with relatively weak infrastructure, digital technology can still translate into psychological well-being by fostering community participation[8]. In addition, Park et al. (2026) pointed out that community participation and relational support also play a non-negligible role in the formation of digital inclusion among older adults, suggesting a potential bidirectional relationship between digital inclusion and community participation[10]. Based on this, we propose Research Hypothesis 2:

H2: Community participation plays a mediating role between digital inclusion and older adults' aging attitudes.

3. Research Design

3.1 Data Source

The data for this study are derived from the China Longitudinal Aging Social Survey.

CLASS is a nationally representative, continuous large-scale social survey project designed to systematically track the health status, eldercare resources, and social adaptation processes of older adults, thereby providing a scientific basis for aging-related policy formulation. The 2023 survey obtained 11670 valid individual questionnaires, covering dimensions such as demographic characteristics, health status, socioeconomic conditions, and social support. After excluding cases with missing values on core variables and inapplicable responses, the final analytical sample comprised 9,860 individuals.

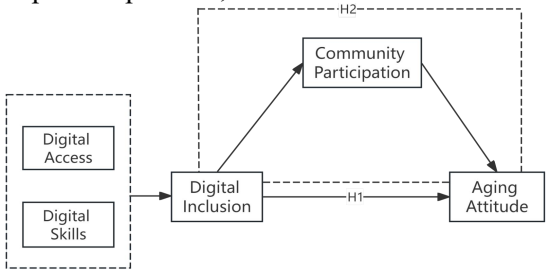

Figure 1. Research Framework Diagram

3.2 Variable Measurement

Dependent Variable

Aging attitude refers to older adults' subjective evaluation and psychological perception of their own aging process, serving as an important psychological indicator of active aging. Following the measurement approach of Zhu and Guo (2025), this study adopted items E5_1 through E5_4 to assess aging attitude[11]. The items include: "I feel that I am already old," "In my view, growing old is a process of continuous loss," "Because of my age, I feel left out," and "After growing old, I find it harder to make new friends." All items were reverse - coded, ranging from 0 = "strongly agree" to 4 = "strongly disagree." The scores of the four items were summed to form a total aging attitude score, ranging from 0 to 16, with higher scores indicating more positive aging attitudes.

Core Independent Variables

According to the classic interpretation of Riggins & Dewan (2005), this study operationalizes digital inclusion into two dimensions [12]: digital access and digital skills, and uses the sum of the two as a comprehensive indicator. Digital access is summed up by two questions : whether there is a network signal in the residence and whether there is Internet access (0 ~ 2 points) ; digital skills are summed up by mobile phones, computers, and tablet proficiency (0-15 points). Proficiency ranges from ' very unskilled ' to ' very skilled ' with 1-5 points (Jiang et al., 2022)[13]. The comprehensive score is the sum of the two. The higher the score, the higher the level of digital integration. The Cronbach 's α of the scale was 0.926, and the reliability was good.

Mediating Variable

In this study, community participation was measured by questionnaire D14, which asked respondents the frequency of participating in seven types of activities in the past year, such as community policing patrols, caring for other elderly / children, environmental health protection, mediation of neighborhood disputes, and escort chatting. If the interviewee is ' several times a year ' or more in any activity, it is coded as 1 (participation), otherwise it is 0 (non-participation).

Control Variables

Given that older adults' aging attitudes are influenced by multiple factors, to rule out potential confounding effects, this study included the following control variables: gender, educational attainment, household registration type, retirement status, subjective economic status, marital status, number of children, and living arrangement.

3.3 Baseline Regression Model

Based on the above research hypotheses and established analytical approaches, the baseline regression model is specified as follows:

$$Y_i = \alpha + \beta D_i + \gamma X_i + \varepsilon_i \quad (1)$$

Here, Y is the aging attitude, D is the digital integration, X is the control variable vector, and ε is the error term.

4. Empirical Results

4.1 Descriptive Statistics

The basic characteristics of the sample are shown in Table 1. The mean value of aging attitude is 6.736, and the standard deviation is 3.032, which is at a moderately positive level, and the difference between individuals is large.

The average value of digital access is 1.249 ; the mean value of digital skills is 3.993, and the standard deviation is 3.964, revealing that there is a significant ' digital polarization ' phenomenon within the elderly group. The comprehensive mean value of digital integration

is 5.242, and the coefficient of variation is close to 0.9, which confirms that a considerable proportion of the elderly are still in the digital ' marginal zone ', while the other part has been deeply integrated.The average value of community participation is 0.330, that is, 33.0 % of respondents participated in at least one community activity.

In terms of control variables, gender distribution is balanced. The education level is between ' primary school and below ' and ' junior high school ', and the overall education level is low. Non-agricultural household accounts for 48.4 %, and the distribution of urban and rural areas is balanced. Retirees accounted for 42.8 %, which is in line with the employment-retirement structure of the elderly population. The subjective economic status is between ' general ' and ' better ', and most people evaluate positively. 83.0 % of them had spouses. The average number of children is 2.126, reflecting the continuation of the traditional multi-child family structure. 92.0 % of them live with their families, and family pension is still the main mode.

Table 1. Variable Coding and Descriptive Statistics

Variable	Coding	Mean	SD	Min	Max
Dependent Variable					
Aging attitude	Continuous	6.736	3.032	0	16
Independent Variables					
Digital access	Continuous	1.249	0.861	0	2
Digital skills	Continuous	3.993	3.964	0	15
Digital inclusion	Continuous	5.242	4.703	0	17
Mediating Variable					
Community participation	Participated = 1; Not participated = 0	0.330	0.470	0.000	1.000
Control Variables					
Gender	Male = 1; Female = 2	1.479	0.500	1	2
Educational attainment	Primary or below = 1; Junior high = 2; Senior high = 3; College or above = 4	1.588	0.787	1	4
Hukou type	Non-agricultural = 1; Agricultural = 0	0.484	0.500	0	1
Retirement status	Retired = 1; Not retired = 0	0.428	0.495	0	1
Subjective economic status	Worse = 1; Average = 2; Better = 3	2.031	0.407	1	3
Marital status	Married = 1; Unmarried/divorced/widowed = 0	0.830	0.376	0	1
Number of children	Continuous	2.126	1.161	0	10
Living arrangement	Living with family = 1; Living alone = 0	0.920	0.272	0	1

4.2 Baseline Regression

Table 2 shows the OLS regression results. The mean value of VIF of each variable is 1.50, the maximum value is less than 5, and there is no obvious multicollinearity.

Model (1) shows that digital access has a significant positive impact on aging attitudes, indicating that digital infrastructure accessibility is the basic condition for shaping positive aging attitudes. The model (2) shows that digital skills also have a significant positive impact on aging attitudes, but the absolute value of the coefficient is smaller than that of digital access, and R2 only rises from 0.029 to 0.032, with a limited increase, indicating that the impact of ' can or can 't access the Internet ' is greater than ' can or can 't use the Internet ', reflecting that the current digital integration of the elderly is still in the primary stage dominated by hardware accessibility. Model (3) shows that the comprehensive score of digital integration has a significant positive impact on aging attitude, and H1 is proved.

In terms of control variables, the educational level has a gradient effect, and the aging attitude of junior college and above is 0.923 units higher than that of primary school and below. The type of household registration has a negative impact on the way of living, and the attitude of agricultural household registration and co-residence with family members is lower. Marriage and subjective economic status have a significant positive impact ; the number of children has a negative impact.

Model (2) included digital skills as the independent variable. The results showed that digital skills also had a significant positive effect on aging attitudes-that is, the more proficient older adults were in operating digital devices such as mobile phones, computers, and tablets, the more positive their aging attitudes. Notably,

compared with Model (1), the absolute value of the coefficient for digital skills was smaller than that for digital access, and the R^2 increased only modestly from 0.029 to 0.032. This finding suggests that, among the older adult population, "whether one can access the Internet" may exert a greater influence on aging attitudes than "whether one knows how to use it," reflecting that digital inclusion among Chinese older adults currently remains at a primary stage dominated by hardware accessibility, and the psychological gains from skill enhancement have yet to be fully realized.

Table 2. OLS Regression of Digital Inclusion on Aging Attitudes

Variable	Model (1)	Model (2)	Model (3)
Digital access	0.157***		
	(0.040)		
Digital skills		0.062***	
		(0.009)	
Digital inclusion			0.050***
			(0.008)
Gender	-0.015	-0.013	-0.014
	(0.061)	(0.061)	(0.061)
Educational attainment (ref: Primary or below)			
Junior high	0.305***	0.263***	0.265***
	(0.077)	(0.077)	(0.077)
Senior high	0.645***	0.538***	0.550***
	(0.104)	(0.106)	(0.106)
College or above	1.047***	0.904***	0.923***
	(0.213)	(0.212)	(0.213)
Hukou type (non-agricultural)	-0.303***	-0.314***	-0.314***
	(0.082)	(0.082)	(0.082)
Retirement status	-0.021	-0.077	-0.070
	(0.088)	(0.088)	(0.088)
Marital status	0.666***	0.601***	0.613***
	(0.106)	(0.106)	(0.106)
Number of children	-0.135***	-0.117***	-0.119***
	(0.030)	(0.030)	(0.030)
Subjective economic status	0.602***	0.586***	0.588***
	(0.080)	(0.079)	(0.079)
Living arrangement	-0.726***	-0.678***	-0.696***
	(0.143)	(0.141)	(0.142)
Constant	5.712***	5.717***	5.706***
	(0.224)	(0.222)	(0.222)
N	9860	9860	9860
R^2	0.029	0.032	0.032

Note: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Same below.

4.3 Robustness Checks

In order to test the reliability of the baseline regression, this study used propensity score matching and Logistic regression.

Propensity score matching

The high and low integration groups were divided by the mean value of the comprehensive score of digital integration. All control variables were used as covariates, and ATT was estimated by radius matching and kernel matching. Before matching, the mean difference between the treatment group and the control group was 0.663. The ATT after radius matching was 0.613 ($p < 0.01$), and the ATT after kernel matching was 0.610 ($p < 0.01$), both of which were significant at the 1 % level, and the direction was consistent with the baseline regression.

Replace the model

The aging attitude was converted into a binary variable according to the mean value, and re-estimated by Logistic regression. The results show that the digital integration coefficient is 0.036 ($p < 0.01$), and the marginal effect is about 0.009, that is, for every 1 point increase in digital integration, the probability of holding a positive aging attitude increases by about 0.9 percentage points. R^2 is 0.023, but the significance and direction of the core explanatory variables are consistent with the benchmark regression, and the influence mode of the control variables has not changed fundamentally, which further verifies the robustness of the conclusion.

4.3 Endogenous Treatment

Benchmark regression may have endogenous bias : on the one hand, there may be reverse causality between digital integration and aging attitude ; on the other hand, unobservable factors (such as personality traits) may affect both. In order to alleviate endogeneity, this study uses the number of fixed telephones per 100 people in each province in 1984 as an instrumental variable. The regional communication infrastructure with high fixed telephone penetration rate is more perfect, and there is a path dependence effect to meet the correlation ; the historical data of 1984 is not directly related to the current individual aging attitude, which satisfies exogeneity (Ge and Yang, 2025)[14].

Table 3. Robustness Checks

Variable	(1) Radius Matching (PSM)	(2) Kernel Matching (PSM)	(3) Model Substitution
High digital inclusion (treat)	0.608***	0.610***	
	(0.091)	(0.092)	
Digital inclusion			0.036***
			(0.005)
Control variables	Controlled	Controlled	Controlled
N	9810	9810	9860
R^2	0.034	0.034	0.023

Table 4. Propensity Score Matching Tests

Matching Method	Sample Type	Treatment Group Mean	Control Group Mean	ATT	SE	t-value
Radius matching	Pre-match	7.039	6.376	0.663***	0.061	10.88
	Post-match	7.022	6.409	0.613***	0.096	6.38
Kernel matching	Pre-match	7.039	6.376	0.663***	0.061	10.88
	Post-match	7.022	6.412	0.610***	0.098	6.24

Table 5 reports the results of 2SLS estimation. In the first stage, the F statistic is 142.51, which is much larger than the critical value of 16.38, excluding weak instrumental variables ; the Kleibergen-Paap LM statistic is 137.61, and the rejection recognition is insufficient. The second stage shows that the influence coefficient of digital inclusion on aging attitude is 0.315 ($p < 0.001$), which is significantly greater than 0.050 of OLS, indicating that there may be downward bias in the baseline regression, and the effect of instrumental variable stripping endogenous variation is stronger. The Cragg-Donald Wald F statistic is 141.70, which further confirms the validity of the instrumental variable. In summary, the conclusion is still robust after controlling endogeneity.

Table 5. Instrumental Variable Estimation Results

Variable	(1) First Stage	(2) Second Stage (2SLS)
	Digital Inclusion	Aging Attitude
Digital inclusion		0.315***
		(0.067)
1984 fixed-line telephone density	0.630***	
	(0.053)	
Control variables	Controlled	Controlled
N	9860	9860
First-stage F-statistic	142.51	
Kleibergen-Paap LM	137.61***	
Cragg-Donald Wald F	141.70	

4.4 Mediating Effect Test

In this study, Bootstrap test (repeated sampling 2000 times) was used to verify the significance of the mediating effect, and the results are shown in Table 6. The indirect effect was 0.028, and the 95 % confidence interval was [0.015,0.042], excluding 0 ; the total effect was 0.050, and the 95 % confidence interval was [0.035,0.064]. The indirect effect accounts for 56 % of the total effect, that is, more than half of the positive impact of digital inclusion on aging attitudes is achieved by promoting community participation. The above findings reveal the ' social transmission path ' of digital integration affecting aging attitudes : digital technology indirectly shapes the cognitive evaluation of the aging process by reconstructing the social network and community role identity of the elderly.

Table 6. Bootstrap Mediation Results

Path	Effect	Effect Size	95% CI
Digital inclusion - Community participation - Aging attitude	Indirect effect	0.028***	[0.015, 0.042]
Digital inclusion - Aging attitude	Total effect	0.050***	[0.035, 0.064]

Note: Bootstrap with 2000 replications; confidence intervals based on percentile method.

4.5 Heterogeneity Analysis

The effect of digital inclusion on aging attitudes may vary depending on the social structural position. This study conducted group regression by gender, household type and age group, and the results are shown in table 7.

Gender differences

The impact of digital inclusion on men 's attitudes towards aging is not significant, but it is significantly positive for women. On the one hand, women usually have more active social needs and relationship orientation, and digital technology provides them with new channels to maintain social connections ; on the other hand, men are more inclined to regard digital technology as a functional tool, and their motivation is mainly information inquiry, with low psychological involvement and limited conversion efficiency. Existing studies have also found that women are more sensitive to age-related social pressure, and the sense of social

connection brought by digital technology is of special significance.

Differences in household registration types

The impact of digital integration on the elderly with agricultural household registration was not significant ($\beta = -0.001$, $p > 0.1$), and it was significantly positive for non-agricultural household registration ($\beta = 0.050$, $p < 0.01$). The application scenarios of the elderly in the city are rich - online registration, mobile payment, community WeChat group, etc. - digital skills can be easily transformed into life convenience and social participation. Rural areas have weak infrastructure and insufficient supply of aging services. Even if they have access conditions, they are difficult to transform into psychological gains. The phenomenon of " digital use polarization " revealed is particularly prominent between urban and rural areas.

Age difference

The effect of digital inclusion on the young elderly (60-69 years old) was significantly positive ($\beta = 0.023$, $p < 0.10$), the effect on the middle-aged elderly (70-79 years old) was the strongest ($\beta = 0.045$, $p < 0.01$), and the effect on the elderly (80 years old and above) was not significant ($\beta = -0.007$, $p > 0.1$), showing an ' inverted U-shaped ' model. The cognitive ability and learning willingness of the young elderly are better ; although the learning ability of the middle-aged elderly has declined, the demand for social connection is more urgent, and the compensation effect is the most prominent. The elderly are generally faced with physiological recessions such as vision, hearing, and fine hand movements, which are difficult to use effectively even with access conditions. This suggests that the digital inclusion policy needs to be precise, and there may be a ' ceiling effect ' on the technical path of the elderly, which needs to be supplemented by traditional social support.

Table 7. Heterogeneity Analysis

Variable	Gender		Hukou		Age Group		
	Male	Female	Agricultural	Non-agricultural	60-69	70-79	≥80
Digital inclusion	0.009	0.044***	-0.001	0.050***	0.023*	0.045***	-0.007
	(0.010)	(0.012)	(0.011)	(0.011)	(0.012)	(0.011)	(0.026)
Control variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Constant	11.573***	10.262***	11.058***	11.020***	6.249***	5.410***	5.312***
	(0.665)	(0.653)	(0.659)	(0.727)	(0.380)	(0.306)	(0.591)
N	5,136	4,724	5,086	4,774	4,075	4,695	1,090
R^2	0.043	0.054	0.037	0.062	0.025	0.015	

5. Conclusion and Discussion

This study used CLASS2023 data to systematically examine the impact of digital integration on the aging attitude of the elderly and its mechanism. Digital integration has a significant positive impact on the aging attitude of the elderly. Digital access and digital skills can significantly improve their enthusiasm. In the robustness test, the results of propensity score matching and Logistic regression are consistent with the benchmark regression. The mediating effect analysis found that community participation played a partial mediating role, indicating that the psychological effect of digital integration was the result of the dual mechanism of ' technology empowerment ' and ' social embedding '. Heterogeneity analysis shows that digital inclusion has a significant impact on women, non-agricultural hukou and middle-aged and young elderly people, but not on men, agricultural hukou and elderly people, revealing the structural inequality of digital dividend distribution.

First, consolidate the aging supply of digital infrastructure and bridge the ' access gap '. The government should prioritize network coverage in rural and underdeveloped areas and accelerate the extension of 5G and fiber-optic broadband to remote areas. At the same time, through financial subsidies, package concessions, public welfare donations and other ways to reduce the cost of Internet access for the elderly, operators are encouraged to introduce low-cost packages for the elderly. Communities and families should assist the elderly to complete the ' first kilometer ' of network access and form a multi-agent security system.

Second, build an enabling system of ' technology-community ' linkage and strengthen the intermediary transformation of social participation. Relying on community pension service centers, universities for the elderly and other carriers, online and offline linkage projects

are designed, and " digital + social " integration courses are set up to organically combine digital skills training with social participation. The community should be equipped with digital assistants to provide technical guidance and psychological support to help the elderly overcome technical anxiety and rebuild social connection. Encourage the establishment of digital mutual aid groups for the elderly to form a virtuous circle of " helping the elderly with the elderly. "

Third, implement precise intervention of hierarchical classification to ensure the inclusiveness and fairness of digital integration. Develop differentiated programs for group heterogeneity : for the rural elderly, focus on solving structural obstacles such as insufficient network coverage and lack of appropriate aging services ; for the elderly, face up to the ' ceiling effect ' of the technical path, supplemented by traditional support such as home visits and neighborhood mutual assistance ; for the male elderly, develop digital content that suits their interests, and strengthen the sense of control and efficacy of technology use.

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