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A study of the deconstruction and construction of self-efficacy in internet use among older people

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Abstract

Internet use is related to self-efficacy among older people. This study used a grounded theory research method to explore the construction of self-efficacy in the experience of Internet use among older people through in-depth interviews. Based on continuous comparative analysis, we concluded that use of the Internet by older people brought about the "abnormal" in their perception. They experienced deconstruction of the "abnormal" and construction of the "normal" in terms of the self-efficacy story line for Internet use. The core categories of these experiences included curiosity, confusion, fear, comparison, reflection, and empowerment. Taken together, these aspects reflected the process of reconstructing older people' s self-efficacy. This reconstruction could not be separated from situational conditions, goal orientation, and functional induction, and also formed a system for seeking self-meaning, preventing vulnerability, and maintaining dignity. These findings provide a basis for policy recommendations and interventions to develop social support networks for older people.

Keywords Older people, Deconstruction, Construction, Network, Self-efficacy

Introduction

World technological progress accelerated the arrival of "information society," and the age group of Internet users has gradually expanded to include older people. China is witnessing swift advancement in its digital society, and the older netizen population warrants special attention. Statistics for December 2024 showed that there were 170 million Internet users aged 60 years and above in China; this trend has continued (China Internet Network Information Center, 2024) [1]. The Internet can provide support for older people's daily lives, improve their ability to participate in society, reduce loneliness, and improve their quality of life. Although the Internet itself has no enabling function, it facilitates information production and dissemination, impacting older people's traditional thinking.

However, in the new era of Internet Plus (Internet integration with traditional industries), older people are in a vulnerable situation for survival and adaptation compared with other age groups, and there are still hundreds of millions of older people [1] who have "failed to catch the information express train" in terms of Internet use. Many challenges faced by older people, such as limited Internet access, lack of guidance, and technological complexity, lead to low levels of digital engagement and the dilemma of the digital divide, which significantly affect their quality of life and health status.

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Although many studies have shown that Internet use can reduce depression and improve cognitive function among older people, the impact on life satisfaction remains unclear from their perspective. It is necessary to explore attitudes and self-perception relating to Internet use and the underlying mechanisms among older people based on a systematic framework that builds on descriptive analyses of their Internet use behaviors and external situations.

Despite recognition of the potential benefits of Internet use for older people, limited research has explored how their attitudes toward technology and self-efficacy in using the Internet influence their digital engagement. Drawing on life course theory, this study examined how life stage transitions shaped older people's motivation and ability to adopt Internet technologies. Understanding this gap is critical because fostering positive attitudes and enhancing self-efficacy could promote digital inclusion and improve older people's well-being in an increasingly digital society.

Literature review

The concept of self-efficacy was first proposed by Albert Bandura (1986) [2] to describe people's confidence or belief in their ability to achieve behavioral goals in specific areas. This definition of self-efficacy emphasized the evaluation of self-motivation and internal beliefs to achieve specific goals. Self-efficacy is an important factor in the behavior of older people and is also central to the demonstration of initiative. Cox and Parsons (1994) [3] put forward the concept of empowerment, which emphasizes helping individuals to gain control of their lives and enhance their self-efficacy via the process and results. Social constructionism posits that reality is constructed through social interactions and shared meanings (Berger & Luckmann, 1966) [4], which can be applied to understand how older people construct their perceptions and behaviors related to Internet use. In turn, this influences their attitudes toward and willingness to engage with technology. Life course theory emphasizes the importance of the timing and sequencing of life events and how they shape individual trajectories (Giele & Elder Jr, 1998) [5]; in the context of older people's Internet usage, this theory can help explain how different life stages and transitions may affect their engagement with digital technologies. The functions of social support [6] for older people include promoting their perspective of their strengths, increasing self-efficacy, enhancing social participation, and resolving the sense of helplessness and loss.

Many foreign studies focused on the impact of Internet use on mental health among older people from a physiological perspective. Two types of internet self-efficacy as new factors reflect older people's behavioral control beliefs in e-service acceptance (Hsu &Chiu, 2004) [7]. Internet use by older people was reported to be conducive to reducing the probability of depression (Ford, 2009) [8], reducing loneliness (Şar, 2012) [9], and improving individual cognitive ability (Lyer et al., 2006) [10]. These benefits are facilitated by digital inclusion (Damant et al., 2022) [11] and obtaining health information (Rockmann, 2015) [12]. Internet use may also promote the health of older people living alone (Kiel, 2005) [13].

Domestic research in China focused on analyzing mechanisms through which efficacy was formed by expanding older people's social participation and satisfaction through Internet channels, including online social networks, to promote social interaction and collective collaboration (Chai wen et al., 2016) [14] and help embed digital life in this population (He Zhiwu, Dong Hongbing, 2021) [15]. Such work also aimed to enhance social support for, and the identity of, older people (Pan Shuya, 2016) [16]. Use of the Internet has been found to promote health, with the underlying mechanism involving the role of leisure preferences, rather than the influence of the Internet as an information source (Wang Lianjie, 2018) [17]. Studies that interpreted the effect of Internet use on the path to efficacy in older age suggested that an older individual's level of happiness was influenced by interpersonal comparisons (Zheng Xingshan, Tang Ningyu, 2017) [18]. Older people may communicate with their peers to eliminate social and spatial barriers (Luo et al., 2024) [19], and enhance their social adaptation (Gong, 2022) [20], which strengthens their sense of efficacy. Therefore, it is necessary to prevent older people from being marginalized and excluded from the Internet because of a lack of digital education (Yu-cheung Wong, 2014) [21], thereby becoming victims of the "digital divide" (Pao, 2013) [22].

Most research on the relationship between Internet use and efficacy among older people focused on analyzing how the path of Internet use in older people affected efficacy based on Bandura's self-efficacy theory. Other studies have aimed to improve older people's Internet use abilities through empowerment theory, enhance their self-efficacy by mitigating vulnerability influenced by social constructivism and promoting adaptive lifestyle changes. These studies primarily analyzed the formation mechanism of Internet use from a structural perspective and examined the effects of Internet use on social interactions, social networks, and cognitive abilities among older people from a functional perspective. Therefore, further research is needed that focuses on how Internet use among older people affects their sense of efficacy and supports the development of tailored interventions to address the digital divide and enhance digital literacy among older people globally.

This paper integrates different theoretical frameworks to provide a nuanced understanding of factors influencing older people's Internet use. It considers social and

cognitive aspects of their interaction with technology, as well as life course dynamics shaping their digital engagement. Furthermore, it explores specific micro details of efficacy in older people's Internet use, discusses interrelationships among elements using an analytical framework, and enriches research on efficacy in older people.

Research process

Research design

The philosophical basis of this study was pragmatism and symbolic interactionism. Pragmatism guided our focus on the practical utility of Internet use. Symbolic interactionism informed our use of field observations and in-depth interviews to explore the meanings older people assigned to their Internet use experiences. It emphasizes meaning interpretation and seeks to understand social interaction, social processes, and social changes from the perspective of the actors involved. Using qualitative research methodology and a design based on grounded theory (Strauss and Corbin, 1998) [23], this study aimed to construct a research approach rooted in theory and an interpretive understanding of primary sources. The researchers strictly abided by ethical principles and protected participants' rights. Research data were handled in a manner that ensured participants' privacy and were managed appropriately. Codes were used to represent participants in the analysis and reporting. This paper focused on the experiences of using the Internet among older people living alone (i.e., "empty nesters"). We conducted on-site interviews and took field notes when staying in the city of Guangzhou in Guangdong Province. We collected relevant documents for this study from October 1st, 2022 to March 20st, 2023.

Through purposeful sampling, we selected sample participants from interviewed older people, with a balance of gender, age, education level, region, and occupation Table 1. The selected participants could communicate fluently with the author, had nearly equal gender proportions, had educational levels ranging from primary school to university, and were aged 60–69 years, 70–79 years, and ≥ 80 years. The interviews allowed sufficient time for conversation. Five focus group discussions were also conducted, and each group included five to seven older people that used the Internet. These 22 selected older people had been using the internet for over 2 years.

Data collection

This study aimed to examine older people's self-efficacy regarding Internet use, with a specific focus on their confidence and ability to effectively use digital technologies.

Table 1 Participants' basic information

NO	Gender	Range of Age categories	Educational Level	Number of Children	Ability level to use the internet
J1	Female	60 ~ 69	College degrees	2	Expert level
J2	Male	60 ~ 69	College degrees	1	Proficient level
J3	Male	80 ~ 89	Primary school education	4	Novice level
J5	Female	60 ~ 69	Primary school education	2	Beginner level
J6	Female	60 ~ 69	high school education	1	Proficient level
J7	Male	70 ~ 79	Primary school education	2	Novice level
J8	Male	60 ~ 69	College degrees	1	Expert level
J9	Male	60 ~ 69	high school	1	Proficient level
J10	Female	70 ~ 79	Primary school education	2	Novice level
J11	Female	60 ~ 69	Primary school education	3	Beginner level
J12	Male	60 ~ 69	Junior middle school	1	Beginner level
J13	Male	60 ~ 69	Junior middle school	1	Proficient level
J14	Female	70 ~ 79	Junior middle school	3	Novice level
J15	Male	70 ~ 79	Junior middle school	2	Beginner level
J16	Female	60 ~ 69	Junior middle school	2	Proficient level
J17	Female	70 ~ 79	Junior middle school	1	Beginner level
J18	Male	70 ~ 79	Junior middle school	2	Beginner level
J19	Female	70 ~ 79	Junior middle school	3	Proficient level
J20	Female	70 ~ 79	Primary school education	3	Novice level
J21	Male	70 ~ 79	high school	1	Proficient level
J22	Female	70 ~ 79	Primary school education	1	Proficient level
J23	Female	60 ~ 69	Primary school education	3	Novice level
J24	Male	70 ~ 79	Primary school education	2	Beginner level
J25	Female	70 ~ 79	Primary school education	3	Beginner level
J26	Male	70 ~ 79	Primary school education	2	Novice level

Note: Based on their Internet operation skills and awareness, the ability of older people to use the Internet was divided into four levels: Novice level, Beginner level, Proficient level, and Expert level (Table 1). During the interview process, on-site tests were used to assign the corresponding levels to participating older people

Data were collected through in-depth, face-to-face interviews with individual participants, as well as five focus group discussions that were conducted in person. Each focus group included five to seven older people. Not all participants completed both focus groups and individual interviews; rather, this study used a mixed-methods approach to gather diverse perspectives.

In addition to interviews/focus groups, participant observations were conducted in naturalistic settings in Guangzhou, China, including community centers, public parks, and participants' homes. An unstructured observation method was employed to form a general impression of older people using the Internet. This approach allowed the researchers to observe behaviors and interactions in real-time, such as navigating mobile apps, engaging in online communication, and accessing online services. These observations provided insights into how older people interacted with digital technologies in their daily lives. Informal conversations during these observations further enriched the data and captured spontaneous interactions and reflections on older people's Internet use. We conducted observations in both public spaces and private settings to obtain a comprehensive understanding of older people's Internet use experiences.

The interviews were guided by a preliminary outline that allowed flexibility to explore participants' unique experiences and perspectives. The interview outline is available in the Supplementary file. This mixed-methods approach ensured a rich and nuanced dataset that captured both individual and group dynamics related to Internet use among older people.

Data analysis

After completing each interview, the researchers transcribed the recordings verbatim, noting speech tones, pauses, and other details, and ensured the transcripts were de-identified for privacy. Data analysis used methods such as three-level coding, memo writing, and continuous comparison. In the initial coding, data were broken down into elements and labeled descriptively. This helped identify direct patterns and themes. The shift to focused coding involved grouping similar codes into categories and examining relationships to find broader concepts. For example, "enhancing self-confidence" and "mastering Internet skills for older people" were compared to form the higher-order concept "enhancing self-efficacy." This was not just a combination of initial codes, but an abstract construct that showed the link between confidence and skill mastery in older people's Internet use. Selective coding was then used to integrate these categories into a theoretical framework. "Enhancing self-efficacy" was identified as a key motivation for older people's Internet engagement. Memo writing throughout the process tracked the evolution of thinking and rationale behind each step. Continuous comparison ensured each data piece was examined against emerging categories, which boosted the credibility and trustworthiness of the findings. This systematic approach ensured traceability and helped achieve theoretical saturation, where no new category properties emerged, indicating a robust and comprehensive theoretical framework.

Deconstruction of Self-efficacy

The use of the Internet by older people could bring about perceptions of "abnormal," referring to behaviors or experiences that deviated from the norm or expected patterns. The deconstruction of "abnormal" experiences hinged on the internal experiences of older people while using the Internet and their interaction with these experiences during the externalization, deconstruction, and evaluation of the challenges they faced.

Curiosity: technological curiosity and adaptive challenges

"Curiosity" encompassed the questions and interest older people developed upon first encountering the Internet. This comprised two subcategories: technological curiosity and adaptive challenges.

Technological curiosity

Participating older people tended to have a strong interest in new things. This interest was not only concerned about the surface appearance of things, but also with the continuous satisfaction of emotions experienced by acquiring certain knowledge or participating in certain activities. If someone in an older person's frequent contacts started to use the Internet, they were also likely to adopt the mindset of trying to use the Internet, thereby reflecting a sense of curiosity. This sense of curiosity attracted older people to explore the Internet. The rise of electronic payment and network services meant older people's curiosity about the Internet was enhanced by the convenience it offered for daily life. For example, one participant shared that they often relied on neighbors to make video calls to stay connected with their children because they lacked a smartphone (J5). Participants commented that the mobile phone was "really amazing," and shared that in the past, children worked elsewhere and had little time to come home, so they were limited in how often they could see each other. The rapid development of science and technology allowed them to see each other more frequently through video calls. Another participant said, "*I haven't learned how to shop on Taobao yet, but I can do it online*" (J13).

Reservations and appointment registration was another area where the Internet offered convenience for older people. Participants observed that for older people, movement is often difficult and using the Internet could help with online shopping as they did not have to go

to the supermarket. They also noted that the Internet allowed them to make hospital appointments online in advance, so they did not have to wait in queues. Although older people were curious about and interested in the Internet, a lack of understanding about network technology may cause confusion about how to operate in the "high-tech" environment.

Adaptive challenges

Factors such as educational level and physiological issues meant older people were likely to encounter difficulties and obstacles in the process of using the Internet. These adaptive barriers were mainly manifested in two aspects: low ease of use and dehumanization.

"Low ease of use" highlighted the challenge older people faced with Internet terminals that used virtual keys instead of physical keys. Older people generally preferred to gain a sense of feedback through touching, which reflected the inevitable age-related decline of their body touch and sensitivity (McIntyre S, 2021) [24]. For example, "*Now the mobile phone is not easy to use, the words are too small. Later, the child bought me an iPad, a little expensive, but the screen is big and good-looking, [I am] hoping to learn to video chat with my granddaughter on the Internet*" (J25).

"Dehumanization" referred to the marginalization and alienation experienced by older people because of the design of network products that failed to account for their physiological and psychological characteristics. These products often overlooked the unique challenges faced by older people, such as poor eyesight, unfamiliarity with input methods and network software functions, and difficulties understanding graphic language. These barriers contributed to network adaptability issues and created a sense of exclusion from the digital world. For example, "*I also want to learn how to surf the Internet and play [with the] mobile phone, but now this mobile phone doesn't even have a button, and I don't know how to do it*" (J20). The screen of the phone that participants had previously used was small, but the keys were big, and they were familiar with its functionality. Furthermore, the new mobile phone screen had to be swiped by hand to answer a phone call, which often did not work well, resulting in ending the call. Therefore, the participants perceived that device as not as good as their old mobile phone. Another participant shared, "*When I took a bus recently, the driver asked me to take the health code. After a long time, I had to give it online on my mobile phone. I didn't know how to operate it. I almost quarreled with the driver about it. Later, I still didn't get on the bus. I had no choice. I had to scan the code wherever I went because of the epidemic*" (J12).

Confusion: technical isolation and emotional stress

The development of mobile terminals and software upgrades based on user-friendly designs have strengthened the consistency of network use. However, older people's physiological characteristics mean they differ from younger groups in the acquisition and processing of information [25]. This can result in a helpless state with the psychological characteristic of wanting to be integrated into network life but deterred by operational adaptability barriers; ultimately, this caused confusion about the use of Internet, and older people easily become "digital refugees" (Leurs K., Smets K, 2018) [26].

Technological confusion

Adaptive challenges for older people often led to technological confusion. This captured the anxiety and fear they experienced when struggling to master new technologies, where they felt overwhelmed and unable to keep pace. This often meant they tend not to try to understand and use new technology products, become self-enclosed, and ultimately are not integrated into modern life. Participating older peoples' fear of Internet technology included various platforms (e.g., WeChat) and aspects such as QR codes and traffic. Some of these fears stemmed from life events, and some were based on stories that they had heard from others. Older people have specific age-related characteristics in functions such as hearing, vision, and memory. Currently, most mobile phone software is focused on youth. There is a lack of consideration for middle aged and older users in product design. For example, "*I changed [to] a new mobile phone, but some contacts didn't get it. This was done by the staff when I bought the mobile phone. I copied the rest on the paper. Recently, I entered it little by little. I was afraid that some information would be leaked*" (J7). "*How can I learn computer at my age? Are you kidding! Countless grid on the computer keyboard, let alone understand, I look dizzy*" (J15). These comments suggested that participating older people were afraid of cutting-edge technology products, and this fear manifested as an initial response; the opposition between cutting-edge technology and initial responses made it difficult for older people to become integrated into network society.

Emotional influence

Older people may feel powerless to use the Internet. Although they want to be integrated, they do not know how to operate the technology and guidance may not be available. Therefore, most older people said they only used their mobile phones to watch the news and did not feel that the Internet offered them practical convenience. Confusion among older people stemmed from the complexity of operating the Internet and smartphones, and the artificial exclusion and even isolation in some

business scenarios. Some older people also had strong self-esteem and doubted the value of the Internet. For example, "*At such an old age, who still wants to learn to surf the Internet on a mobile phone?*" (J18). "*During the epidemic, as long as I went out to do something, I had to scan the code everywhere. This made me deeply realize the inconvenience of not being able to use a smart phone. I had no choice but to learn, but I learned one. I have to use a new app in another place, and I always feel that I can't keep up with it*" (J12). Furthermore, some stores no longer accept cash for purchases, and only scan codes for payment. The decline of self-control ability among older people means that perceived dehumanization often places them under psychological pressure. If older people cannot form good cognition about and accept stressful events, their mood is likely to deteriorate. Overall, digital anxiety can greatly affect older people's ability to embrace the digital age (Shi, 2024) [27]. Without proper understanding, they may face significant stress and resistance to participating in digital society. In this era, lifelong learning is vital for their mental health. Adopting continuous learning can ease anxiety, promote a positive view of digital progress, and improve their quality of life in a tech-driven world.

Fear: deception and lack of social support

"Fear" encompassed the distrust experienced by older people who felt uncertain about using the Internet after being exposed to the Internet for a period of time (Everett M, 1983) [28]. This mainly included the fear of being cheated and the fear of lack of support. In addition to the obstacles encountered in the process of using the Internet, middle-aged and older people tend to be more worried about various kinds of network risks than younger people. When influenced by fear, older people may develop specific views about using the Internet to avoid risks, leading to passive withdrawal from digital engagement.

Fear of being cheated

Fear of being cheated reflected participating older people's distrust of the Internet because of the negative effects they encountered in the process of using the Internet. These effects were mainly attributable to their poor ability to identify the authenticity of network information, credulity, and fear of fraud/rumors and distrust of society. For example, "*There was an old lady in our community who met a nutrition agent on the Internet. She was fooled into buying a lot of nutrition and healthcare products, but they were all fake and the money was not coming back. She said there were many cheaters on the Internet*" (J1). "*Last time, I went to the supermarket to buy something. Someone at the door said that he would send me a tube of toilet paper if he scanned the code on WeChat. I thought it would be nothing to scan the code, but when I got home, I found that my mobile phone had received a call saying that my bank card was in danger, and I wanted to strengthen the security protection of the verification code, so I sent it, and my money was transferred as soon as it was sent. The main reason is that it is difficult for me to distinguish the risks in this respect. Fortunately, the card money I bound is not much. I hate these cheaters and bullies. We don't understand the Internet*" (J13). The formation of older people's fear of being deceived stemmed from their experiences of being deceived, as well as "self-blame" for their lack of ability to identify network risks despite the strengthening of the news media's awareness of older people.

Lack of support

The fear of being cheated may be reduced if a person has sufficient social support, or through improvement of their technological ability and self-reinforcement of safety awareness. However, middle-aged, and older people cannot always obtain support from their relatives and friends. Older people are also accustomed to traditional cash shopping, queuing for registration, buying tickets at the window, and similar lifestyle factors. Since the outbreak of COVID-19 in 2020, most window services shifted to online services. Additionally, the adult children of older people may be busy working, may not have patience to teach their parents, or could even feel uneasy about the Internet themselves. Many people want their older relatives to stay away from the Internet, but fail to identify and provide help for their new needs. Such situations lead to a lack of interpersonal support for older people, which results in them feeling confused, isolated from the "digital world," and fearing the Internet age. In addition, many public services set restrictions on the use of services to protect older people, which introduced further obstacles for this group. For example, "*I went to the bank to do mobile banking business, according to the procedure, I should be able to do it on the spot, but the bank insisted on calling my son and asking him to sign. Only after confirmation can I handle this business. When asked, I know that this is a threshold set specifically for the elderly. I am old, but not old and confused. I have to do something with the consent of my children*" (J7). Lack of social support may mean older people perceive there is cultural prejudice in relation to using the Internet, resulting in the self-perception of being "old and useless." However, realistic demands are likely to "force" older people to rethink this coping style, and may lead to them weighing up network risks and benefits. For example, "*Since the outbreak of the epidemic, I have to scan the health code wherever I go. I even need to get in and out of the community. Sometimes I am not allowed to get on the bus because I can't scan the code. When I finally get to the hospital*

gate, I am stopped outside because I can't scan the code. I was also hard and forced out, we have to learn how to use [the] app over and over again, otherwise we old people can only wait for death at home" (J14).

Construction of Self-efficacy

Just as the past influences the present, what occurs now prepares for the future. Through the situational construction of "problem externalization" and "relative influence," older people can find a state that cannot be affected by the problem from their unique experience. This involves examining the relationship between themselves and network use events. This means they can obtain different inspirations, experiences, and meanings, and then project these attitudes toward their future.

Comparison: efficacy in self-comparison and interpersonal comparison

"Comparison" referred to the contrast between an individual's perceived expectations and reality, which can also be called cognitive comparison. Comparison runs through almost every stage of people's lives. People often evaluate their quality of life and happiness based on personal feelings and societal norms. From the perspective of objects, comparison can be divided into self-comparison and interpersonal comparison (Damant J., 2017) [29], which is comparison between oneself and others in the same age group. Such comparisons allowed participating older people to develop a good sense of efficacy, but may also produce a sense of inferiority, loss, and other negative experiences. In the process of comparison, through "problem externalization," older people found that the problems they faced in the process of using the Internet were independent of themselves, did not originate from themselves, and were not owned by themselves.

Self-comparison produces efficacy

After using the Internet, participating older people often gained a positive experience of self-affirmation because of the acquisition of new skills (e.g., data acquisition) and feelings such as "I can do it" and "I keep up with the times." This data acquisition, ability development, and intergenerational integration may mean older people give-up negative views such as "old people are useless" through problem externalization. However, this efficacy can also be related to external adverse factors. To obtain good results and promote adaptation, older people themselves need to have endowment conditions such as cultural literacy and judgment ability. First, data acquisition referred to the process of improving self-management difficulties caused by the data gap through accessing social services, checking health information, or seeking social support through the Internet. However, not all older people have equal opportunities to access and use the technologies, and more importantly, to be able to benefit from the technologies (R Yang et al., 2024) [30]. Older people that could not operate the Internet may be limited in many aspects of daily life, resulting in an "information island" state. Older people commented that they used the Internet to meet their personalized service needs. For example, "*Now I have to deal with bank accounts, hospital registration, and water and electricity charges online, which I didn't know before. Now try to use, also slowly will, feel convenient*" (J16). Second, "I can do it" referred to a confident attitude when using the Internet, such as "I can do it as long as I want to learn" and "I can teach others." For example, "*I surfed the Internet by myself, also because I saw the Internet celebrity old man and old woman playing very well before. Others can. I just want to prove that I can also live and learn. Old people can also do it as long as they learn hard. I am very happy that I can learn to use the computer and feel that I have the ability*" (J13). After trying to use the Internet, many older people found that the Internet was not as complicated as they had imagined; they realized they could still learn, and their self-confidence improved. This comparison brought about improvement in self-confidence as well as a sense of self-efficacy among older people. Third, "keeping up with the times" meant that older people felt that they were keeping up with progress and had not been abandoned by society compared with previously when they did not use the Internet. For example, "*I used to think that people are old and don't understand young people, so I don't want to get in touch with new things. But now I learn to surf the Internet and find that I'm not as bad as I imagined, as long as I'm willing to learn. Those who can keep up with the society*" (J22). It was also hoped that using Internet will offer more care options for older people.

Interpersonal comparison produces a sense of loss

"Comparison" is a double-edged sword in that it can facilitate older people developing a good sense of self-efficacy, but may also result in a sense of inferiority and loss (Houshangi, 2017) [31]. In the process of using the Internet, older people often had negative experiences after comparing themselves with others. Older people with limited physical and learning abilities tended to have difficulties using the Internet. When compared with people with strong learning ability, they felt inferior, resulting in inferiority and loss. For example, "*Look at other old people who learn computers quickly, but their brains are not open, and they forget to learn. Here we go. An old man who learned to surf the Internet later than me showed me that he could make an appointment with his mobile phone now. I could only watch the news on my mobile phone, but not pay online*" (J18). However, some older people were addicted to the Internet, and people around

them felt lost and that the Internet took away their communication time and opportunities. For example, "*I used to go dancing with my partner. Now, after learning dancing on my mobile phone, I am addicted to online dance teaching videos. I don't go even if I call her. I learn by myself. I say that the movements taught on the Internet are accurate. I follow my mobile phone to learn more than everyone else. But we used to dance together happily, how can we become blind dancing after the Internet? I really can't figure it out*" (J6). This narrative suggested that the use of the Internet itself was not the key factor affecting the efficacy and data acquisition of older people, as it was only one external factor. Efficacy was also related to the representation of older people experiencing similar information stimulation, individual psychology, and decision-making feedback. The external factors to which older people may not easily adapt included both favorable and unfavorable external factors. Encountering adverse external factors may mean older people experience prolonged emotional discomfort.

Reflection: realizing the efficacy of self-empowerment in reflection

"Reflection" referred to older people's attitudes toward the Internet before and after contact with the Internet and the role it brought. When older people had new ideas about their past experience in the process of using the Internet, it represented the beginning of deconstruction. In the path from deconstruction to construction, it is necessary to acknowledge the function of cognitive adjustment among older people using the Internet. Interactions with the surrounding population will help them become integrated into the collective. Therefore, if they had dialogue with themselves (who had experienced difficulties in surfing the Internet in the past), this could encourage their "present self" based on their "past self," and allow themselves to realize self-empowerment. This included two aspects: changing the conservative aspect and social interaction/network construction.

Changing the Conservative attitude

"Changing conservative attitude" represented older people developing an open and inclusive attitude toward the Internet after they reflected on the impact they felt from using the Internet. For example, "*Now try to keep up with the times. If you are afraid of this and that and don't want to try, [you] isolate yourself from society. People have to communicate more with the outside world. Although they are old, they still have to keep a young attitude. I am very supportive of the Internet for the elderly, and it is good to have a happy old age. Why worry so much? Enjoy the benefits of the Internet*" (J15). Digital feedback can be difficult, and the key to its implementation is to promote willingness for self-active learning among older people; whether they obtain substantive "acquisition" in reality is an important factor affecting their willingness to learn. For example, "*I used to feel old and useless, and I felt abandoned by society. Now contact with the Internet, [I can] learn popular things, can communicate with children, the outside world, can shop online, booking housekeeping services, feel more substantial than before. Not only the Internet, I am interested in new things and I want to try it*" (J22).

Social interaction and network construction

Internet use could have positive or negative effects on the efficacy of older people, which was related to the endowment of the older person themselves, and to the attitudes and support behavior of the surrounding population. Older people experienced positive efficacy when they had good network use skills and cultural endowments, an open attitude, active communication with the surrounding population, and expanded the scale of their social networks. However, when the scale of social networks was reduced, support from family members was relatively new, or the older person became to absorbed in online content, use of the Internet could result in personal loneliness, depression, and weakened motivation to communicate with others. For example, "*Old people, but also most afraid of being said useless by others, in fact, I also want to learn network skills, but [am] also afraid of lagging behind this era, but by a variety of influences, such as no one to teach, forget after teaching, or once not done well, the young people next to despise, slowly dare not operate, afraid of being laughed at*" (J17).

Network application software provided channels and opportunities for older people to participate in society, enhanced social contact, promoted understanding of community dynamics, promoted their subjective initiative, and supported their integration into the collective. These factors highlighted the value of interpersonal networks achieved by social participation. One participant shared, "*The community now holds activities that will be released on the WeChat public account. I didn't pay much attention to them before, but now I can vote on the type of activities I want to hold on my mobile phone. I have a strong sense of participation. When I see children working well in other places, I can also send their photos to friends circle, you can also publish emoticons. During the festival, relatives who haven't seen each other for many years can also send red envelopes and make an Internet phone call, which warms their hearts*" (J19).

Empowerment: efficacy in emotional empowerment and value identification

In the process of transitioning and integrating between the historical experience of using the Internet and the realistic situations, older people may enjoy the benefits

offered by the Internet and construct their sense of self-efficacy based on aspects of emotion and value.

Emotional empowerment

Technological empowerment provided older people with friendly conditions to achieve technological aging. It is important to have a good inclusive social environment to stimulate resonance in emotional empowerment among older people. "Emotional empowerment" referred to older people's use of the Internet and social networks to achieve emotional satisfaction and improve mental well-being, which may help promote their physical and mental health. In the process of using the Internet, older people deepened their understanding of and respect for other age groups in their community and broader social environment. To achieve the state of the "ideal self," it is important to realize the continuous internalization and externalization of the interaction between self and social situation and interpret the significance of the individual's socialized action and the relationship with intergenerational integration. For example, "*After I learned to use WeChat on my mobile phone, I often had video calls with my daughter. I used to feel lonely because no one talked. Now I use WeChat not only to chat with children, but also to see the circle of friends. I feel closer to my children*" (J14). In terms of the special "threshold" set by society for older people to use the Internet, some experiences meant that older people realized the perceived social prejudice and discrimination against them was actually to protect them from the risks in the digital environment. This reflected the perspective of older people in general rather than the individual.

Value identity

"Value identity" reflected to the process by which individuals formed a sense of self-worth and purpose through their values and beliefs. Use of the Internet among older people may also create self-reality, resulting in the perception of aging and subsequent adjustment as a unique personal process, and encouraging the formation of conclusions and views on the functioning or maladjustment of older people according to their own social understanding. As Cicero said, "*The weakness of childhood, the passion of youth, the steadiness of middle age, and the wisdom of old age all have some natural advantages, which people should enjoy at the right time* [32]." In the process of introspection, older people began to examine the value of the Internet and its impact on themselves, which promoted changes in cognitive biases from the past, and treating the Internet objectively. Therefore, they could look forward to actively integrating into Internet society. For example, "*In the Internet age, everyone can't stay out of it. Instead of complaining, losing, and escaping, it's better to take the initiative to look at, actively adapt to, and embrace the Internet society. As the saying goes, it's never too old to learn. I'm also making constant progress. People have to pursue something. It's not because they're afraid of being looked down upon by others, but because it's a state of life*" (J8).

Case study: from digital struggle to empowerment

Introduction Mr. Zhang (J21) was always curious about technology. However, his journey with smartphones was challenging. Despite his enthusiasm, he struggled with complex functions, feeling overwhelmed and inadequate. His attempts to connect with his grandchildren through video calls often ended in frustration, leaving him isolated. Misleading online information and scams further eroded his confidence, threatening his dignity and self-worth.

Challenges Mr. Zhang's eagerness was stifled by the steep learning curve. His inability to master basic functions led to feelings of inadequacy. His efforts to bridge the digital gap with his family only deepened his sense of isolation. Because he was vulnerable to scams, he felt distrustful of technology.

Process Determined to overcome these challenges, Mr. Zhang joined a community activity group supported by a welfare project. There, he met peers facing similar struggles, and their shared experiences gave him hope. With the group's support, he began documenting his progress, reflecting on each small victory. This self-empowerment transformed his mindset from frustration to determination. As his skills improved, Mr. Zhang started teaching other seniors. This role reversal not only reinforced his knowledge but also gave him a renewed sense of purpose and dignity. He found joy in sharing his journey and was uplifted by his peers' gratitude.

Conclusion Mr. Zhang's journey from digital struggle to empowerment highlights the power of community support and self-reflection. By comparing himself to others, reflecting on his progress, and finding value in helping others, he regained his sense of dignity and purpose. His story is a testament to the resilience of the elderly in seeking self-meaning and overcoming vulnerability through technology.

Conclusions and contributions of the study

The results of this study showed that the self-efficacy structure constructed by the six main categories discussed above suggests that in using the Internet, older people finally moved toward empowerment from many possible choices. This was the result of the process of seeking self-worth and exploring their sense of agency. The reconstruction of self-efficacy in the use of the Internet by older people was directly motivated by their

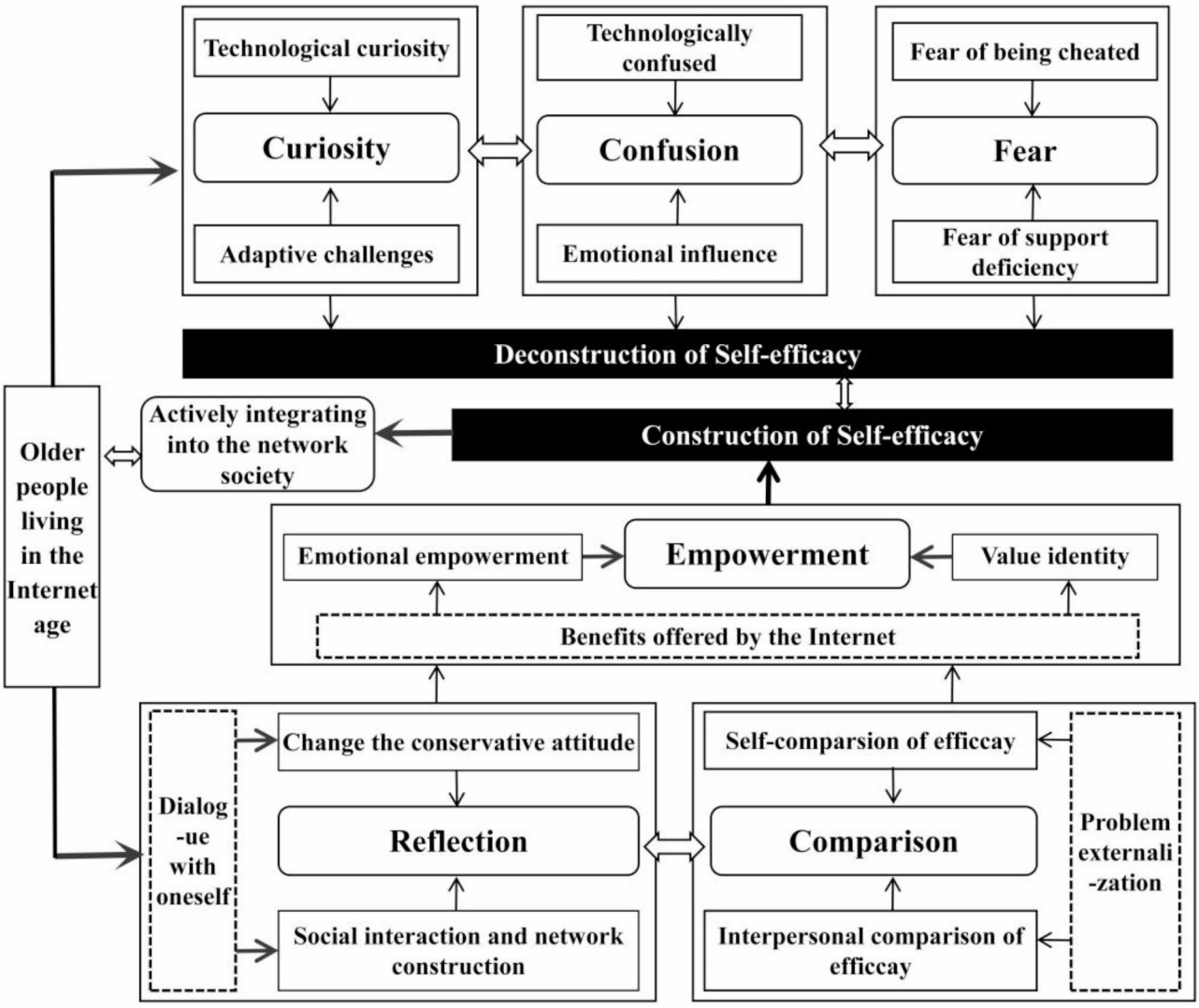

Fig. 1 Deconstruction and construction of internet use "self-efficacy" among older people

empowerment, and self-empowerment was inseparable from the construction of the situation. The empowerment of older people in terms of Internet use stemmed from the combination of "individual initiative" and "external force," the former emphasizing the initiative of the older person themselves and the latter emphasizing the function of the situation. Through preliminary research and analysis, the model of Internet use "Self-efficacy" among Older People is constructed as follows. Overall, the process of forming a sense of efficacy among older people in using the Internet is a system of seeking self-meaning, preventing vulnerability, and maintaining dignity. The story line of this study is summarized in Fig. 1.

In this study, it was observed that older people adjusted their Internet use based on the practicality of strategies in specific situations. Whether this behavior translated into a sense of efficacy depended on whether it delivered the desired functional benefits. This finding aligns with pragmatism, which posits that behavior is judged by its practical utility. Through interviews and observations, we found that older people continuously constructed their self-efficacy in internet use through interactions with others. This process of meaning-making is central to symbolic interactionism, which emphasizes that meanings are constantly built and rebuilt through social interactions. This study revealed that the sense of efficacy in internet use among older people is dynamic and context-dependent, influenced by their interpretation of the environment and their social interactions. Drawing on social constructionism, we highlighted how shared meanings and social interactions shaped participants' attitudes toward Internet use.

First, the situation is the basic condition for older people to deconstruct "abnormal." They then construct "normal" behavior of Internet use, which is influenced by the

objective social situation. The perceptions and reactions of older people to Internet use situation, irrespective of the environment (humanistic or natural), are the result of the older person's self-construction and also affect their health status. In addition to their cognition and interest, the formation of the older person's drive to use the Internet is closely related to their own environmental system. COVID-19 became a catalyst for changes in the relationship between older people and the Internet. However, for passive older people, it was reflected in "top-down promotion," which regarded the older group as "others" rather than "real" participants.

Second, the goal is to construct a "normal" value orientation for older people. A situation has many possible characteristics, and there are always certain factors that are important in any particular situation (Wu Weihua, Jiang Mina, 2021) [33]. In the context of Internet use by older people, an important factor is the presence of clear "goals" as a basis for their judgment and choice. These drive factors affect older people's cognitive process and cognitive structure, promote a deep understanding for the individual and improve their cognitive structure of Internet use, and affect their participation behavior. The construction of a social network is the demand, drive, or desire that the older person may encounter when they participate in social activities, and these goals are brought into the situation in using the Internet to enhance the older person's knowledge and ability to adapt to network society. To construct the value of sense of self, it is necessary to realize the control older people have over themselves and their expected life.

Third, function served as a driving factor for older people to transition from deconstruction to construction. Function is an objective consequence, but the decision as to whether to intervene and the degree of function are affected by many factors, all of which impact human behavior. There are major differences among older people, including differences in physical and mental conditions and social and economic situations; therefore, digital protection and incentives for older people are important. The learning function of older people in pursuing the "truth" of things is an important driving factor, and will affect their views on the function of the Internet, and ultimately form change. By using the Internet, older people could change the relationship between themselves and the Internet, acknowledge their life's value, and stimulate, maintain, and regulate themselves from deconstructing "abnormal" to constructing "normal" thereby helping to meet the needs of individuals or society.

Discussion

First, our findings were aligned with Bandura's (1986) [1] theory of self-efficacy, which emphasizes individuals' confidence in their ability to achieve goals in specific contexts. However, our study extended this theory by focusing on the unique challenges and opportunities faced by older people in the digital age. Drawing on Hsu and Chiu's (2004) work on older people's acceptance of e-services, we highlighted how behavioral control beliefs influenced Internet use patterns among older people and examined how older people navigated the complexities of Internet use. This revealed the critical role of self-efficacy in their digital engagement.

Second, we built on He Zhiwu and Dong Hongbing's (2021) [14] research on digital inclusion, which focused on the structural and environmental factors that facilitate digital inclusion. Our research added a new dimension by exploring the interplay between individual agency and situational context. We demonstrated how older people actively constructed their sense of self-efficacy through reflection, comparison, and empowerment, even in the face of significant barriers.

Third, we extended Nimrod's (2020) [34] argument that older people possess the potential to adapt and thrive in the digital age when provided with appropriate support and resources. We showed how older people moved from deconstructing their "abnormal" experiences of Internet use to constructing a "normal" sense of self-efficacy.

Finally, our study contributes to the growing body of literature on Internet self-efficacy among older people by introducing a novel framework that integrates situational context, social support, and individual agency. This framework extends existing theories of self-efficacy and provides practical insights for policymakers and practitioners aiming to create aging-friendly digital societies. By addressing the gaps identified in previous research, our work offers a comprehensive understanding of the barriers to and facilitators of Internet use among older people, ultimately advocating for more inclusive digital policies and interventions.

Recommendations

This study suggested that specific measures should be adopted to improve the environment for older people to use the Internet, relieve their "sense of abandonment," and promote self-efficacy.

The first measure is to respect the dominant position of older people. It is important to recognize that older people have specific demands and multiple social roles, and should be treated in accordance with their different endowments and social structures. They should not be forced to access digital society. Excessive exaggeration of the digital difficulties they may face should also be avoided, and older people should be given a variety of options.

The second measure is establishing comprehensive social support networks in communities. It is important to strengthen family support for older people in using the

Internet, set-up interest groups for Internet use among older people in the community, implement digital literacy programs, promote mutual assistance among older people and cross-age support for using the Internet, and give older people a "hot start" for the Internet. This will be conducive to getting through the "last mile" of information sharing for older people, improving their knowledge and skills in using the Internet, reducing their fear of science and technology, and enhancing their recognition of the value of the Internet.

The third measure involves enhancing the digital technology adaptation for older people by internet companies. Businesses and research and development institutions must shift their design concepts to better address the needs of older individuals, considering both their physiological aspects and user habits. Key strategies include promoting the development of "Internet + pension" integration technology; ensuring the unification of technology standardization with the individualization of older people's needs; and building an intelligent pension service support system. Technology and network products should be developed with aging-friendly features, considering aspects such as font size, color contrast, and keyboard design, thereby enhancing the support functions of network use for older people's health and daily life.

The fourth measure involves creating an age-friendly Internet ecosystem to leverage the government's role. In the construction of government informatization, it is important to fully consider the needs of older people and set up transitional and special groups of service channels to achieve "free switching" and "flexible compatibility" between older people and other groups using the same network services. Other approaches include establishing standards for network products for older people, implementing a preferential system for Internet access fees for older people, and registering and financially subsidizing the development of patented network software products suitable for this population.

The fifth measure is guarding against network risks with policy norms. We urge the legislature to improve the system of laws and regulations as soon as possible. This will help to strengthen the construction of the rule of law on the Internet, guide Internet enterprises to actively practice their social responsibilities, and enable a targeted network and financial management for older people. It may also be necessary to resolve problems older people encounter in the process of using the Internet, and provide legal remedies to reduce risks for older people using the Internet.

Limitations and further research

There were some limitations in this study. First, some of the interviewees were from remote rural areas of China, and their digital literacy and language expression abilities were limited, which may lead to an insufficient collection of the views of some older people. Second, this study was based on research in a specific area, and there is room for improvement in terms of the number and representativeness of the older population, especially objective factors such as the internal differences in older people population, which were relatively insufficiently considered. Third, urgent problems that remain to be solved are the scientific measurement of the level of "identity" and the factors that affect the level of identity in the process of deconstructing and reshaping "normal."

In response to these limitations, our further research will focus on geographical and population diversity, employing large-scale, longitudinal, cross-regional, and mixed-methods approaches to enhance generalizability. We aim to include older people from diverse socioeconomic backgrounds and varying digital literacy levels to better capture the diversity of their experiences. In addition, exploring identity measurement in the context of Internet use will provide deeper insights into its role in self-efficacy and digital engagement. Furthermore, we plan to use experimental methods to examine how self-efficacy is shaped by active learning and situational factors, to offer insights into the dynamic interplay between individual agency and external influences. This will contribute to a more comprehensive understanding of older people's Internet use and inform the development of inclusive digital policies and interventions.

Conclusion

In conclusion, this study explores the deconstruction and construction of self-efficacy in Internet use among older people. We revealed a dynamic and context-dependent process shaped by situational conditions, goal orientation, and functional induction. Our findings align with life course theory, which emphasizes how life stage transitions influence older people's digital engagement. The findings also highlight the critical role of self-efficacy in older people's digital engagement and emphasize the importance of individual agency, social support, and environmental factors. The reconstruction of self-efficacy is a means of adapting to the digital age and a pathway to maintaining dignity, preventing vulnerability, and seeking self-meaning. This study underscores the need for tailored interventions, inclusive digital policies, and age-friendly technologies to promote digital inclusion and improve the well-being of older people in an increasingly digital society. By addressing these factors, society can empower older people to embrace the benefits of the Internet and fully participate in the digital world.

Supplementary Information

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Supplementary Material 1

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Author contributions
Xinchao Tian conceptualized the research idea, reviewed the literature, synthesized the relevant information, prepared the initial draft, incorporated the comments of the anonymous reviewers, and finalized the manuscript. Shihuan Mi mainly assists in data organization and writing.

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Data availability
Data will be made available on reasonable request.

Declarations

Ethics approval and consent to participate
This study has used secondary data, which is in public domain. Therefore, ethical approval and consent to participate are not required.

Consent for publication
Not applicable.

Competing interests
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