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THE ROLE OF CRITICAL THINKING AS A PREDICTOR OF STUDENTS' DIGITAL LITERACY SKILLS

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ABSTRAK

Tantangan dalam implementasi Era Revolusi Industri 4.0 dan Society 5.0 di Indonesia perlu dikaji secara mendalam untuk merumuskan solusi yang tepat dan efektif. Meskipun telah dimulai sejak tahun 2011 dan diikuti oleh Era Society 5.0 di Jepang pada tahun 2019, implementasi Era Revolusi Industri 4.0 di Indonesia masih menghadapi berbagai tantangan. Keterampilan digital menjadi bagian penting dalam pendidikan masa depan karena merupakan bagian dari sistem pendidikan modern, namun tidak menggantikan keaksaraan tradisional, melainkan melengkapinya dengan pengetahuan dan atribut baru. Perguruan tinggi selaku institusi Pendidikan perlu menyesuaikan kurikulum yang dipergunakan untuk menjadi wadah membangun mahasiswa untuk memiliki keterampilan 4C pembelajaran abad 21, yaitu keterampilan *communication* (berkomunikasi), *Critical thinking* (berpikir kritis), *creative thinking* (berpikir kreatif), dan *collaborator* (berkolaborasi). Jenis penelitian ini merupakan ex post facto dengan teknik pengumpulan data berupa angket dan open-ended question yang disusun dan disebarkan melalui *Google Form*. Hasil penelitian terhadap 62 responden menunjukkan tingkat literasi digital mahasiswa di level cukup (lower middle). Sebanyak 67,74% mahasiswa dikategorikan memiliki tingkat berpikir kritis yang cukup, 19,35% memiliki tingkat berpikir kritis tinggi, dan 12,9% dikategorikan memiliki kemampuan berpikir kritis yang rendah. Berpikir kritis berperan signifikan sebagai predictor keterampilan literasi digital sebesar 46,6% pada mahasiswa jurusan Pendidikan ekonomi Universitas Musamus Merauke.
Kata Kunci: *berpikir kritis, literasi digital, pendidikan*

ABSTRACT

The challenges associated with implementing Industry 4.0 and Society 5.0 in Indonesia need to be carefully analyzed to develop suitable and actionable solutions. Despite its initiation in 2011 and the subsequent introduction of Society 5.0 in Japan in 2019, Indonesia still encounters several hurdles in adopting Industry 4.0. Digital skills are crucial for the education of the future, complementing traditional literacy with new knowledge and abilities rather than replacing it. Educational institutions like universities must adjust their curricula to cultivate the development of 21st-century skills, known as the 4Cs: communication, critical thinking, creative thinking, and collaboration. Data was gathered through questionnaires and open-ended responses. This study was involving 62 students indicated that their digital literacy levels fall within the lower middle range. In detail, 67.74% of participants demonstrated an adequate level of critical thinking, while 19.35% exhibited a high level, and 12.9% had low essential thinking skills. Notably, critical thinking is a significant predictor of digital literacy skills for 46.6% of students in the economic education program at Musamus University, Merauke.
Keywords: *critical thinking, digital literacy, education*

INTRODUCTION

Analyzing the challenges of implementing the Era of Industrial Revolution 4.0 and Society 5.0 in Indonesia is crucial for developing effective and practical solutions to navigate this transformative period. Although Industrial Revolution 4.0 was launched in 2011, followed by Japan's Society 5.0 concept in 2019, Indonesia continues to encounter various obstacles in

fully adopting these paradigms. Known as the digital revolution, Revolution 4.0 is defined by technological innovations that empower computers to connect, communicate, and make decisions independently of human input, fundamentally altering operational frameworks. This era has witnessed the prolific emergence of IoT (Internet of Things), AI, robotics, machine learning, and other advanced technologies that have profoundly transformed many aspects of human life, including the critical sector of education, thus requiring a responsive transition to Industrial Revolution 4.0 and the Society 5.0 concept through reforms in higher education to cultivate capable, creative, and adaptable graduates for the digital age.

According to the 2024 Indonesian Statistics, the growth of Information and Communication Technology (ICT) in Indonesia has demonstrated a positive trajectory over the past three years, indicating an expansion of digital infrastructure and access. This upward trend has been particularly pronounced in Papua Province, highlighting significant advancements in a region previously facing greater digital divides. In 2021, statistical data revealed that 26.4% of Papua's population had accessed the internet within the preceding three months; this figure experienced a marginal decrease to 26.32% in 2022. However, the subsequent year saw a notable rebound and increase, with internet access rising to 29.87% in 2023, showcasing renewed progress in digital engagement.

The Programme for International Student Assessment (PISA) provides a comprehensive definition of digital literacy, framing it as the ability of students to meticulously evaluate information sourced from a variety of digital and non-digital texts. This includes the capacity to assess the usefulness and credibility of these texts by applying multiple established criteria, thereby fostering discerning information consumption (OECD, 2015). Furthermore, this skill set involves tackling tasks that necessitate locating information pertinent to ambiguous and unfamiliar contexts that are not explicitly defined, demanding adaptability and resourcefulness. In alignment with this comprehensive view, List et al. (2020) emphasized that digital literacy is an indispensable skill for modern students, who must skillfully navigate the complex technological, informational, cognitive, and socio-emotional challenges characteristic of the digital age.

Digital competencies are increasingly recognized as essential for the future of education, profoundly serving the interests and enhancing the capabilities of both students and educators alike in an evolving learning landscape. These competencies represent a crucial and integral component of the modern educational framework, offering new avenues for knowledge acquisition and skill development. However, it is important to understand that they do not aim to replace traditional literacy but rather to augment and enhance it by introducing supplementary knowledge and skills vital for digital citizenship. Consequently, without the thoughtful integration of digital activities, the learning experience, especially within elementary education, would be significantly less engaging and motivating for young minds.

Learners today are not just students absorbing information; they are also envisioned as active change-makers, a role which necessitates the cultivation of a variety of skills, encompassing both soft and hard competencies. Among the key soft skills deemed critical for students to thrive are creativity in problem-solving, the capacity for critical thinking and analysis, and adaptability in response to rapidly changing environments. Educational institutions, particularly universities, therefore need to proactively revise their curricula to create a supportive and dynamic learning environment that equips students with these essential skills necessary to succeed in this modern, technologically driven age. Higher education, in its pursuit of excellence, should continuously evolve its pedagogical approaches to effectively nurture students' 21st-century skills, often referred to as the 4Cs: communication, critical thinking, creative thinking, and collaboration.

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Higher education institutions must undergo a significant evolution to effectively incorporate and leverage digital learning methodologies within their teaching and research frameworks. The prevailing digital epoch generously offers numerous advantages to both educators seeking innovative teaching tools and students pursuing flexible learning opportunities. For instance, access to e-books via various electronic devices, the utility of search engines for locating diverse academic literature, and the dynamic nature of social media platforms that furnish a plethora of learning resources markedly enhance the overall educational landscape. While the plentiful availability of such digital resources is a direct and welcome consequence of continuous advancements in information technology and the internet, it is also true that the progress of a nation remains intricately linked to the mastery of literacy across multiple dimensions of life, particularly in the crucial realm of education; yet, despite Indonesia's substantial population, the literacy rate remains disconcertingly low, highlighting the need to strike a balance between population size and quality for sustainable development, and recognizing that the evolution of information and communication technology (ICT) serves as a double-edged sword, presenting both considerable benefits and potential negative consequences for society.

The inherent characteristics of students who possess and actively utilize critical thinking skills have been observed to positively influence and strengthen the broader culture of literacy within their learning communities (Handayani, 2020). Concurrently, Naufal (2021) posits a compelling argument that concerted efforts aimed at enhancing these critical thinking skills can substantially promote the acquisition and proficient application of digital literacy skills. It is understood that several fundamental factors collectively affect an individual's competency in digital literacy, making it a complex skill set. These essential factors include not only foundational functional skills for operating digital tools but also the more sophisticated abilities related to critical thinking, alongside effective communication and interaction skills within digital environments.

METHOD

This research employed an ex post facto design to investigate events that have already occurred and identify their potential underlying causes, aligning with description of such research aiming to clarify causal factors post-event. The primary focus of this investigation was to examine the role of critical thinking skills as a key determinant influencing students' digital literacy levels. The study was specifically conducted within the Economic Education Department at Musamus University, located in Merauke, Papua, providing a distinct regional and institutional context for the findings.

The population for this study comprised all active students enrolled in the Economic Education Department, specifically those in their fourth through eighth semesters, which amounted to a total of 157 individuals. To derive a representative sample from this population, the Slovin formula was utilized, resulting in a calculated sample size of 62 students. This sampling procedure was implemented to ensure that the selected participants accurately reflected the characteristics of the broader student body within the specified department and semester range, allowing for generalizable inferences.

Data for the study were collected through the administration of carefully constructed questionnaires, which were distributed to the sampled students from the Economics Education Department, specifically those enrolled in the Macroeconomics course. The questionnaire was designed as the primary instrument and consisted of two main sections: the first section contained items addressing various aspects and indicators of digital literacy. The second section was dedicated to assessing critical thinking skills, with questions formulated based on

established principles of higher-order thinking skills (HOTS) to gauge the students' analytical and evaluative capabilities.

RESULT AND DISCUSSION

Result

Digital Literacy

Digital literacy has been studied academically for fifty years, yet the term was first introduced by Paul Gilster in 1997 (Martínez-Bravo et al., 2020). This idea includes four essential competencies and has evolved significantly, reflecting both specialized skills and broader understandings. Its use varies by region and academic fields. For instance, "digital literacy" is more commonly used in Asia, the United States, and in health and arts disciplines, while " digital competence " is favoured in continental Europe, South America, and fields like teacher education and economics. Despite these differences in terms and interpretations, the conceptual framework consistently encompasses technical skills and the ability to access, analyse, and utilize information from various sources.

According to Gilster (1997), as cited in (Diani & Amiruddin, 2023), four fundamental competencies delineate the concept of digital literacy. An individual is considered digitally literate if they can successfully perform the following four tasks using digital technology. The first task is online searching, which entails the ability to utilise the internet for various purposes, including information retrieval and task completion. This competency encompasses skills that enable the execution of diverse online tasks and the effective use of search engines to obtain information. The second competency is hypertext navigation, which requires an individual to comprehend and interpret hypertext on a search page. This includes understanding how hypertext and hyperlinks operate, distinguishing between reading traditional textbooks and browsing online materials, grasping the functionality of the web, and recognizing the characteristics of web pages. The third competency, knowledge gathering, involves the ability to organize information, manage and classify the acquired data, and collect information from diverse sources- both online and offline- while assessing facts and opinions with objectivity and impartiality. The four abilities encompassed within this competency include performing internet searches, creating personalized news feeds, engaging in newsgroups, cross-referencing information, utilizing various media formats such as text, images, and videos to validate the accuracy of information, organizing online sources for future reference, and critically evaluating content to assess the quality of material accessible from online platforms.

The American Library Association describes digital literacy as “the ability to utilize information and communication technologies for finding, assessing, generating, and sharing information, which requires both cognitive and technical skills. " This definition reveals that digital literacy demands technical proficiency with digital devices, along with the cognitive skills necessary to understand, analyze, and process information acquired through technology. Yustika & Iswati (2020) explain that digital literacy is the capacity to comprehend written content and interpret data in the digital environment. Additionally, it involves a blend of knowledge, attitudes, and skills that enable individuals to use digital communication technology responsibly and effectively to access, manage, integrate, analyze, and evaluate information. This ability empowers individuals to create new knowledge, produce and share digital content, and engage meaningfully in the digital society (Setyaningsih et al., 2019).

Digital literacy was evaluated through a questionnaire and test items designed to measure the critical thinking abilities of 62 students enrolled in Economic Education at the Faculty of Teacher Training and Education, Musamus University. The findings from the research questionnaire were subsequently categorized into three levels: high, medium, and low, utilising SPSS, which yielded the following data:

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Tabel. 1 Distribusi Frekuensi Tingkat Literasi Digital

		FREQUENCY	PERCENT	VALID PERCENT	CUMULATIVE PERCENT
VALID	Rendah	5	8.1	8.1	8.1
	Sedang	57	91.9	91.9	100
	Tinggi	62	100.0	100.0	

No students were identified as possessing a high level of digital literacy; 91.9% were evaluated as having a medium level, while the remaining 8.1% were assessed as exhibiting a low level. This finding aligns with the results from the Indonesian Digital Society Index (Kementerian Komunikasi dan Digital, 2024), which indicates that the IMDI value for South Papua Province in 2024 is 40.11, categorizing it as sufficient, in comparison to the national IMDI value of 43.34. Furthermore, CNBC Indonesia (2024) reports that Indonesia's digital literacy level is a mere 62%, the lowest within ASEAN, whereas other ASEAN nations average approximately 70%. Research conducted by (López-Meneses et al., 2020) posits that digital literacy competence at the low-intermediate level correlates with digital content creation, particularly regarding the production and distribution of digital content across various devices. Additionally, upper-intermediate competence pertains to communication and collaboration. Similarly, a study by (Pham Tra & Dau Thi Kim, 2024) revealed that attitudes toward utilising technology were fully mediated by one's knowledge of the technology itself.

Digital writing and reading skills encompass a range of competencies associated with digital literacy and broader educational issues. A foundational level of digital literacy is crucial for effectively utilising technology in educational environments, highlighting the need for training to enhance students' digital literacy abilities (Farias-Gaytan et al., 2023). This training can act as a model for learning that integrates e-learning (online learning) into the educational framework. Studies demonstrate that this approach promotes personal digital literacy through active learning and inquiry, ultimately developing essential skills, critical understanding, and effective communication (Cahyo et al., 2022).

The Role of Critical Thinking as a Predictor of Digital Literacy

Self-efficacy refers to a person's self-assessment of their ability to plan and execute actions needed to achieve specific goals (Chung et al., 2021). Critical thinking is a multifaceted cognitive process involving a thorough, logical, and rational evaluation of information. Its purpose is to uncover biases and fallacies in reasoning while constructing robust arguments. Skills associated with critical thinking include analysis, synthesising arguments, assessing information, drawing conclusions, as well as both deductive and inductive reasoning, and problem-solving (Lai, 2011 in Prima Lestari Situmorang et al., 2023). Unlike argumentative thinking, which focuses on winning debates, critical thinking is a constructive approach aimed at problem-solving. In our fast-changing world, critical thinking is vital for individual success (Aktoprak & Hursen, 2022; Rochmatika & Yana, 2022). Thus, enhancing adaptive literacy is essential for everyone to navigate diverse changes effectively. Developing critical thinking skills empowers individuals to make informed, logical, and thoughtful decisions. For example, when faced with new information, individuals skilled in critical thought will verify its validity to confirm its reliability.

Critical thinking emerged as a significant idea in the early 20th century. Recognised as the pioneer of modern critical thinking, John Dewey (1933) defined it as "reflective thinking. " He highlighted the necessity of carefully and thoughtfully reviewing beliefs or knowledge supported by strong evidence. According to Thomson (2011) in (Aktoprak & Hursen, 2022), critical thinking constitutes a systematic method for solving problems, conducting inquiries,

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and exploring concepts, which helps individuals identify optimal solutions through effective information evaluation.

The Delphi Report states that critical thinking is a structured decision-making process that aids in interpretation, analysis, evaluation, and inference. It clarifies the evidence, concepts, methodologies, criteria, and contextual analyses guiding decisions (Facione, 1990). (Indah et al., 2022; Meyers et al., 2013) highlight the importance of critical thinking in digital literacy, particularly due to the ease of generating vast amounts of information online. These digital literacy skills enhance individual thinking abilities when performing assigned tasks. Thus, critical thinking should be essential in fostering information literacy, particularly in the evaluation process of information (Goodfellow, 2011).

Critical thinking, categorised as a higher-order skill, is acknowledged as indispensable for moral, social, psychological, cognitive, and scientific advancement (Dhewi & Ningrum, 2021). This competency functions as a protective measure against diverse threats and losses. Through the practice of critical thinking, individuals can meticulously evaluate alternate perspectives, ascertain the truth, and evade actions that may jeopardise their safety.

The assessment of critical thinking abilities was conducted through a series of questions pertaining to inflation within the context of the macroeconomics course. This assessment comprised ten questions, with the results illustrated in Figure 2.3. A total of 3.2% of respondents (2 individuals) obtained the lowest score, whereas 1.6% (1 individual) achieved the highest score of 98. The average score for evaluating critical thinking was found to be 75.9, with the most prevalent score of 74, which accounted for 11.3% of respondents.

The data illustrates the critical thinking levels of Musamus University Economics Education students, as shown in the image below:

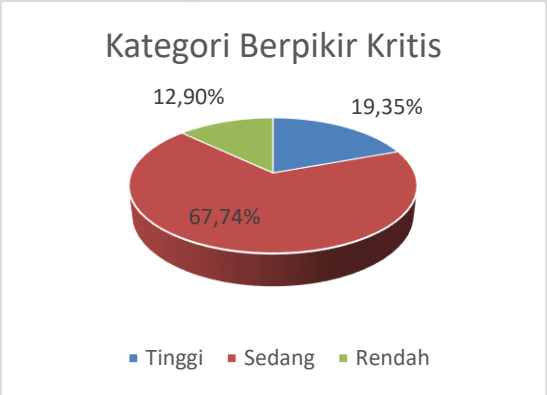

Figure 1. Frequency of Critical Thinking

Critical thinking is crucial for defining digital literacy, the ability to understand, access, critically evaluate, utilise, and produce information via digital media (Chan et al., 2017; Riana Mardina, 2017; Roche, 2017).

The research instrument distributed to 62 respondents was analyzed to determine the extent to which critical thinking predicts students' digital literacy skills in the Economic Education program at Musamus University Merauke. The research data were analyzed using ordinal logistic regression measured by SPSS. Logistic regression is a statistical method that describes the relationship between response variables with two or more categories and interval scale predictor variables, aiming to understand the influence of the relationship between these variables. Figure 4 displays the results of the model suitability test, which provides information on whether the multinomial logistic regression model fits the observed data.

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Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	12.865	29	.996
Deviance	13.154	29	.995

Link function: Logit.

Figure 2. *Goodness of Fit* Ordinal Distribution Regression

The basis for decision-making is to examine the significant value of Chi-Square, as the table indicates if the Sig value is more significant than *alpha* (sig. > 0.05). In this case, a decision is made that the ordinal logistic regression model fits the observational data. Next, to assess the magnitude of the influence of critical thinking variables on digital literacy skills, refer to the following table.

Pseudo R-Square

Cox and Snell	.200
Nagelkerke	.466
McFadden	.398

Link function: Logit.

Figure 3. *Pseudo R-Square*

The Nagelkerke model's highest R-Square analysis yielded a result of 0.466. This indicates that the independent variable, critical thinking, can predict the dependent variable, digital literacy skills, by 46.6%, while the remaining 53.4% is affected by other variables not covered in this study.

Digital literacy involves more than just technical abilities; it includes cognitive aspects that necessitate proficiency in seven essential competencies for being digitally savvy in the 21st century, with critical thinking being a key element (Audrin & Audrin, 2022; van Laar et al., 2019). Colleges and universities play a crucial role in promoting research on digital transformation and enhancing the digital literacy of their communities (Farias-Gaytan et al., 2023).

The integration of critical thinking into the digital literacy curriculum is essential for enhancing students' capability to navigate and assess digital information proficiently. Critical digital literacy plays a significant role in augmenting analytical skills, facilitating a deeper comprehension of data, and advancing digital inclusion (Gutiérrez-Ujaque, 2024).

Discussion

Digital literacy has evolved over the past fifty years, with its conceptual roots traced back to Paul Gilster in 1997. Gilster's framework identified four essential competencies: online searching, hypertext navigation, knowledge gathering, and critical evaluation of information. These competencies reflect both specialized technical skills and broader cognitive abilities, and their interpretation varies across regions and academic disciplines. For example, while the term "digital literacy" is more prevalent in Asia, the United States, and certain fields like health and the arts, "digital competence" is favored in continental Europe and South America, particularly in teacher education and economics. Despite terminological differences, the core concept consistently emphasizes the ability to access, analyze, and utilize information from a variety of sources1.

According to Gilster, as cited by Diani & Amiruddin (2023), digital literacy requires individuals to effectively perform four tasks using digital technology. These include the ability

to search for information online, navigate hypertext, gather and organize knowledge, and critically evaluate digital content. For instance, hypertext navigation involves understanding how hyperlinks work and distinguishing between reading traditional textbooks and browsing online materials. Knowledge gathering, on the other hand, encompasses organizing information, managing data, and critically assessing facts and opinions from diverse sources, both online and offline1.

The American Library Association defines digital literacy as “the ability to utilize information and communication technologies for finding, assessing, generating, and sharing information, which requires both cognitive and technical skills.” This definition underscores the dual necessity of technical proficiency and cognitive skills, such as comprehension, analysis, and data interpretation. Yustika & Iswati (2020) further elaborate that digital literacy is not just about understanding written content but also about interpreting data, managing information responsibly, and engaging meaningfully in digital society. This blend of knowledge, attitudes, and skills enables individuals to create, share, and evaluate digital content effectively.

Empirical research conducted at Musamus University has shown that the digital literacy levels among Economic Education students are predominantly at a medium level, with 91.9% of students falling into this category. Notably, no students achieved a high level of digital literacy, while 8.1% were categorized as having low digital literacy. This pattern mirrors national trends, as Indonesia’s overall digital literacy rate is only 62%, which is the lowest among ASEAN countries and falls short of the regional average of 70%. Furthermore, the Indonesian Digital Society Index for South Papua Province in 2024 was rated as "sufficient," with a score of 40.11, which is slightly below the national average of 43.34.

These findings underscore a significant challenge for Indonesia in the realm of digital competency. The data points to an urgent need for more comprehensive digital literacy training and educational initiatives, especially in higher education institutions. As digital skills become increasingly essential for academic success and future employment, it is crucial for universities and policymakers to prioritize the development of digital literacy programs. By doing so, Indonesia can better prepare its students to compete in the digital era and gradually close the gap with other ASEAN countries in terms of digital proficiency.

Critical thinking emerges as a crucial predictor of digital literacy. It is defined as a multifaceted cognitive process involving the logical and rational evaluation of information, aimed at uncovering biases and constructing robust arguments. Skills associated with critical thinking include analysis, synthesis, evaluation, and both deductive and inductive reasoning. John Dewey, recognized as the pioneer of modern critical thinking, described it as “reflective thinking,” emphasizing the importance of carefully reviewing beliefs and knowledge supported by strong evidence. In the digital age, critical thinking is indispensable for navigating the vast and often unreliable information available online1.

The research at Musamus University assessed critical thinking through macroeconomics questions, revealing an average score of 75.9 among students. Logistic regression analysis showed that critical thinking could predict digital literacy skills by 46.6%, as indicated by the Nagelkerke R-Square value. This suggests that while critical thinking is a significant factor, more than half of the variance in digital literacy is influenced by other variables not examined in the study. This finding underscores the multifaceted nature of digital literacy, which encompasses not only cognitive and technical skills but also attitudes and contextual factors.

Integrating critical thinking into digital literacy curricula is essential for equipping students with the skills needed to navigate and assess digital information effectively. As noted by Audrin & Audrin (2022) and van Laar et al. (2019), critical thinking is one of seven essential competencies for digital proficiency in the 21st century. Higher education institutions play a

pivotal role in fostering research on digital transformation and enhancing digital literacy within their communities. As Gutiérrez-Ujaque (2024) highlights, critical digital literacy strengthens analytical skills, deepens data comprehension, and promotes digital inclusion, making it a cornerstone of modern education

CONCLUSION

Critical thinking represents an essential element in the development of students' digital literacy levels. These competencies empower students to analyze, evaluate, and critique various sources encountered in digital media. This ability is particularly significant for their prospective roles as educators, where ongoing technological advancements necessitate elevated levels of digital literacy. Enhancements in digital literacy among students pursuing economic education at Musamus University are imperative for future preparedness. Such improvements may be realised through the integration of digital-based learning (e-learning) across all subjects, alongside an increase in problem-based learning (PBL) methodologies to cultivate analytical and critical thinking skills. Current challenges regarding the digital literacy of students within the economic education program at Musamus University, who currently demonstrate a satisfactory level of competence, include limited access to technological devices (such as smartphones, laptops, and computers), which results in insufficient proficiency in utilising digital tools.

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