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Analysis of the Impact of Digital Literacy Understanding on the Digital Citizenship Behavior of Generation Z Students in the Era of the Industrial Revolution 4.0 (Case Study in the PPKN Undergraduate Program at UNY)

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ABSTRACT

This research aims to analyze the relationship between digital literacy understanding and digital citizenship behavior among Generation Z students in the Pancasila and Civic Education program at Yogyakarta State University. Using a qualitative case study approach, research subjects were selected purposively, and data were collected through observation, interviews, and documentation with the help of interview guides, observation sheets, and document checklists. Data validity was ensured through technique and source triangulation, while data were analyzed using the Miles and Huberman interactive model, which consists of data reduction, data display, and conclusion drawing. The findings show that Gen Z students generally have a good understanding of digital literacy and digital citizenship, yet still exhibit weaknesses in critical thinking, privacy awareness, and media ethics. Their digital behavior reflects active use of technology for learning, communication, and digital participation, but it is not consistently accompanied by responsible digital practices, especially regarding personal data security and legal awareness. Digital literacy positively influences digital citizenship by enhancing information access, creativity, and participation in online public discussions. However, inadequate digital literacy also increases risks such as exposure to negative content, hoaxes, hate speech, and cyberbullying, indicating that technological progress without digital competence can worsen digital citizenship behavior.

Keywords:

Digital Literacy; Digital Citizenship; Generation Z; Fourth Industrial Revolution.

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INTRODUCTION

The use of digital technology among the younger generation, especially Generation Z students, is very diverse and not limited to educational purposes only. Gen Z students are required to master digital literacy across various aspects, such as the ability to communicate, collaborate, think critically, be creative, and actively learn by utilizing technology. Therefore, Indonesian people need to be smart in utilizing technology as a foundation to participate positively both in the real world and in the digital space. Amid rapid digital development, Generation Z students must still adhere to the values of Pancasila as a guide in their daily lives. Pancasila functions as the foundation of national life and character formation, yet its implementation faces challenges due to technological advances (A. D. Rahmawati, 2025). The cultivation of these values must be carried out deeply, supported by education and a solid understanding of digital literacy. Digital literacy is not just about technical abilities to operate technological devices but also includes social skills, analytical thinking, creativity, and the ability to inspire.

The digital society is one of the main aspects of technological development that affects human life. The shift towards digital platforms has changed social dynamics, making society more pragmatic, hedonistic, and secular, while encouraging efficiency in behavior and action. In this context, understanding the influence of knowledge and attitudes on the civic behavior of digital societies is essential for comprehending and guiding their actions. Knowledge is a crucial factor shaping civic behavior in the digital space, where people's understanding of citizenship principles, digital rights, and responsibilities significantly influences various behaviors—from compliance with legal regulations, participation in the electoral process and electronic democracy, to involvement in technology-based political activities. People's knowledge of technology also affects their behavior in using technology to gather information, communicate with others, and participate in online elections.

Factors influencing digital citizenship behavior include knowledge of digital citizenship, positive attitudes toward citizenship, comprehensive citizenship education, digital etiquette, high information literacy, and technological influence. Those with strong knowledge of digital citizenship concepts tend to comply more with the rule of law, actively participate in elections, and engage in political activities. Civic education serves as an important medium for political education, aiming to increase political literacy and participatory attitudes among young voters (A. Rahman, 2018). Positive attitudes toward citizenship also influence behaviors related to regulation compliance, electoral participation, and political engagement.

This technology has also blurred the boundaries between private and public spaces, making personal data more vulnerable. Human interaction has fundamentally changed, with digital platforms replacing face-to-face interactions in many cases (Juliana et al., 2023). Alongside technological advancements, it is important to develop critical awareness and wise management so digital media can contribute constructively to human civilization (Indriani & Sitorus, 2025; Setiawan, 2017). The positive impacts of digitalization include facilitating quick completion of work in various life sectors, accelerating information distribution, easing communication between individuals and countries, and providing easy access to information. Conversely, negative impacts include increased anti-social behavior, cyberbullying, the spread of fake news (hoaxes), pornography, sabotage and extortion online, hate speech, and cybercrime such as hacking, identity theft (carding), and system break-ins (cracking).

A comprehensive review of previous studies reveals consistent patterns in digital literacy research while highlighting significant contextual gaps. (Choi, 2016) established the foundational framework of digital citizenship, comprising social responsibility, issue understanding, and active participation, providing a theoretical basis for digital citizenship education. (Ribble, 2007) expanded this by emphasizing normative behaviors and ethical technology use, although their research primarily focused on Western educational contexts. In the Indonesian context, (Ummah & Kurniawan, 2020) demonstrated the crucial role of digital literacy in promoting positive social media engagement, while Silvana & Darmawan (2018) identified significant gaps in digital literacy education among Indonesian youth. However, these studies collectively exhibit limitations in addressing the unique intersection of digital citizenship with civic education values, particularly

within the context of Pancasila and Citizenship Education (PPKn) programs. Furthermore, existing research has insufficiently explored how digital literacy specifically impacts the behavioral patterns of Generation Z students who are simultaneously training to become citizenship educators themselves.

The novelty of this research lies in its specific focus on Generation Z students within the PPKn program at Yogyakarta State University, who represent a unique demographic as both digital natives and future citizenship educators. This study introduces a comprehensive analytical framework that examines the direct impact of digital literacy understanding on digital citizenship behavior within the specific context of civic education values. Unlike previous research that treated digital literacy and citizenship as separate domains, this investigation explores their interconnectedness through the lens of Pancasila values, providing insights into how future educators navigate digital citizenship while upholding national ideological principles. The research also pioneers the examination of the "double responsibility" phenomenon—where PPKn students must not only practice good digital citizenship themselves but also prepare to teach these values to future generations.

Departing from the above background, the researcher is interested in studying the impact analysis of digital literacy understanding on digital citizenship behavior in the Industrial Revolution Era 4.0. By choosing Yogyakarta State University, especially the Pancasila and Citizenship Education Study Program as the research location, it is hoped that the results can provide a comprehensive and in-depth picture of the impact of digital literacy understanding on digital citizenship behavior among Generation Z students, as well as provide useful recommendations for the development of the Pancasila and Citizenship Education Bachelor Study Program, State University of Yogyakarta in the digital era.

This study aims to comprehensively analyze the levels of digital literacy and digital citizenship understanding among Generation Z PPKn students, examine the direct impact of digital literacy on their digital citizenship behavior, and identify the challenges and opportunities in integrating Pancasila values into digital citizenship practices. The research offers multifaceted benefits by contributing to the theoretical framework of digital citizenship in Indonesian educational contexts, providing evidence-based insights for curriculum development in citizenship education programs, offering recommendations for digital literacy integration in higher education policy, and supporting the development of future educators who can effectively navigate and teach digital citizenship in alignment with national values. Ultimately, this research seeks to strengthen the role of civic education in shaping responsible digital citizens who can contribute positively to Indonesia's digital transformation while maintaining strong ideological foundations.

METHOD

This research employed a qualitative approach to gain an in-depth understanding of the research phenomenon through narratives, descriptions, and interpretations, rather than through numerical or statistical data. The study utilizes a case study design to intensively investigate the specific object of research, namely Generation Z students in the Pancasila and Citizenship

Education Study Program at Yogyakarta State University. This approach was selected to fully understand how digital literacy understanding impacts digital citizenship behavior within its natural context. The research was conducted within the Pancasila and Citizenship Education Study Program at Yogyakarta State University, with Generation Z students serving as the primary research subjects. Participants were selected purposively to ensure they could provide rich information relevant to the research objectives. Data were collected through three main techniques: observation, in-depth interviews, and documentation study. Research instruments included interview guides, observation sheets, and document checklists to facilitate systematic data collection. To ensure data validity, technique triangulation and source triangulation were implemented. Data analysis followed an interactive model comprising three concurrent flows of activity: data reduction, data display, and conclusion drawing/verification. This analytical approach allowed for continuous refinement of understanding throughout the research process, ensuring that findings emerged systematically from the collected data while maintaining the natural context of the phenomenon under investigation.

RESULTS AND DISCUSSION

Analysis of Generation Z Students' Understanding of PPKn UNY Study Program on Digital Literacy and Digital Citizenship

Generation Z students are a group of individuals born between the mid-1990s and early 2010s, who grow and develop amid the rapid advancement of digital technology. They are known as the digital native generation, which is a generation that has been familiar with gadgets, the internet, social media, and various forms of modern communication technology since childhood. Their lives are deeply connected to the digital world, where learning, interacting, and even expressing activities are mostly done through virtual spaces. Bencdik and Machova (2016) revealed that generation Z has better mastery of technology and information compared to the previous generation, namely generation X.

Digital literacy is increasingly important for students in the digital era and Society 5.0, allowing them to think critically, communicate effectively, and create. These skills include information literacy, media, and technology, information and communication that help students access, evaluate, and use information efficiently (Nurul Fauziah Amri et al., 2024). Students can take advantage of digital literacy for independent learning, access quality learning resources, and develop skills such as hypertext navigation and content evaluation (Nurul Fauziah Amri et al., 2024). In addition, digital literacy allows students to play an active role in contributing to the progress of the nation, increasing interest in reading, and overcoming the challenges of the Society 5.0 era (Aditya Yoga Pratama et al., 2022; Inayatul Muyassaroh et al., 2022). As well as mastering the nine components of digital literacy is the key for students to face and welcome the Society 5.0 era (Inayatul Muyassaroh et al, 2022).

The rapid development of information and communication technology in the era of the Industrial Revolution 4.0 has brought major changes in the way Generation Z students interact, learn, and participate in the digital space. Students of the Pancasila and Citizenship Education

Study Program (PPKn) of Yogyakarta State University as part of this generation show unique characteristics in understanding and utilizing digital literacy, both in academic and social contexts. In general, the understanding of digital literacy of Generation Z PPKn UNY students is relatively good. They have been able to use digital technology for various academic needs such as looking for scientific references, accessing online journals, attending lectures virtually, and participating in online discussion forums. Students demonstrate adequate technical skills in operating digital devices, learning applications, and social media that support academic activities.

Media literacy efforts aim to control the influence of media on the lives of individuals and society (Setiaman & Mulyana, 2024). Media users who have good literacy will respond to media content with a conscious and responsible attitude (Setiaman & Mulyana, 2024). Hierarchically, media iteration consists of two words, namely literacy and media. In general, literacy can be interpreted as the ability to read and write, or in other contexts it is also called media literacy. The media itself refers to intermediary means, both in the form of objects, individuals, and events. Therefore, digital literacy can be interpreted as the ability to search, understand, and utilize various media sources in various formats. Digital literacy has an important role in ensuring the fulfillment of citizens' rights on social media as well as encouraging responsible online behavior (Fudzni & Aulia, 2021).

Digital literacy allows individuals to filter correct and accurate information amid the rise of hoax news and disinformation. This ability also plays a role in increasing awareness of social media ethics, respecting the privacy rights of others, maintaining the security of personal data, and communicating responsibly in the digital space. In addition, digital literacy supports the use of technology in various fields, such as education, economy, and government, so that people can adapt to the times. This is in accordance with the statement according to Fuadzni and Aulia (2021) that digital literacy is very important to support the fulfillment of citizens' rights in the realm of social media and foster responsible online behavior.

The digital literacy program aims to expand insights, increase understanding, and hone the ability to access and use information from various digital sources effectively (Ummah & Kurniawan, 2020). This includes these abilities including skills in recognizing misleading information, producing positive content, and using social media wisely and responsibly (Ummah & Kurniawan, 2020; Melina et al., 2025).

Technology has become an integral part of modern life, influencing various aspects such as communication, work, education, and household activities (Pratama & Wahyudin, 2023; Paidil & Sari, 2025). Smart devices and the internet of things (IoT) increase comfort and efficiency at home, but also pose data security and privacy issues (Pratama & Wahyudin, 2023). In the interview stage, the researcher conducted the use of technology in daily life. However, based on the results of interviews with students, there are various opinions about the use of technology in daily life. As a student, he argues that digital technology is very helpful in finding reliable sources for academic assignments and to find information that supports learning from credible sources and the importance of sorting out information so as not to be trapped in less reliable sources. In addition,

platforms such as TikTok can also be used to create educational content that is beneficial to many people.

The integration of the concept of digital citizenship in the citizenship education curriculum is crucial to form responsible online behavior among Generation Z students (M. Saputra, 2022; Ryand Daddy Setyawan et al., 2023). This approach aims to develop digital ethics, privacy awareness, and an understanding of cybersecurity in students (Ryand Daddy Setyawan et al., 2023). Research shows that strong digital citizenship correlates with increased nationalism and civic participation among college students (Matang & Riyanti, 2023). To implement this effectively, educators must update learning tools and consider students' academic backgrounds (M. Saputra, 2022).

In addition, Pancasila and Civic Education must be integrated into the curriculum, with a focus on building digital citizenship character (A. Permana, 2023). This education serves as a moral guide for students in the digital era, emphasizing value-based learning through digital multimedia (A. Permana, 2023). Overall, these studies highlight the importance of adapting citizenship education to meet the challenges and opportunities of the digital age for Generation Z learners.

This understanding shows that digital citizenship has a strong ethical and social dimension, where every individual is required to be critical, responsible, and contribute positively in the digital environment. Digital literacy is also seen as the main foundation in forming active, intelligent, and ethical digital citizens in the midst of rapid information technology developments. From the above informant's statement, it is in line with Moonsun Choi's (2016, p. 21) statement that digital citizenship consists of three main elements, namely social responsibility, adequate understanding of an issue, and active participation in community life. Thus, students' understanding of digital citizenship needs to continue to be developed through education and habituation that emphasizes the values of responsibility, legal awareness, and positive participation in cyberspace.

This is in line with the argument according to Jones and Mitchell (2016), formulating that digital citizenship is the foundation of digital literacy that focuses on respecting online behavior, and citizen engagement online. Therefore, the concept of digital citizenship that is most often used as a reference, especially in the context of education, refers to a set of norms and behaviors that reflect responsibility in utilizing technology (Ribble & Bailey, 2007, 2011). Thus, students' understanding of digital citizenship is growing, not only limited to the ability to use technology, but also includes ethical awareness, social responsibility, and compliance with norms in cyberspace. This shows the need to strengthen digital literacy in a sustainable manner through formal and informal education so that Gen Z students are able to become smart, wise, and integrity digital citizens in facing the challenges of the information age.

According to Ummah and Kurniawan (2020), the digital literacy program aims to develop individual knowledge, understanding, and skills in accessing and utilizing information from various digital sources. This program includes the ability to recognize false information, produce positive content, and use social media intelligently and responsibly (Ummah & Kurniawan, 2020; Melina et al., 2025). This confirms that the digital literacy gap between urban and rural

communities is still a significant challenge in dealing with online fraud. The lack of understanding of the digital transaction system and limited access to information make rural communities more vulnerable to becoming victims of fraud.

Therefore, the equitable distribution of digital education is an urgent thing to do. This education needs to include increasing awareness of the importance of verifying information before making a transaction, caution in sharing personal data, and understanding of threats that may arise in cyberspace. With good digital literacy, people are expected to be more vigilant, critical, and able to protect themselves from various forms of cybercrime that are increasingly complex in today's digital era.

Analysis of the Impact of Digital Literacy Understanding on Digital Citizenship Behavior of Generation Z Students of PPKn UNY Study Program

Globalization has now entered the era of the Industrial Revolution 4.0 and Society 5.0, where technology and information have become an inseparable element of human life and the presence of innovations such as autonomous vehicles, artificial intelligence, and the internet have a direct impact on various aspects of people's daily activities. Globalization has slowly but significantly overturned the social order and structure of humans. But behind the convenience it offers for various aspects of life, this change brings its own challenges. Historically, the journey of globalization has reflected the changing dynamics of the times driven by key factors. Technology has become an integral part of modern life, affecting various aspects such as communication, work, education, and household activities (Pratama & Wahyudin, 2023; Paidil & Sari, 2025).

Smart devices and the internet of things (IoT) increase comfort and efficiency at home, but also pose data security and privacy issues (Pratama & Wahyudin, 2023). The development of technologies such as artificial intelligence (AI), blockchain, and 5G brings convenience as well as challenges such as the digital divide and negative impacts on mental health (Paidil & Sari, 2025). Technology is also changing the way humans interact, with digital interactions replacing face-to-face meetings (Tamimi & Munawaroh, 2024; Juliana et al., 2023). While technology expands access to information and communication, it also creates a reliance on digital devices and social media, which can hinder direct interaction between individuals (Tamimi & Munawaroh, 2024; Juliana et al., 2023).

Advances in the field of information and communication technology today make Generation Z an inseparable group in modern society. In the results of research conducted by Bencdik and Machova (2016) revealed that generation Z has a better mastery of technology and information compared to the previous generation, namely generation X. Technology has become an important element in their daily lives. Generation Z is often referred to as the generation that grew up in the digital era (digital native), because they are very familiar with devices such as computers and the internet. A characteristic that Gen Z has is the desire to always be connected to the internet, create content and share it with others. In addition, they are also actively involved in social media every day (Rastaty, 2018).

According to Baharizqi et al. (2023), we are currently in the era of Society 5.0, which is a period in which people's lives have been integrated with technological advances. In this reality, technological developments are an inseparable part of daily life, because scientific progress is always in line with technological innovation. These various innovations were created to make a real contribution and great benefits to human life. Technology has presented various conveniences and new ways of carrying out human activities. In the last ten years, many benefits from technological innovations have been enjoyed by humans.

Based on the above explanation, it can be interpreted that digital literacy is as important for Gen Z students in the digital era and Society 5.0, allowing them to think critically, communicate effectively, and work. These skills include information, media, and ICT literacy, which helps students access, evaluate, and use information efficiently (Nurul Fauziah Amri et al., 2024). Therefore, what was conveyed by the informant above shows that students are aware of the importance of technology as a tool as well as a challenge in shaping digital ethics and social responsibility. This awareness encourages the need for a targeted educational strategy so that the use of digital technology truly supports the development of ethical, critical, and responsible citizenship characters.

While rapidly evolving technology presents ergonomic challenges, it is also important to highlight the potential benefits that technological advances can provide to human life (Kadir et al., 2019). On the one hand, the impact of technology on civic behavior can be seen in changes in the way individuals carry out the rights and obligations that individuals have as part of citizens in the digital era. On the one hand, technology facilitates access to information, public participation, and the dissemination of national values and social action. However, on the other hand, technology also triggers negative behaviors such as the spread of hoaxes, hate speech, and privacy violations due to a lack of digital literacy and ethical awareness. Therefore, it is important for every citizen, especially the younger generation, to use technology wisely and responsibly to create a healthy and democratic digital space.

One of the main challenges facing Generation Z is their tendency to over-rely on technology and social media. Easy access to smartphones and the internet keeps them connected, but this condition also has the potential to cause various problems (Maturbongs, 2023; Laka, 2024). Most Generation Z have difficulty distancing themselves from their digital devices, which can trigger addiction, disrupt sleep patterns, and reduce the quality of face-to-face direct interaction (Maturbongs, 2023; Laka, 2024). In addition, uncontrolled use of technology, both in terms of time and purpose, has the potential to trigger various psychological problems such as stress, anxiety, sleep disorders (insomnia), and depression. Social pressures in digital media, such as the desire to always look perfect or gain recognition from others, also affect emotional balance and form unrealistic personal identities.

The positive impact of the development of science and technology in the political aspect is the creation of a democratic and transparent government, considering that government is an important element that is inseparable from a country. If the government shows honesty, integrity, and a progressive attitude, then the community will tend to respond positively. In the economic

aspect, this development opens global market opportunities, expands job opportunities, and increases foreign exchange income for the country. This contributes to the improvement of the country's economic life, which ultimately helps to reduce the number of poor people. In the socio-cultural realm, we can adapt positive ideas that have been successfully implemented in other countries, such as a disciplined work spirit and the application of science and technology to strengthen national discipline. This will encourage the progress of the nation and strengthen the identity of the Indonesian state (Azizah et al., 2022).

To minimize the negative impact of technology on digital citizenship behavior, it is necessary to increase digital literacy which includes the ability to sort information, understand the ethics of interacting, and be responsible in the media. Character education that instills national values and digital ethics is also important to be carried out through curriculum and training. These characteristics allow citizens to rationally and logically distinguish credible sources of information, contributing to positive civic participation in the digital realm (Pradana, 2017).

Digital literacy education is very important to build awareness and critical attitudes in the use of media, especially among adolescents (Silvana & Darmawan, 2018; Darwadi et al., 2022). Digital literacy plays an important role in reducing the negative influence of technology on student behavior in the current digital era. With good digital literacy, students are able to understand, evaluate, and use information critically, so that they are not easily influenced by hoaxes, hate speech, or other negative content that is widely circulated in the digital space.

One of the main obstacles Generation Z faces is the tendency to over-rely on technology and social media. The ease of accessing smartphones and the internet keeps them connected, but this also has the potential to cause various problems (Maturbongs, 2023; Laka, 2024). Most Generation Z have difficulty disconnecting from their digital devices, which can lead to addiction, disrupted sleep patterns, and decreased quality of face-to-face interaction (Maturbongs, 2023; Laka, 2024). The duration of use of gadgets and the impact of their use on health is an important issue in today's digital era. The increasingly intensive use of gadgets, both for study, work, and entertainment, has become an inherent element in daily activities, especially among students and the younger generation.

In the current digital era, the issue of privacy and data protection is a significant challenge for Generation Z. Many of them do not fully understand the importance of maintaining personal information and managing digital footprints wisely (Maturbongs, 2023; Laka, 2024). Personal data shared by them on digital platforms has the potential to be used by companies or third parties for purposes that are not always in line with their needs, such as the delivery of targeted ads or even the risk of identity theft (Maturbongs, 2023; Laka, 2024). Most Generation Z still lack understanding of various threats in the digital world, such as phishing, malware, and other types of cyberattacks, that can damage their devices or leak their personal information.

Digital e-commerce has changed the business landscape and the economy extensively. Trading activities, including online buying and selling transactions are increasingly dominating compared to conventional face-to-face transactions (Ribblle & Bailey, 2007). Millennials and Gen Z are very active in using this method. However, the increasingly rampant scourge of online fraud

in today's digital era has left a deep wound trail for many individual social media users. It is nothing more than material losses, however, the impact of online fraud spreads to the psychological and social realms, undermining a sense of security and trust. The experience of being a victim of online fraud is a bitter journey that often begins with optimism or even innocence, then leads to disappointment, anger, and even trauma.

Generation Z students who grew up in the midst of the rapid flow of digital information, view the existence of irresponsible buzzers as a serious threat to the intelligence and collective consciousness of society. Buzzers who spread hoax information are considered agents of public deception that undermine the integrity of the digital space and create social polarization. Students realize that the spread of hoaxes by buzzers often has hidden motives, both political and economic, which not only harm individuals but also weaken public trust in information. Although Gen-Z is generally technologically literate and even though they are critical in absorbing information, they are still easily influenced by the spread of hoax news (Komara & Widjaya, 2024). The proliferation of disinformation is partly due to low media literacy skills and lack of critical thinking when engaging with media messages (Clara Novita et al., 2016). There is a misconception about the role of social media "buzzers", which are often considered negative even though they have the function of reinforcing messages and shaping public opinion in a digital context (Arianto, 2020).

To overcome this problem, strategies that focus on digital literacy education and the cooperation of various parties play an important role in shaping Gen-Z's resilience to the spread of misleading information (Komara & Widjaya, 2024). In their view, this kind of action hurts the principles of communication ethics and misleads people who do not have adequate digital literacy. However, Generation Z students do not stop at criticism. Many of them have taken concrete steps to combat the spread of hoaxes, such as engaging in digital literacy campaigns, creating educational content, and building communities that actively verify information. They believe that fighting buzzers is a form of moral responsibility to keep the digital space healthy and informative. This critical and proactive attitude shows that Generation Z is not only skilled in using technology, but also has a high social sensitivity in maintaining the truth and protecting society from misleading information manipulation.

Thus, the level of understanding of digital literacy has a direct effect on the quality of students' digital citizenship behavior. The higher the level of digital literacy possessed, the greater the ability of students to behave as intelligent, ethical, and characterful digital citizens. In the context of students of the S1 PPKn UNY Study Program, this understanding is important because they are expected to become prospective educators and agents of change who are able to instill digital citizenship values in society at large.

CONCLUSION

The research reveals generally good levels of knowledge in both areas. Students recognize the importance of digital technology for learning, communication, and civic engagement, demonstrating increased abilities in information access, creativity, and digital participation. However, gaps remain in critical thinking, digital privacy awareness, and media ethics, indicating

insufficient digital responsibility regarding personal data security and legal compliance online. While a solid grasp of digital literacy fosters positive civic behaviors, limited understanding in some students leads to exposure to harmful content, hoaxes, and antisocial behaviors like hate speech and cyberbullying, highlighting the dual-edged nature of technological advances in the Industrial Revolution 4.0 era. Future research should explore targeted interventions that enhance critical digital literacy skills, focusing on privacy protection and ethical behavior to strengthen responsible digital citizenship among university students.

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