



# A Study on the Current Status and Improvement Strategies of Algorithmic Literacy among Older Adults --A Case Study of Zhenjiang China

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**Abstract.** This study investigates the algorithmic literacy of older adults in Zhenjiang, focusing on their understanding of algorithmic knowledge, usage skills, critical evaluation abilities, privacy and security awareness, and recognition of the social and ethical impacts of algorithms. The widespread use of algorithms in smart and digital environments offers convenient services like intelligent recommendations but also presents risks, including algorithmic bias and manipulation. The research aims to assess older adults' adaptability to these algorithm-driven environments, identifying strategies to enhance their algorithmic literacy. The goal is to help older adults become active participants in the digital ecosystem and promote a healthy, positive digital culture.

**Keywords:** Algorithmic Literacy; Older Adults; Digital Environment; Algorithmic Bias; Critical Evaluation.

## 1 Introduction

With the rapid development of information technologies, especially big data and artificial intelligence, people's lifestyles and work practices have undergone tremendous changes. Algorithms, as the core of these technologies, are widely applied across various fields, significantly impacting personal cognition, decision-making, and daily life. Whether in healthcare, social media, or everyday activities, an increasing number of services and products rely on algorithmic technology. However, as the application of algorithms becomes more widespread, the societal impacts have also become more pronounced, including issues like data misuse, the "black box" nature of algorithms, and concerns around algorithmic manipulation involving legal, ethical, and social challenges.

Older adults, as a unique demographic group, face specific challenges and needs. Compared to younger people, older adults encounter more difficulties in understanding

and adapting to new technologies. They often lack sufficient digital skills, making it hard to navigate the vast amounts of information online, which can lead to misinformation or information anxiety. Additionally, older adults generally have weaker knowledge of online security and privacy protection, leaving them more vulnerable to online fraud and information leak

The "Administrative Regulations on Algorithm Recommendations for Internet Information Services" implemented in China in 2022 sets key boundaries for the use of algorithm recommendations, with special emphasis on the protection of specific groups such as the elderly. This regulation requires platforms to provide convenient services to assist the elderly in using algorithm recommendation technology safely and ensure that their rights are not infringed. The introduction of this policy marks that the country is gradually increasing its attention to the digital rights of the elderly, but it still needs to be further promoted and implemented.

Despite the growing emphasis on algorithm applications at the national level, most people in China have limited knowledge about algorithms, particularly older adults. As digital technologies rapidly evolve, algorithms and their applications are also changing swiftly, creating a new digital divide due to the lack of algorithmic literacy among older adults. In this context, studying algorithmic literacy in older adults becomes especially important. Older adults need to understand basic algorithms and related technologies to fully benefit from the conveniences brought by AI.

The concept of "algorithmic literacy" has emerged to describe individuals' abilities to understand, apply, evaluate, and innovate within algorithm-driven digital environments. This concept is not only crucial for personal information security and privacy protection but also for achieving social fairness and ethical technology use. In the era of digitalization and intelligence, improving access to information services, enhancing service quality, and promoting digital inclusivity have become essential aspects of building a digital China. Enhancing algorithmic literacy among older adults is a vital issue that affects not only their personal development but also the overall progress in digitalization and intergenerational harmony within society.

## 2 The Concept of Algorithmic Literacy and its Core Dimensions

The concept of algorithmic literacy was initially introduced by<sup>[1]</sup> in "The Enlightenment of Algorithms", laying the groundwork for understanding its core aspects. Currently, there is no unified, clear definition of algorithmic literacy among scholars globally. <sup>[2]</sup> defines algorithmic literacy as a set of competencies that encompass understanding algorithmic decision-making processes, collaborating with algorithmic systems, and critically assessing their impacts. Shin (2021)<sup>[3]</sup> developed an algorithmic literacy scale, highlighting the importance of algorithm comprehension, usage skills, and critical evaluation within algorithmic literacy. Deng et al.(2024)<sup>[4]</sup>, Xia et al. (2023)<sup>[5]</sup> and Wang (2022)<sup>[6]</sup> suggest that algorithmic literacy should include awareness, understanding, usage, and critical thinking concerning algorithms. Zhu Zhiyu (2024)<sup>[7]</sup> expands this to encompass not only technical comprehension but also an awareness of algorithmic

transparency, ethics, and societal impacts. Meanwhile, Shi Xuan (2023)<sup>[8]</sup> emphasizes the role of privacy protection awareness in algorithmic literacy, pointing out the unique role libraries can play in promoting this essential skill.

Through a summary of findings from both domestic and international researchers, the definition of Algorithmic Literacy generally encompasses an individual's basic understanding of how algorithms operate, along with the ability to critically evaluate and assess the impacts of algorithms. This includes the skill to understand algorithmic decision-making processes and to apply critical thinking to analyze potential biases, ethical concerns, and societal implications associated with algorithms. The concept is often expanded to include competencies in collaborating with and using algorithmic systems effectively while maintaining an awareness of privacy protection and transparency issues.

Therefore, the core of algorithmic literacy lies in understanding how algorithms work and the role they play in decision-making processes. Its primary competencies include algorithm comprehension, Transparency and explainability of algorithms, critical thinking skills, privacy and social impact awareness.

## **2.1 Algorithm Comprehension**

Algorithmic literacy requires individuals to understand the fundamental principles of algorithms. This does not mean that everyone needs to be able to write complex algorithmic code, but they should grasp basic concepts, such as what algorithms are and how they solve problems through a series of rules and steps. They should also understand how different types of algorithms operate, such as sorting algorithms, recommendation algorithms, and machine learning algorithms. Furthermore, it is important to recognize the applications of algorithms in everyday technologies, such as search engines, social media recommendation systems, and targeted advertising.

## **2.2 Transparency and Explainability of Algorithms**

Understanding the transparency and explainability of algorithms is a critical component of algorithmic literacy. This involves recognizing the extent to which an algorithm's processes and decisions can be made visible and understandable to users. Transparency refers to how openly the workings of an algorithm are disclosed, while explainability focuses on whether users can comprehend how and why an algorithm arrives at specific decisions or recommendations.

## **2.3 Critical Thinking Skills**

Algorithmic literacy also requires users to possess critical thinking skills, enabling them to evaluate and question the accuracy and validity of algorithmic outputs. This involves determining whether users can critically assess and reflect on algorithmic results, rather than blindly accepting them. When faced with algorithmic recommendations or decisions, users should be able to make the final decision based on their own judgment.

Additionally, users should be capable of identifying algorithmic biases, especially when outputs are generated based on unfair or incomplete training data.

## 2.4 Privacy and Social Impact Awareness

Algorithms are not just technical issues, they have far-reaching impacts on society, the economy, and culture. Algorithmic literacy includes understanding the influence and potential risks of algorithms in society, such as the role of algorithms in information dissemination and news push, and how they affect people's understanding of the world and access to information. The role of algorithms in decision-making systems (such as financial lending, recruitment, legal decisions) and the bias or injustice they may introduce. Collection and privacy issues of user data, how algorithms use personal data to make decisions, and the ethical and privacy challenges that may arise.

Based on the definitions above, this paper summarizes the core competencies of algorithmic literacy as follows: understanding algorithmic knowledge, skills in using algorithms, critical evaluation ability, awareness of privacy and security, and recognition of the social and ethical impacts of algorithms. In other words, individuals with algorithmic literacy should be able to:

- Possess the ability to use algorithms and related technical tools to solve problems encountered in various contexts.
- Be aware of and understand algorithm-driven societal structures and their operating principles.
- Objectively evaluate both the positive and negative effects of algorithms, with an awareness of algorithmic risks.

The following sections of this paper will analyze algorithmic literacy through these core dimensions, delving into each aspect to offer a comprehensive exploration.

## 3 The State of Research on Algorithmic Literacy for Older Adults

As research on information literacy and data literacy deepens, both domestic and international researchers have recognized that, beyond basic digital skills, the public needs an understanding of algorithms, including how they operate, their impacts, and the logic behind them. This realization has driven algorithmic literacy to become an emerging field within information literacy education. Key topics such as algorithmic transparency, algorithmic bias, and data privacy have garnered significant attention.

Research in this field highlights various facets: Pangrazio et al. (2019)<sup>[9]</sup> discusses how data literacy can enhance public understanding of personal digital data and its algorithmic applications. Shin (2021)<sup>[3]</sup> examines how transparency and explainability influence users' trust in algorithms, promoting discussions on explainability. Bucher (2019)<sup>[10]</sup> delves into the concept of algorithms and their influence on personal understanding, emphasizing the need for tailored algorithmic literacy programs for different demographics. Lloyd (2019)<sup>[11]</sup> explores algorithmic literacy from an information

literacy perspective, offering theoretical support for integrating algorithmic literacy into broader literacy education and examining how users interpret and evaluate algorithmic outcomes and their social impacts. Scholars <sup>[2, 12-15]</sup> focus on how educational methods can promote algorithmic knowledge among the public. Through the construction of an algorithmic literacy evaluation framework, Deng et al. (2023)<sup>[16]</sup> and Zhang et al. (2024)<sup>[17]</sup> propose ways to enhance users' adaptability to algorithm-dominated environments, helping them navigate challenges posed by these technologies. Liu (2024)<sup>[18]</sup> explores users' understanding of algorithmic technology, critical usage abilities, and awareness of privacy and security in algorithm-driven digital environments, aiming to develop a model that enables users to tackle challenges brought by intelligent technologies effectively. Meanwhile, Deng Shengli et al.(2023)<sup>[16]</sup> and Zhou Xuemei (2022)<sup>[19]</sup> concentrate on college students, advocating for deeper algorithmic knowledge dissemination and practical applications.

The literature review reveals that current research on algorithmic literacy primarily focuses on understanding and perceiving algorithms, interacting with algorithms, developing evaluation frameworks for algorithmic literacy, and enhancing users' awareness of fairness, ethics, transparency, and privacy protection in algorithmic decision-making <sup>[20]</sup>. The main target groups for these studies are the public and college students. However, there is limited research on how specific vulnerable groups <sup>[21]</sup>, especially older adults, understand and use algorithmic technology. Most studies on older adults have concentrated on digital literacy, which focuses on helping them use and operate digital technologies to integrate into the digital society.

In contrast, algorithmic literacy delves deeper into how older adults can critically understand and use algorithm-driven systems, particularly when algorithms affect personal decisions and privacy. While digital literacy is crucial for older adults to maintain independence, access information, and engage socially, algorithmic literacy is key to further enhancing their digital adaptability.

The review also highlights that, although the concept of algorithmic literacy has been widely discussed, empirical studies based on actual data remain limited, especially those examining older adults' understanding, behaviors, and response mechanisms related to algorithms. This gap results in a disconnect between theory and practice, making it challenging to devise targeted educational interventions.

In response to current research gaps, this study conducts an empirical investigation into algorithmic literacy among older adults, focusing on its core dimensions. The aim is to gather specific data and case studies to understand older adults' knowledge levels, usage skills, and response capabilities concerning privacy and security issues posed by algorithm-driven technologies. By supporting the research with empirical data, this study seeks to design adaptive educational programs and technical support tailored for older adults, helping them overcome the digital divide and become active participants in the digital society.

## 4 Research Methodology

This study employs a mixed-methods approach to investigate algorithmic literacy among older adults. The research includes both quantitative and qualitative data collection to gain a comprehensive understanding of older adults' interactions with algorithm-driven technologies. Specifically, the methodology comprises:

- **Survey Questionnaires:** To assess knowledge levels, usage skills, and awareness of privacy and security related to algorithmic technologies, a structured questionnaire is administered. This tool collects quantitative data on core aspects of algorithmic literacy, such as comprehension of algorithms, critical thinking, and privacy concerns.
- **Interviews and Case Studies:** In-depth interviews are conducted with a subset of participants to gather qualitative insights into their experiences, challenges, and perceptions when using algorithm-driven technologies. This approach allows for a deeper exploration of older adults' attitudes toward algorithm transparency, fairness, and ethical considerations.
- **Data Analysis:** Quantitative data from the surveys are statistically analyzed to identify patterns and correlations among variables, while qualitative data from interviews are analyzed thematically to highlight key issues and contextual understanding.
- **Educational Needs Assessment:** Based on the collected data, the study evaluates older adults' educational needs regarding algorithmic literacy. This helps inform the development of targeted educational interventions aimed at enhancing older adults' adaptability and engagement with digital technologies.

The combined use of quantitative and qualitative methods provides a robust framework for understanding and improving algorithmic literacy among older adults.

### 4.1 Questionnaire Design

When designing a questionnaire to assess algorithmic literacy among older adults, careful consideration is given to their technology usage habits, comprehension abilities, and the application of algorithmic technologies in their daily lives. The questionnaire is straightforward and easy to understand, covering:

- **Basic Information:** Collects demographic details such as age, gender, and education level.
- **Technology Usage:** Inquires about frequency of use, commonly used devices, and general comfort with technology.
- **Practical Applications:** Examines how they use social media, engage in online shopping, and interact with other algorithm-driven technologies.

The questionnaire also includes core dimensions of algorithmic literacy, such as understanding of algorithms, critical thinking skills, transparency awareness, and privacy and social impact awareness. This approach ensures that the questions are relevant and accessible, tailored to the unique needs and experiences of older adults.

### 4.2 Structure Characteristics of the Survey Sample

This study focuses on adults aged 60 and above in Zhenjiang City. A total of 230 questionnaires were distributed using both online and offline methods, incorporating both open-ended responses and targeted prompts. A total of 200 valid questionnaires were returned, resulting in a response rate of 86.9%.

In the valid sample, there were 102 men and 84 women; 121 respondents resided in urban areas, while 65 were from suburban areas. In terms of age distribution, 65% were between 60 and 65 years old, 22% were aged 66 to 70, and 13% were over 70. Regarding educational background, 25% had completed primary school or below, 40% had a middle school education, and 35% had completed high school or higher.

### 4.3 Usage of Smart Devices Among Older Adults and Main Daily Application Scenarios

Among the older adults surveyed, the usage rates for electronic devices were as follows: 70% for mobile phones, 12% for smart home devices, 10% for computers, and 8% for tablets. This indicates that mobile phones are the most used devices, showing a preference among older adults for portable, multifunctional devices.

Most respondents reported using electronic devices for 1-2 hours daily. The primary uses of these digital devices included social communication (e.g., staying in touch with family and friends through WeChat and video calls), entertainment (such as watching videos, listening to music, and playing games), accessing news and information (via news websites and social media), health management (using health monitoring apps and telemedicine services), and online shopping.

### 4.4 Analysis of Survey Results

**Awareness and Understanding of Algorithms.** The survey results on older adults' awareness of algorithms are shown in Figure 1. The survey indicates that 50% of respondents have heard of the term "algorithm," but only 15% report having a clear understanding of its meaning. Most older adults indicated limited comprehension, particularly regarding the specific principles behind data processing and decision-making, suggesting that their overall awareness of algorithms remains limited.

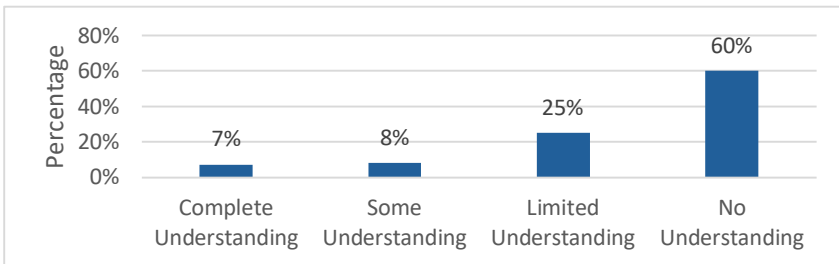
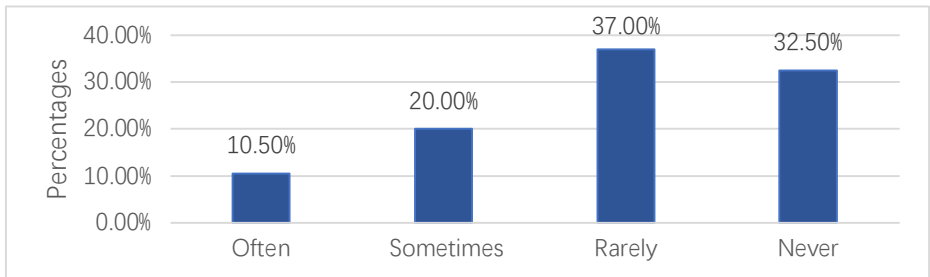


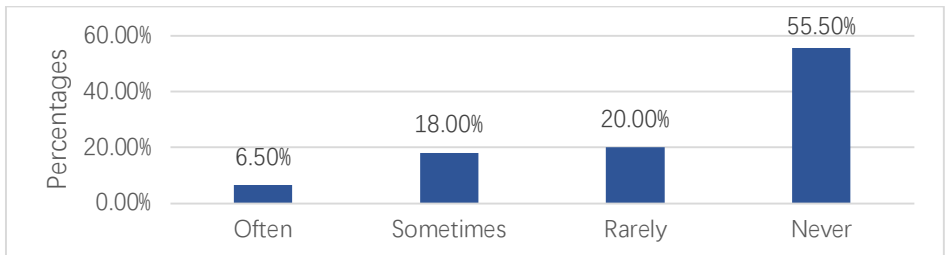
Fig. 1. whether understand the content and purpose of algorithms provided by companies

When asked about their experience with algorithmic recommendations, 65% of respondents reported feeling occasionally or frequently confused, indicating a need to strengthen their understanding of how algorithms operate. Older adults who frequently use the internet (more than 6 hours per week) generally displayed a better understanding of algorithms, suggesting that higher engagement with technology may enhance their algorithmic awareness.

**Critical Thinking and Algorithm Evaluation.** Critical Thinking and Algorithm Evaluation assessed whether older adults question algorithmic recommendations and if they verify information through other means. The results are shown in Figures 2 and 3. The survey reveals that 70% of older adults rarely question algorithmic recommendations, with only a small minority of 6.5% frequently questioning the results. This indicates that older adults tend to exhibit weak critical thinking when accepting algorithmic recommendations.



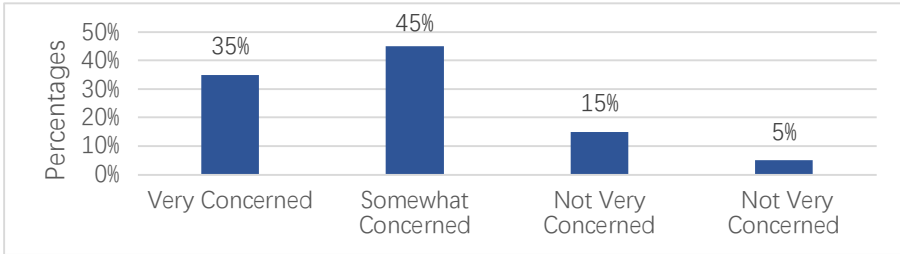
**Fig. 2.** Do you question algorithmic recommendations?



**Fig. 3.** Do you verify algorithmic recommendations through different information sources?

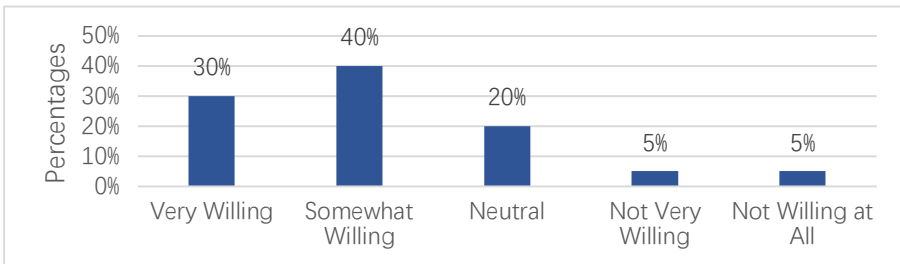
**Algorithm Transparency Awareness.** The survey found that 59% of respondents consider algorithm transparency "very important", as they feel uneasy about non-transparent algorithmic decisions. However, 30% of respondents indicated that they are "indifferent" to transparency, suggesting that a portion of older adults may lack sufficient awareness or concern regarding the transparency of algorithms. This variation in responses highlights differing levels of attention to the implications of algorithmic transparency among older adults.

**Privacy and Security Concerns.** As shown in Figure 4, the survey indicates that 75% of older adults express concerns about privacy and security issues, demonstrating a general lack of trust in technology.



**Fig. 4.** How concerned are you about privacy and security issues related to algorithms?

**Willingness to Learn Algorithm Knowledge.** As shown in Figure 5, 70% of respondents expressed a desire to learn more about algorithms. The survey also indicated that around 65% of older adults prefer learning in a face-to-face environment, as it offers direct interaction and immediate feedback. Approximately 40% of older adults reported that they prefer learning through videos, as visual content is easier to understand. With the widespread use of smartphones, about 30% of older adults indicated a willingness to try using relevant apps for learning. This can provide practical insights for educating and training older adults in algorithm literacy.



**Fig. 5.** Are you willing to learn more about algorithms?

## 5 Conclusion and Recommendations

Through survey analysis, this study comprehensively examines the state of algorithm literacy among older adults in Zhenjiang across multiple dimensions, including basic understanding of algorithms, perception of algorithm transparency, and awareness of algorithmic bias. This allows for a thorough exploration of older adults' experiences in algorithm-driven environments and their levels of critical thinking regarding algorithms. The findings indicate that most older adults lack sufficient understanding of algorithm concepts, exhibit limited critical thinking, and have a weak sense of privacy awareness. However, they actively use digital devices and show significant interest in

improving their algorithm knowledge. This suggests that effective algorithm literacy education, particularly in areas related to privacy and data security, can enhance older adults' adaptability in an algorithm-driven digital society.

Research on algorithm literacy among older adults is a multidimensional topic that involves various aspects, including education, social, psychological, and technological factors. Therefore, a collaborative effort across multiple levels is needed to enhance algorithm literacy among older adults.

- **Combining foundational digital literacy with algorithm knowledge education:** Given that 70% of older adults express a desire to learn more about algorithms, it is recommended to offer digital literacy courses specifically for older adults that incorporate basic algorithm concepts. These courses could introduce the definition, uses, and impacts of algorithms to help older adults understand their practical applications in daily life, thereby enhancing their understanding and ability to apply algorithms. Additionally, integrating critical thinking training on algorithms into digital literacy courses—such as how to identify fake news, recognize biased algorithms, and understand their societal impacts—can encourage older adults to reflect on their perceptions of algorithms and explore the potential benefits and drawbacks algorithms may bring to their lives. By combining digital literacy education with algorithm literacy training, older adults' skills and confidence in the digital world can be effectively improved.
- **Technical Design Improvements:** Many older adults express uncertainty and confusion with the recommended content on social media and shopping websites. Optimizing these systems to provide content that better aligns with the needs of older adults is essential for enhancing their digital experience and quality of life. Encouraging technology companies to consider the experiences of older adults in algorithmic applications, design user-friendly interfaces, and reduce usage complexity is crucial. Establishing feedback channels to regularly solicit opinions and suggestions from older users about their system experiences can facilitate ongoing optimization.
- **Actively Improving Algorithm Accountability:** By actively enhancing algorithm accountability and establishing a comprehensive system for the use and management of algorithmic technologies, a digital environment that is safe and friendly for older adults can be created. This approach not only significantly increases older adults' sense of participation and satisfaction in the digital society but also strengthens their trust in technology, thereby protecting their rights and privacy.
- **Promoting Social Interaction:** Encouraging technology exchange among older adults and sharing experiences and tips can help them better understand algorithms and their applications. Regularly organizing tech-sharing sessions, where older adults can exchange their experiences and tips on using technology products and services, can be beneficial. Setting different themes, such as “Social Media Usage Tips” or “Online Shopping Safety,” can attract more participants and foster deeper discussions. Gathering feedback from participants regularly will help identify the challenges and needs they encounter during these exchanges, enabling improvements in the design of these activities. Creating a supportive learning environment

where older adults can learn from and support each other will aid their adaptation to the rapidly changing digital world.

- **Enhancing Collaborative Governance Among Diverse Stakeholders:** Achieving "good governance" of algorithms requires the broad participation of diverse social actors. Through the combined efforts of the government, businesses, academia, communities, and the public, a transparent, inclusive, and accountable algorithmic governance ecosystem can be established. This approach ensures that the design and application of algorithms align with the public interest, promoting fairness and justice, and laying the foundation for building a better digital society.

Improving algorithm literacy among older adults not only helps them better understand and use algorithmic technologies but also contributes to building a healthier, more just, and transparent digital society. In the future, research in this field will increasingly focus on the practical needs of the elderly population and the effective implementation of algorithm literacy education. Studies should consider various aspects such as cognition, decision-making, bias and transparency, and privacy protection, to help older adults better adapt to and utilize algorithmic technologies. This will narrow the algorithmic divide and promote technological fairness and inclusiveness, meeting the developmental needs of the digital era.

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