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Digital Literacy and Analytical Thinking in Facing Misinformation during Digital Era: Systematic Literature Review

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Abstract: This study aims to investigate the critical roles of digital literacy and analytical thinking skills in addressing misinformation challenges in the 21st-century digital era. Using a systematic literature review (SLR) guided by PRISMA methodology, ten peer-reviewed articles published in the last four years were analyzed to provide a comprehensive understanding. The results reveal that deficiencies in digital literacy and analytical thinking increase vulnerability to misinformation, hinder online participation, and limit educational opportunities. Conversely, these competencies empower individuals to evaluate information critically, foster civic engagement, and enhance learning experiences. Technological interventions, such as e-tutorials, project-based learning, and digital storytelling, effectively develop these skills when supported by structured teacher guidance. The study concludes that integrating these skills into educational frameworks is essential to foster resilience against misinformation and nurture informed digital citizens. It advocates for collaborative efforts among educators, policymakers, and technology experts to design adaptive and sustainable learning environments tailored to diverse needs. These insights contribute to the discourse on combating misinformation and preparing individuals for challenges in a rapidly evolving digital landscape.

Keywords: Analytical Thinking, Digital Literacy, Misinformation, 21st Century Digital Era

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Introduction

The internet, mobile devices, and digital platforms have revolutionized information access, impacting behavioral aspects and decision-making (Farooq et al., 2020). However, this ease of access also brings risks, including an increase in misinformation cases. Misinformation is false or inaccurate information intended to mislead, often affecting highly perceived individuals who primarily use online media as news sources (Hameleers et al., 2022).

Misinformation, a growing issue in the digital era, is influenced by social media's ability to spread information quickly, lack of knowledge, uncertain evidence, and lies motivated by specific goals (Hameleers & Brosius, 2022). This can lead to increased anxiety levels, and disrupt the learning process (Laato et al., 2020). On the political aspect, public trust in the government to make a policy is

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significantly affected by the spread of misinformation that often occurs on social media (Islam et al., 2023). The concept of conceptual contamination suggests that the learning process can be disrupted when incorrect information clashes with misinformation (Danielson et al., 2024). Therefore, education should focus on teaching how to recognize and deal with misinformation through evaluation rather than relying solely on one's understanding (Allchin et al., 2024).

The Indonesian government has implemented Digital Literacy in the National Literacy Movement to address the challenges of assessing the credibility of information sources in today's diverse data. Digital literacy involves using digital technology, understanding and interpreting data, identifying, analyzing, evaluating, sharing, and using digital applications ethically and responsibly. (Dalgıç et al., 2024). It goes beyond just using technology; it involves understanding and utilizing data generated by digital technologies, finding, evaluating, and organizing information. (Imjai et al., 2024) Digital literacy enables effective communication by using digital media to support activities. (Martzoukou et al., 2024) Digital literacy ultimately enables people to communicate effectively by using information in digital media to support their activities (Smith & Storrs, 2023).

Digital literacy is crucial for developing communication and information assessment skills in the digital world. It helps students engage effectively with digital content and regulate their use (Wei, 2023). Digital literacy is essential in various aspects of life, including social, cultural, and economic interactions (Liu, 2023). With rapid technology development and digitalization, digital literacy skills improve cognitive abilities, including critical thinking and creativity, preparing individuals for the digital age (Jatmoko et al., 2023).

Analytical thinking is crucial in the 21st century, particularly in education and science, as it aids in problem-solving and decision-making by breaking down complex information into smaller parts. (Liline et al., 2024). In education, analytical thinking includes elements like analysis, organization, generalization, and evaluation, which enhance higher-order thinking skills, essential in the era of industry 4.0 and society 5.0 (Noris et al., 2024). This skill is essential for better problem-solving and decision-making in the rapidly developing technology landscape.

Analytical thinking is useful in situations where information comes from multiple sources and varies in quality; it helps in making rational arguments, making evidence-based decisions, and finding effective solutions to complicated problems (Küçükaydın & Ayaz, 2024). Good analysis allows us to make more informed decisions based on valid data and facts (Udonsathian & Worapun, 2024). By using analytical thinking, we can sort out relevant and accurate information from potentially misleading ones.

Digital literacy and analytical thinking are interconnected, as digital literacy aids in understanding and evaluating online information, while analytical thinking aids in formulating and implementing solutions. Both skills are crucial for identifying false or misleading information in the digital world (Rodrangsee et al., 2022). Digital literacy helps users recognize biases in digital media, while analytical thinking helps them understand how these biases affect the information presented (Blegur et al., 2023). Thus, digital literacy and analytical thinking complement each other in counteracting misinformation, ensuring a more accurate and trustworthy digital world (Monzani et al., 2021).

Misinformation, a form of false or misleading information, has become a significant challenge in the 21st century due to the digital landscape. It can spread rapidly through social media and online

platforms, making it difficult for individuals to discern truth (Morais & Sobral, 2020). To effectively combat misinformation, individuals must balance digital literacy and analytical thinking skills.

Digital literacy and analytical thinking are interconnected, enabling individuals to approach information with discerning minds (Fidiastuti et al., 2020). Digitally literate individuals can identify factual inaccuracies in online content, while analytical thinking allows them to evaluate context, understand sources' motives, and make informed judgments (Pothier, 2020). This dual capability fosters a culture of critical inquiry, encouraging individuals to question and verify information before accepting it as truth. Digital literacy and analytical thinking empower individuals to be proactive information consumers, building resilience against misinformation and contributing to a more informed society for constructive dialogue and sound decision-making.

Misinformation is a growing issue in the digital era, facilitated by the rapid spread of information via social media and online platforms. This rapid dissemination of false or misleading information can manipulate public opinion, eroding trust in democratic institutions (Valenzuela et al., 2024). In education, misinformation on health topics can lead to public health crises, posing risks to children and the community (Ali & Rashid, 2024). The consequences of misinformation are profound, emphasizing the need for individuals to develop digital literacy and analytical thinking skills to make informed decisions.

The current generation faces unique challenges in managing digital information due to the rapid growth of the internet and social media. They must navigate a complex digital landscape with both credible sources and misinformation, requiring higher discernment and critical thinking (Ali & Rashid, 2024). The rise of algorithms can create echo chambers, reinforcing existing beliefs and limiting exposure to diverse viewpoints (Lang et al., 2023).

This article examines the role of digital literacy and analytical thinking skills in addressing misinformation in the 21st century. It emphasizes the importance of these skills in enabling individuals to critically assess information and make informed decisions. The review examines existing research and theories related to digital literacy and analytical thinking, highlighting their significance in fostering a more informed society. It provides insights into strategies for enhancing these skills among individuals of different age groups and educational backgrounds. The article aims to contribute to the ongoing discourse on equipping individuals with the necessary tools to confront misinformation and promote a more resilient and informed citizenry.

Method

In this study, the method to be used is Systematic Literature Review (SLR) with an analysis approach using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). The SLR method was chosen for its ability to systematically identify, evaluate and synthesize relevant research in the fields of digital literacy, analytical thinking and misinformation. The process begins with a literature search using the Publish or Perish search engine, which allows researchers to access scholarly articles indexed in Scopus.

The search will be limited to articles published within the last four years to ensure that the information collected is current and relevant to the current context. In the initial stage, keywords that will be used include “digital literacy,” “analytical thinking,” and “misinformation.” After data collection, PRISMA steps will be applied, which include identifying, screening and selecting studies that meet the

established inclusion criteria (Galvão et al., 2022) These criteria will ensure that only quality and relevant studies are included in the analysis.

Using this method, it is hoped to gain an in-depth understanding of how digital literacy and analytical thinking skills contribute to the challenge of misinformation in the digital age, and provide recommendations for the development of these skills.

Results

The results obtained from the screening of articles for the purpose of this literature review showed that 10 articles were selected that met the predetermined criteria. The criteria included publication within the last four years, indexed in the Scopus database, and relevance to the education domain. The screening process was careful to ensure that only quality and up-to-date articles were included in this review.

Table 1. Article Source Details

No	Author(s) & Publication Year	Titles of Articles	Article Category	Topics
1	(Küçükaydın & Ayaz, 2024)	Validation of the Scientific Reasoning Competencies Instrument: Relationships with Epistemological Beliefs and Analytical Thinking	Scopus Q1	The relationship of analytical thinking skills with scientific reasoning competence and epistemological beliefs.
2	(Noris et al., 2024)	Quality Education: Development and Validation of Analytical Thinking and Entrepreneurial Thinking Skills in Science Learning	Scopus Q3	Development of analytical and entrepreneurial thinking skills in science learning.
3	(Zhang et al., 2024)	Effects of Digital Media Literacy Course on Primary School Students' Digital Media Literacy	Scopus Q1	The impact of digital media literacy course on digital literacy of elementary school students.
4	(Noble & Gachago, 2022)	Developing Critical Digital Literacies Through Digital Storytelling: Student Attempts at Re-Telling the District Six Story	Scopus Q2	Development of critical digital literacy through digital storytelling projects in higher education.
5	(Qian et al., 2023)	Fighting Cheapfakes: Using a Digital Media Literacy Intervention to Motivate Reverse Search of Out-of-Context Visual Misinformation	Scopus Q2	Digital media literacy intervention to counter visual misinformation with image retrieval.

No	Author(s) & Publication Year	Titles of Articles	Article Category	Topics
6	(Luthfia et al., 2021)	The Role of Digital Literacy on Online Opportunity and Online Risk	Scopus Q2	The role of digital literacy in addressing online opportunities and risks among Indonesian youth.
7	(Boulianne & Hoffmann, 2024)	Perceptions and Concerns About Misinformation on Facebook in Canada, France, the US, and the UK	Scopus Q1	Perceptions and concerns about misinformation on Facebook in a cross-national context.
8	(Otgaar et al., 2021)	Protecting Against Misinformation: Examining the Effect of Empirically Based Investigative Interviewing on Misinformation Reporting	Scopus Q1	The impact of empirically-based investigative interviewing in protecting children from the influence of misinformation.
9	(Caled & Silva, 2022)	Digital Media and Misinformation: An Outlook on Multidisciplinary Strategies Against Manipulation	Scopus Q2	A multidisciplinary strategy to tackle misinformation in digital media.
10	(Artmann et al., 2023)	Elementary School Students' Information Literacy: Instructional Design and Evaluation of a Pilot Training Focused on Misinformation	Scopus Q2	Evaluation of inquiry-based information literacy training for elementary school students on misinformation.

Discussions

The Impact of Lack of Digital Literacy and Analytical Thinking

The lack of digital literacy and analytical thinking skills can have a significant impact on various aspects of life in today's digital era. One of the main impacts is the increased vulnerability to online misinformation and disinformation that is increasingly prevalent. Research by Qian et al., (2023) shows that 20% of content shared on social media contains elements of misinformation. As also shown in a study by (Küçükaydın & Ayaz, 2024) on scientific reasoning competence, the ability to evaluate evidence and make appropriate inferences is crucial in understanding scientific information. This means that a lack of digital literacy can lead to difficulties in sorting and evaluating valid information amid the flood of digital information. This can lead to individuals being easily exposed to and believing inaccurate or misleading information. Another impact is the reduced opportunities and benefits that can be derived from the internet. A study by Luthfia et al., (2021) found that digital literacy has a

greater positive influence on online opportunities than online risks. This means that those with higher levels of digital literacy tend to be able to utilize the internet more optimally for various purposes such as learning, social interaction, and even economic benefits. Conversely, individuals with low digital literacy may not be able to maximize the potential of the internet for their personal and career development.

Lack of digital literacy can also hinder active participation in digital society. For example, in an educational context, students who lack digital literacy may struggle to engage effectively in online learning or utilize digital resources for their research (Zhang et al., 2024). This can widen the digital divide and limit learning and development opportunities. Moreover, in the context of digital citizenship, a lack of digital literacy can reduce an individual's ability to critically participate in online discussions or understand the policy implications of digital technologies (Noble & Gachago, 2022).

Lack of analytical thinking skills can also hinder the development of scientific reasoning competencies (SRC). SRC is an important 21st century skill that includes the ability to design experiments, test hypotheses, and draw conclusions from data (Küçükaydın & Ayaz, 2024). Without strong analytical thinking abilities, individuals will struggle to break down complex problems into manageable parts, which is at the core of scientific reasoning. This can negatively impact one's ability to engage in scientific problem solving and evidence-based decision making.

Furthermore, a lack of digital literacy and analytical thinking can increase vulnerability to information manipulation and propaganda. In the era of post-truth and fake news, the ability to analyze information sources, evaluate their credibility, and understand context is crucial. Without these skills, individuals may be more easily swayed by misleading narratives or conspiracy theories. This not only impacts the individual level, but can also affect public discourse and democratic processes more broadly (Noris et al., 2024). In the context of education, the lack of digital literacy and analytical thinking skills can hinder the learning process, especially in the era of distance learning. Research shows that digital literacy through e-tutorials can increase student engagement and help them gain optimal benefits from the learning process (Luthfia et al., 2021). Without these skills, students may have difficulty accessing online learning resources, collaborating effectively in a digital environment, or critically evaluating the credibility of information they find.

Utilizing Technology to Strengthen Digital Literacy and Analytical Thinking

Utilizing technology to strengthen digital literacy and analytical thinking skills can be done through various systematic and structured approaches. One effective strategy is through active digital literacy interventions that involve hands-on learning and practice using digital tools. Research shows that active interventions that involve both knowledge and behavioral components are more effective in improving digital literacy skills compared to passive interventions that only focus on providing information (Qian et al., 2023).

The use of technology has great potential to strengthen digital literacy and analytical thinking skills. One effective approach is through the use of digital storytelling in learning. Digital storytelling allows students to express their understanding of complex topics through multimedia narratives that combine text, images, sound and music. The process of creating these digital stories encourages students to analyze information from various sources, synthesize their understanding, and communicate it creatively. This is in line with the goal of developing digital literacy which includes not

only technical skills, but also the ability to understand, evaluate and use digital information critically (Noble & Gachago, 2022). In addition to digital storytelling, the use of technology in the form of digital media literacy courses can also have a positive impact. A 10-week intervention study conducted on elementary school students in Beijing by Zhang et al. (2024) showed that a digital media literacy course can significantly increase students' civic participation. Although there was no significant increase in technical skills, critical understanding, or creation and communication, the increase in civic participation showed that students became more aware of their role in a digital society. This illustrates how technology can be used to develop important aspects of digital literacy that go beyond mere technical skills. In the context of education, technology utilization can be integrated through e-tutorials and project-based learning to increase student engagement. E-tutorials are proven to increase student engagement and help them gain optimal benefits from the digital learning process (Luthfia et al., 2021). This approach also enables the development of analytical skills through activities such as designing experiments, testing hypotheses, and drawing conclusions from data which are important components of scientific reasoning competencies (Küçükaydın & Ayaz, 2024)..

Technology can also be used to develop analytical thinking skills through dimensions such as analysis, organization, generalization, and evaluation. Research shows that developing these dimensions of analytical thinking can be done through good planning, strategic thinking, creativity, communication, and leadership (Noris et al., 2024). The integration of technology in this process allows for more interactive and project-based learning. However, it is important to note that the utilization of technology must be accompanied by appropriate support and guidance from teachers. Research shows that scaffolding support from teachers has a positive relationship with students' digital literacy. Teachers have an important role in helping students evaluate inconsistent information from various online sources and identify the characteristics of the most credible websites (Zhang et al., 2024). Therefore, the development of scientific reasoning competencies (SRC) in prospective teachers is very important. SRC includes the ability to analyze, evaluate, and make evidence-based inferences, which are essential components of digital literacy and analytical thinking (Küçükaydın & Ayaz, 2024). In the context of higher education, the development of SRC can be done through various technology-based approaches. For example, the use of computer simulations and virtual laboratories can help students develop their skills in designing experiments, collecting and analyzing data, and testing hypotheses. In addition, online learning platforms that provide access to scientific resources and data analysis tools can support the development of analytical thinking skills (Küçükaydın & Ayaz, 2024).

Finally, it is important to note that the utilization of technology to strengthen digital literacy and analytical thinking should be done by considering the specific needs of the target group. Research shows that effective digital literacy interventions should involve active components such as hands-on practice and feedback, rather than just passive information delivery (Qian et al., 2023). This approach allows for more sustainable skill development and can be applied in a variety of contexts.

The Role of Digital Media in Spreading and Detecting Misinformation

Digital media plays a complex role in the spread and detection of misinformation in this modern era. Boulianne & Hoffmann (2024) in their research showed that concerns about misinformation are very high around the world, surveys put misinformation and disinformation as the main concerns in the next two years. Digital media has an important role in the spread and detection of misinformation, especially with the increasing use of the internet and social media platforms. The use of digital media facilitates the rapid dissemination of information, but also contributes to the

spread of false or misleading information. According to (Qian et al., 2023), social media has become a fertile ground for the production and distribution of visual misinformation, where many users are caught up in the speed of sharing information without considering the accuracy of its content. This phenomenon becomes more complex with the high level of user interaction on digital platforms, which often ignores the verification process.

The role of digital media in the spread of misinformation is significant, with a survey in Boulianne & Hoffmann (2024) showing that 29% of respondents considered social media to be the most worrying medium for the spread of misinformation, much higher than news sites or apps (20%). The study also found that exposure to false information is much more common on social media than other platforms.

The connectivity offered by digital media allows information dissemination to happen very quickly, often without going through an adequate validation process. Caled & Silva (2022) note that social media, with its dynamic nature, accelerates the virality of news, be it accurate or misleading. In this context, while digital media offers broad access to information, major challenges arise regarding public trust in the news presented. Misinformation can easily accumulate and influence people's understanding of important issues, including health and political issues. However, digital media also provides tools and opportunities to detect and counter misinformation. Active digital literacy interventions that involve hands-on learning and practical use of digital tools have been shown to be more effective in improving digital literacy skills compared to passive interventions that only focus on providing information (Zhang et al., 2024). This approach allows for more sustained skill development and can be applied in a variety of contexts.

Misinformation is a complex problem that requires a multidisciplinary approach to address. Research by (Caled & Silva, 2022) suggests that effective strategies should include journalistic, educational, governmental and computational solutions perspectives. Each approach offers its own advantages and disadvantages, but collaboration between different disciplines can create more effective solutions. For this reason, it is important for various parties - government, academia and civil society - to work together to identify and implement appropriate solutions to counteract misinformation. In the context of education, research by (Artmann et al., 2023) shows that information literacy training among elementary school students can significantly improve their ability to assess the credibility of online news. Research-based educational interventions can help children to develop critical thinking skills and the ability to recognize misinformation, so that they are better prepared to face information challenges in the digital world. Through a structured and interactive educational approach, students are not only taught to identify correct information, but are also equipped with the necessary skills to explore and critically evaluate information.

It is important to note that the effectiveness of digital media in detecting misinformation relies heavily on proper support and guidance. Research shows that without teacher support, students often have difficulty in dealing with inconsistent information across different websites and identifying the characteristics of the most credible websites (Otgaar et al., 2021). Therefore, the development of comprehensive digital literacy interventions should include both technical and cognitive components, including an understanding of how to use digital tools and the ability to critically evaluate information (Otgaar et al., 2021). Thus, the role of digital media in the dissemination and detection of misinformation depends not only on technology alone, but also on the digital literacy of its users. Efforts to improve media literacy should be achieved through multidisciplinary collaborations that include education, public policy and technological innovation, so that people can better cope with the complex information challenges of this digital era.

Conclusion

The study highlights the critical need for digital literacy and analytical thinking in addressing the challenges posed by misinformation, lack of engagement in digital society, and hindered learning opportunities. Digital literacy is essential for discerning accurate information, optimizing online opportunities, and fostering civic participation. Analytical thinking complements this by enabling individuals to process and critically evaluate data. The integration of technology through methods like digital storytelling, e-tutorials, and project-based learning has proven effective in enhancing these skills. Moreover, structured interventions tailored to the needs of target groups, with active teacher support, yield better outcomes. The findings suggest that to bridge the digital divide and empower individuals as informed digital citizens, a collaborative effort involving educators, policymakers, and technology designers is imperative. These efforts should focus on creating interactive and supportive learning environments that nurture both technical and cognitive competencies, ensuring sustainable skill development in a rapidly evolving digital landscape.

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