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Enhancing Digital Literacy in the Elderly through Media and Technology to Prevent Hoaxes in Indonesia: A Systematic Literature Review

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ABSTRAK

Penyebaran berita hoaks di kalangan lansia di Indonesia semakin meningkat akibat kemudahan akses informasi di internet, di mana banyak lansia belum memiliki kemampuan yang memadai untuk menyaring informasi yang mereka terima. Literasi digital menjadi aspek penting dalam menanggulangi permasalahan ini karena dapat membantu lansia mengembangkan keterampilan kritis dalam mengevaluasi keabsahan suatu berita sebelum menyebarkannya. Penelitian ini bertujuan untuk mengevaluasi peran literasi digital dalam membantu lansia mengidentifikasi informasi yang salah serta mengeksplorasi teknologi pendukung dalam proses verifikasi informasi agar mereka dapat lebih mandiri dalam memilah berita yang beredar. Penelitian ini menggunakan metode *Systematic Literature Review* (SLR) untuk menganalisis berbagai literatur akademik yang relevan dengan topik penelitian dari tahun 2014 hingga 2024, dengan fokus pada strategi peningkatan literasi digital dan efektivitas teknologi dalam membantu lansia mengenali berita hoaks. Hasil penelitian menunjukkan bahwa lansia dengan keterampilan digital yang baik lebih mampu memilah informasi yang akurat dan cenderung lebih berhati-hati sebelum membagikan berita kepada orang lain, sementara teknologi seperti chatbot di media sosial dapat menjadi alat bantu yang efektif untuk memverifikasi informasi dengan cepat dan mudah. Oleh karena itu, peningkatan literasi digital melalui pendekatan edukatif dan pemanfaatan teknologi berbasis kecerdasan buatan menjadi langkah penting dalam menangkal hoaks di era digital, sekaligus meningkatkan kualitas konsumsi informasi di kalangan lansia.

KATA KUNCI : literasi digital; misinformasi; lansia

ABSTRACT

The spread of hoax news among the elderly in Indonesia has been increasing due to the ease of access to information on the internet, where many elderly individuals still lack the necessary skills to filter the information they receive. Digital literacy plays a crucial role in addressing this issue, as it helps the elderly develop critical thinking skills to assess the credibility of news before sharing it. This study aims to evaluate the role of digital literacy in assisting the elderly in identifying misinformation and exploring supporting technologies in the verification process, enabling them to be more independent in filtering circulating news. This research employs the Systematic Literature Review (SLR) method to analyze various academic literature relevant to the research topic from 2014 to 2024, focusing on strategies to enhance digital literacy and the effectiveness of technology in helping the elderly recognize hoax news. The findings indicate that elderly individuals with strong digital skills are more capable of distinguishing accurate information and tend to be more cautious before sharing news with

others, while technologies such as chatbots on social media can serve as effective tools for quickly and easily verifying information. Therefore, improving digital literacy through educational approaches and utilizing artificial intelligence-based technology is a crucial step in combating hoaxes in the digital era while enhancing the quality of information consumption among the elderly.

KEYWORDS : *digital literacy; misinformation; older adults*

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INTRODUCTION

In this digital era, the spread of information through various social media and online platforms has become faster and more accessible to people from all walks of life, including the elderly. Older adults are increasingly using the internet for various purposes (Marler & Hargittai, 2024). Interestingly, 73% of elderly individuals have incorporated the internet into their daily activities, such as interacting with family (63.4%), reading online news (33.6%), shopping online (27.7%), and browsing websites (30.7%) (Md Fadzil et al., 2023). However, this ease of access also creates opportunities for the spread of misinformation or hoaxes, which can cause social unrest and affect societal well-being (Chan, 2024), particularly among the elderly. Data shows that 11% of users aged 65 and older share hoaxes, compared to only 3% of users aged 18-29 (CNN Indonesia, 2019). This indicates that older adults are more likely to spread misinformation than younger generations. They often share news with others based solely on the headline without reading the full content (Kominfo, 2018). This phenomenon suggests that low digital literacy can significantly impact the ability of elderly individuals to filter and assess the information they receive. Digital literacy has been recognized as a key factor in preventing the spread of hoaxes across various countries. In Finland, for example, digital literacy programs have been implemented from an early age, with the government actively providing educational resources to strengthen critical thinking skills in evaluating digital information (Hänninen et al., 2021). In the United States, various community-based initiatives, such as computer classes, have been developed to help older adults understand the risks of digital misinformation (Pihlainen et al., 2023). Meanwhile, in developing countries like Malaysia and Brazil, efforts to promote digital literacy among the elderly have also been introduced through community-driven approaches and social interventions (Pihlainen et al., 2021). However, in Indonesia, despite the introduction of several digital literacy programs, participation among older adults remains limited.

Many face challenges such as restricted access to technology training, low motivation to learn, and a lack of support in developing their digital skills. Therefore, more effective and inclusive approaches are still needed to

enhance digital literacy among the elderly. Several factors contribute to older adults' susceptibility to hoaxes. First, they tend to adopt and engage with digital platforms at a slower pace than younger generations, leading to lower levels of digital literacy (Tirto.id, 2019). This disparity contributes to the digital divide, a term referring to the gap between individuals who are digitally connected and those who are not. This divide often results in digital exclusion for older adults, negatively affecting various aspects of their daily lives (Gates & Wilson-Menzfeld, 2022). Second, several internal factors contribute to this vulnerability. As people age, they may face difficulties in processing large amounts of information, particularly if they experience cognitive decline, physical health issues, loss of independence, or safety concerns.

Additionally, social and psychological factors exacerbate their susceptibility to misinformation, as older adults tend to place greater trust in information from friends or close family members rather than official news sources (Kang et al., 2023). In such cases, support from family and friends is crucial in helping seniors navigate complex information and ensuring their safety in the digital world. Efforts to enhance digital literacy among older adults should be tailored to their specific needs and learning styles. Research suggests that personalized approaches, such as intensive support from family members, peers, and trained educators can significantly improve their ability to engage with digital technology (Mubarak & Suomi, 2022). Strengthening digital literacy in this manner is expected to help older adults recognize misinformation and mitigate its negative impacts. Given this background, this study highlights the importance of digital literacy among older adults in preventing the spread of hoaxes.

Additionally, it explores the role of various technologies and media in helping seniors assess and verify the credibility of the information they encounter. A considerable body of research has explored the challenges older adults face in using digital technology, particularly in relation to digital literacy and misinformation dissemination. For instance, (Xiao et al., 2021) found that seniors often struggle to differentiate between credible information and misinformation, especially when dealing with complex digital content, largely due to their limited internet experience compared to younger generations. To address this issue, (Pihlainen et al. , 2021) recommended improving digital literacy among older adults through a social contact-based approach, fostering an engaging learning environment that encourages senior participation. Meanwhile, (Segal, 2024) proposed specific measures to protect seniors from online fraud, emphasizing the need for adequate training and support to enhance their digital literacy. However, existing studies have not yet provided a comprehensive analysis of the effectiveness of digital literacy improvement methods for older adults or compared different types of technologies that can aid them in recognizing hoaxes. Therefore, this study aims to bridge this gap by investigating strategies to enhance digital literacy among seniors and identifying the most effective technologies to support their ability to detect misinformation. Ultimately, this study seeks to contribute to the existing body of literature by providing

insights into the development of effective digital literacy programs for older adults. In this study, a systematic literature review is employed to explore research trends related to digital literacy among older adults in the context of preventing the spread of hoaxes. This method was selected for its ability to comprehensively identify research patterns and compare the effectiveness of various approaches in enhancing seniors' digital literacy.

The study aims to synthesize the objectives and key findings of selected articles from six scientific databases: IEEE Xplore, Sage Journals, ScienceDirect, Taylor & Francis, Springer, and Wiley Online Library. These articles examine the role of digital literacy in combating hoaxes, as well as how digital technology and media influence seniors' ability to recognize and prevent misinformation. The research focus is summarized in the following research questions:

RQ 1: How important is it for the elderly to understand and have digital literacy skills to prevent misinformation?

RQ 2: What types of technology or media can the elderly use to prevent misinformation?

Through this study, the researcher hopes to provide in-depth insights into the role of digital literacy in protecting the elderly from the negative impacts of misinformation in today's digital era.

RESEARCH METHODS

The Systematic Literature Review (SLR) is a research method that systematically searches, evaluates, and synthesizes research findings in a structured and transparent manner, providing a comprehensive synthesis of existing knowledge in a particular field (Zhang, 2023). This method not only facilitates the collection of relevant studies but also ensures that selected research meets high standards of quality and relevance through rigorous criteria. In this study, SLR is employed to examine the role of digital literacy among the elderly in preventing the spread of hoaxes. Additionally, this research investigates various technologies and media that can support older adults in identifying misinformation and disinformation.

The literature search was conducted using Publish or Perish software, which extracts data from leading international journal databases, including IEEE Xplore, Sage Journals, ScienceDirect, Taylor & Francis, Springer, and Wiley Online Library. These databases were selected for their extensive academic publications in technology, social sciences, and health, particularly those related to digital literacy among older adults. The selection criteria in this SLR were specifically designed to ensure that the chosen studies were relevant and of high quality, with the following criteria: (1) research participants were elderly; (2) the study focused on the role of digital literacy among the elderly in preventing the spread of misinformation, as well as the technologies or media that can enhance digital literacy; and (3) the article was published in English in accredited international journals between 2014 and 2024.

The search was conducted using a combination of keywords: ("digital literacy" OR "digital skills" OR "digital competence") AND ("older adults" OR "elderly" OR "seniors") AND ("fake news" OR "hoax" OR

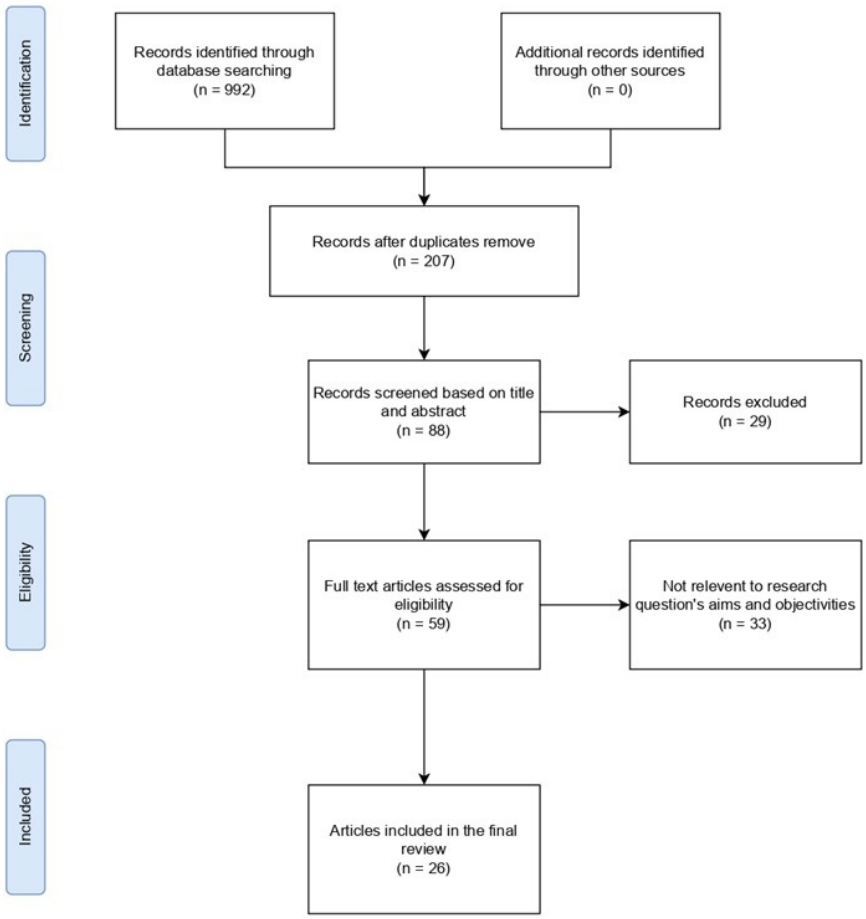

Figure 1. PRISMA Diagram

"misinformation"). These keywords were chosen to encompass various terms related to digital literacy, older adults, and misinformation. The initial search was performed on September 24, 2024, yielding 992 articles. These articles were then further screened, retaining only those most relevant to answering the established research questions. The selection process is illustrated in the following figure.

Figure 1 presents a PRISMA diagram illustrating the article screening process. The authors selected the PRISMA diagram as it is a widely adopted research protocol for conducting systematic reviews across diverse fields. PRISMA provides clear guidelines to ensure transparent and comprehensive reporting at each stage of the systematic review. This protocol also mandates authors to outline the rationale and objectives of the systematic review, the search strategies employed, and the eligibility criteria applied. Therefore, employing PRISMA can enhance the accuracy and robustness of study findings (Malik et al., 2023).

During the identification stage, a total of 992 articles were retrieved from predefined journal databases, with no additional articles identified from other sources (n = 0). Next, a screening process was performed by removing duplicate entries, resulting in 207 unique articles. These articles were further screened based on their titles and abstracts for relevance to the research topic, reducing the count to 88

articles, while 29 were excluded for not meeting the inclusion criteria. At the eligibility stage, the remaining 59 articles underwent full-text assessment to evaluate their relevance to the research questions and objectives, leading to the exclusion of 33 articles due to irrelevance. In the final stage, 26 articles met the inclusion criteria and were deemed relevant to the research focus, thus included in the final literature review. The findings from these 26 articles will be analyzed and synthesized to address the research questions.

RESULTS AND DISCUSSION

Based on the results of the systematic literature review, this study synthesizes findings from the selected articles.

The Importance of Digital Literacy for the Elderly in Preventing Hoaxes

Digital literacy skills are crucial for older adults in preventing the spread of hoaxes. Although many elderly individuals have access to digital devices, their ability to utilize social media and smartphone features often remains limited (Wendt et al., 2023). Older adults generally use digital devices for daily needs, such as reading news and searching for health information. However, digital literacy interventions for this group often do not include critical understanding of media content, which is essential in helping them accurately recognize and evaluate information (Ferrucci & Hopp, 2023). News consumption can help reduce social isolation among older adults, particularly for those who spend a significant amount of time alone and have cognitive impairments. The routine and predictable nature of news makes it a reliable source for elderly individuals with cognitive difficulties, enabling them to stay connected with the outside world (Fisher et al., 2021). These limitations make older adults vulnerable to fraud and misinformation, especially due to their digital skill gap compared to younger generations, who are more adept at navigating digital technology (Moore & Hancock, 2020).

From the perspective of digital literacy theory, Digital Media Literacy (DML) plays a crucial role in enhancing critical thinking skills, ultimately helping to create a healthier and safer online environment for users (Suwana, 2021). However, socio-economic factors often act as barriers for many older adults in acquiring these skills, making it essential for service providers and policymakers to offer accessible training opportunities, particularly in small and rural communities (Ivan & Cutler, 2021). This highlights the importance of addressing the digital divide and recommends internet training programs as well as the development of age-friendly infrastructure for older adults (Wang et al., 2023). Informal digital literacy education, such as computer classes, can help them identify reliable information and navigate the internet more safely (Seo et al., 2021). With strong digital literacy skills, older adults can critically assess information and gain confidence in using technology, ultimately contributing to social engagement and the responsible sharing of knowledge (Zhou et al., 2023).

Although most older adults have adopted devices such as smartphones, their ability to evaluate information remains limited, making them vulnerable to the

spread of hoaxes (Sriwisathiyakun & Dhamanitayakul, 2022). This issue also arises because older adults rarely use digital resources independently and often rely on assistance from others, a phenomenon referred to as "borrowed access" (Steinfeld, 2023). Older adults frequently require technical support for various issues, ranging from device settings to online security concerns, which they typically obtain from informal sources such as family and friends, as well as formal sources like computer classes (Hjorth et al., 2024). Therefore, fundamental digital skills such as information literacy, digital communication, and cybersecurity are essential to mitigate the risks of fraud and social isolation (Rose et al., 2020). Additionally, enhancing these digital skills can help maintain cognitive health in older adults, as technology-related activities often serve as important mental exercises for them (Oh & Kang, 2021).

Further research indicates that older adults not only need skills to use and understand media but also the ability to create their own media content (Rasi et al., 2021). However, internet usage rates among older adults remain low, with only approximately 35.9% actively using the internet. This highlights that digital literacy is not yet widespread within this age group (Flynn, 2024). Older adults often share content without verifying its accuracy, particularly when it originates from trusted contacts. Their primary motivation for sharing content is its alignment with their personal interests, rather than its accuracy or truthfulness. Trust in the source of information significantly influences their decision to share content. Additionally, emotional factors especially those triggered by anger-driven discourse also play a crucial role in their decision-making process. As a result, older adults tend to act impulsively before critically evaluating the accuracy of the information they share (Herrero-Diz et al., 2020). Beyond limited access, cognitive decline and a tendency to be more trusting make older adults more susceptible to inaccurate or manipulative information, reinforcing the urgency of enhancing digital literacy as a safeguard against online deception (Brashier & Schacter, 2020).

Moreover, older adults' access to social media platforms, such as WeChat, without adequate digital literacy guidance often increases the risk of rumor dissemination, particularly due to anxiety triggered by information overload, which becomes difficult to manage without sufficient digital literacy skills (Hjorth et al., 2024). In China, older adults rely on heuristic cues and self-assessment to evaluate the credibility of digital health-related information they encounter on WeChat (Chang et al., 2023). Digital literacy comprises two key aspects: information literacy and media literacy. Information literacy focuses on the ability to locate, verify, and use reliable information, whereas media literacy emphasizes a critical understanding of media messages received. Both types of literacy need to be taught to society, especially to older adults, to help them distinguish between false and factual news (Jones-Jang et al., 2021). Older adults require training across all dimensions of media literacy using, understanding, and creating. This training should primarily focus on technology usage, as technology plays a crucial role in daily life (Rivinen, 2020).

Consequently, older adults can more easily access information, communicate, and participate effectively in the digital society.

One example of digital literacy implementation is a four-month weekly computer class program specifically designed for African American older adults, aimed at helping them develop digital skills. As a result, participants demonstrated improved attitudes toward security, privacy, and the ability to verify online information (Pihlainen et al., 2023). These findings suggest that participation in digital training sessions supports the development of digital literacy and enhances the well-being of older adults. They are motivated to learn digital skills due to anticipated personal and social benefits, such as increased independence and social inclusion. Ultimately, this can strengthen their self-confidence and self-image, contributing to their overall well-being (Pihlainen et al., 2021).

The discussion on the importance of digital literacy for older adults has highlighted challenges such as the digital divide and limited technological skills within this group. However, a more in-depth evaluation of the effectiveness of implemented solutions is still needed. For instance, various digital literacy programs have been initiated by nonprofit organizations and governments in different countries, yet their success rates vary. Successful digital literacy programs generally adopt a community-based approach, involve instructors who understand the needs of older adults, and utilize interactive and adaptive teaching methods (Seo et al., 2021). For example, a digital training program in South Korea that combines hands-on training with continuous technical support has shown positive impacts in boosting older adults' confidence in using digital technology (Wang et al., 2023). In contrast, digital literacy programs in some rural areas of the United States have had limited impact due to a lack of long-term technical support and restricted access to digital devices (Munger et al., 2021). This indicates that the success of such programs depends not only on the training materials but also on the ongoing support provided to participants. Additionally, the effectiveness of digital literacy programs is also influenced by the sustainability of their impact on older adults' ability to critically evaluate information. A study by Sriwisathiyakun & Dhamanitayakul (2022) found that although short-term training can lead to immediate improvements in digital skills, older adults tend to revert to old habits if continuous reinforcement is not provided. Therefore, long-term learning strategies, such as periodic training sessions or digital learning communities for older adults, are necessary.

Although research indicates that digital literacy can help older adults prevent the spread of hoaxes, several limitations need to be considered. Most studies remain limited to specific geographical areas, making the generalization of their findings potentially less accurate. Additionally, many studies focus more on the impact of digital literacy training without assessing its long-term effectiveness in changing older adults' behavior in evaluating information credibility (Kang et al., 2023). External factors such as internet quality and the affordability of digital devices also present challenges that can influence the success of digital literacy programs. Older adults in rural areas with

limited internet access tend to have more difficulty obtaining accurate information compared to those living in urban areas. Furthermore, technical limitations and psychological barriers such as fear of new technology due to previous negative experiences, including online fraud or difficulties in using digital devices often make older adults more reluctant to participate in digital literacy programs. Therefore, an approach that prioritizes digital security and personalized assistance can help overcome these psychological barriers (Brashier & Schacter, 2020). Considering these aspects, more comprehensive policies and strategies are needed to enhance the effectiveness of digital literacy programs for older adults. A combination of community-based training, continuous mentorship, and improved access to better digital infrastructure can serve as solutions to address the challenges older adults face in today's digital world.

Based on the findings above, digital literacy has proven to not only serve as a protective measure for older adults against hoaxes but also play a crucial role in maintaining their social and mental well-being in an increasingly complex digital world. Digital literacy skills enable older adults to assess the accuracy of information, reduce the risk of fraud, and safeguard themselves from the negative impacts of misinformation, which can trigger anxiety and confusion. Moreover, digital literacy allows older adults to stay connected with the outside world, reducing feelings of loneliness and enhancing their confidence in using technology. Active participation in digital communities whether through social media, computer classes, or other online activities-can help maintain cognitive health by stimulating mental abilities and providing opportunities for social interaction. As technology becomes increasingly integrated into various aspects of life, these skills are becoming even more essential for older adults to continue participating in an inclusive and secure digital society.

Technology and Media That Can Be Used by the Elderly to Prevent Hoaxes

Various technologies and media have been proven effective in helping older adults prevent the spread of hoaxes by tailoring solutions to their specific needs. The following are findings on technologies that can assist older adults in mitigating misinformation.

First, smart intelligent personal assistants (sIPAs) can enhance interactions between older adults and technology through emotion recognition and sentiment analysis features. These features allow sIPAs to respond with empathy and adjust information according to the cognitive capacity of older adults, ensuring they do not feel overwhelmed by complex information (Islam & Chaudhry, 2023). This technology helps older adults feel more comfortable and secure when using modern digital tools.

Second, online education programs tailored to the preferences of older adults, such as the Your Health Online website, provide access to credible health information. These programs feature an interactive interface designed for older adults with low health literacy, making it easier for them to understand and filter information independently (Marston & Musselwhite,

2021). Third, in Thailand, the widely used Line platform among older adults has now been enhanced with the Senior See Net chatbot. This chatbot is designed to improve digital literacy among older adults and help them avoid online scams. With a simple and interactive design, the chatbot addresses digital literacy gaps caused by the limited availability of literacy trainers, enabling older adults to learn independently and gain more confidence in navigating digital challenges (Sriwisathiyakun & Dhamanitayakul, 2022).

Fourth, intelligent virtual assistants (IVAs) are also beneficial for older adults, especially those with low incomes. IVAs can enhance access to health information by providing personalized recommendations based on individual needs. This greatly helps older adults access relevant and reliable information, enabling them to make more informed health decisions (Nallam et al., 2020).

Fifth, the presence of virtual communities (VCs) is also highly beneficial for older adults, as they serve as digital spaces where they can engage in social interactions, share valid information, and strengthen their digital literacy. By participating in social interactions within VCs, older adults can develop a more critical approach to evaluating information, ultimately reducing their likelihood of being exposed to or spreading hoaxes (Zhou et al., 2023).

Finally, in Finland, support from information technology experts plays a crucial role in helping older adults navigate the increasing complexity of technology use. The presence of these experts not only provides motivation and practical advice but also offers continuous technical assistance, making it easier for older adults to access and utilize information and communication technology (ICT) effectively in their daily lives (Hänninen et al., 2021).

Additionally, as an extra step to support older adults in overcoming digital challenges, access to telephone helplines managed by professionals and ChatGPT based chatbots is highly recommended to help them recognize and avoid digital scams. These chatbots can assist older adults in identifying suspicious offers and providing useful advice while simultaneously enhancing their digital literacy to be more vigilant against hoaxes (Segal, 2024). Furthermore, another study highlights the emergence of a new technology called CoronaAI, a chatbot that has responded to over 7,000 interactions, primarily focusing on information related to COVID-19 symptoms and testing. This chatbot is designed to tailor content based on user needs. By utilizing the easily accessible WhatsApp platform, CoronaAI provides convenience for individuals with low digital literacy, including older adults, to access accurate health information, helping them make better-informed decisions and reducing the impact of misinformation (Abonizio et al., 2023).

Based on the findings above, a more comprehensive digital literacy strategy is needed for older adults in Indonesia to help them navigate information challenges in the digital world, particularly in preventing the spread of hoaxes. One relevant solution in line with current technological advancements is the use of interactive chatbots that can tailor information to individual needs,

provide easier access to identifying digital scams, and enhance digital literacy among older adults. The presence of simple and user-friendly chatbots, such as Senior See Net in Thailand and CoronaAI, demonstrates significant potential in assisting older adults in accessing credible information and making more informed decisions in their digital activities.

However, the implementation of this technology still faces challenges, particularly for older adults who have limited access to digital devices or are unfamiliar with advanced technology interfaces. Therefore, a more inclusive approach is needed, such as community-based training with local instructors who understand the specific needs of older adults, as well as the provision of free digital literacy classes at community centers or village halls. Continuous support is also a crucial factor, which can be facilitated through the formation of digital learning groups that allow older adults to practice and share experiences regularly, along with providing support channels such as call centers or interactive chatbots to help them identify hoaxes in real time.

In terms of improving access to technology, the government and nonprofit organizations can collaborate to provide more affordable digital devices and develop applications with senior-friendly interfaces to help them independently verify information. Additionally, public education campaigns should be strengthened through media frequently accessed by older adults, such as television and radio, while also raising awareness among families and surrounding communities about the importance of guidance in using digital technology. By implementing an inclusive and sustainable approach, older adults can more easily access and utilize information technology safely and effectively. This not only helps them prevent hoaxes but also enhances their social and mental well-being in the digital era.

CONCLUSION

This study confirms that digital literacy plays a crucial role in reducing the spread of hoaxes among the elderly. Elderly individuals with adequate digital skills are better equipped to recognize misleading information and are more likely to share credible information. This indicates that strengthening digital literacy not only benefits elderly individuals but also contributes to improving the overall quality of information in society.

The study's findings further reveal that factors such as family support, access to digital literacy training, and government policies significantly influence the enhancement of digital skills among the elderly. Technologies, including social media chatbots, have the potential to be effective tools in assisting the elderly in identifying accurate information. However, the effectiveness of such technologies depends on user-friendly designs and proper guidance in their use.

The main contribution of this research is providing a new perspective on the importance of collaboration between families, educational institutions, and the government in building a sustainable digital literacy learning ecosystem for the elderly. Families can serve as primary facilitators by offering emotional and technical support, while educational institutions can design

training programs tailored to the cognitive needs of the elderly. The government, on the other hand, is responsible for providing supportive infrastructure and developing policies that promote awareness of the dangers of hoaxes.

As a follow-up, this study recommends further research into the most effective educational models for enhancing digital literacy among the elderly, including an in-depth exploration of specific technologies such as chatbots or specialized educational applications. Further research is also needed to evaluate the effectiveness of various strategies in fostering critical thinking among the elderly regarding digital information, thereby identifying the best approaches to mitigate the spread of hoaxes within this demographic.

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