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Thinking about Thinking, from Searching to Evaluating: Students' Metacognitive Strategy in Digital Literacy Practices

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Abstract

This study investigated students' metacognitive strategies in digital literacy practices with focus on how they plan, monitor and evaluate their digital reading practice. As digital learning environments demands higher levels of self-regulation, students' understanding of metacognitive awareness becomes crucial to foster their effective understanding and critical engagement. By employing descriptive quantitative approach, this study distributed a questionnaire developed from Metacognitive Awareness of Reading Strategies Inventory (MARSI) to 122 vocational university students in a public university in Indonesia. Quantitative data analysis was accomplished to identify frequency and pattern of strategy, problem solving and support strategy. This study revealed that students often applied problem-solving strategy but show low engagement in evaluative and reflective practice, especially in evaluating credibility and online epistemic information. Although students reflected relative high awareness of surface-level strategies, their critical evaluation remained limited. This finding highlighted the fundamental of explicit instruction in metacognitive regulation in digital literacy curriculum. This study concludes that cultivating students' evaluative and epistemological awareness are crucial to prepare them to navigate complex digital information environment.

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Introduction

In the twenty-first century, digital technologies have escalated the ways users' access and engage with digital information. The existence of social media platform, digital search and AI tools has provided spaces for knowledge development. However, the information provided has also emerged paradox in education setting that students often have more access to the information than it used to, yet they often encountered difficulties in critically evaluating and using the knowledge effectively (Livingstone, 2014; Leu et al., 2019). In high education, this challenge has become more intense. Undergraduate students are expected to finish their academic task which demand the skills to evaluate information (credible and noncredible), understanding bias and synthesizing the evidence or data from various sources. These processes do not only need digital literacy skill but also the high order thinking skill, especially metacognitive skill-"thinking about thinking" (Flavell, 1979).

Digital literacy, as conceptualized in contemporary study, extends beyond the skill to operate the digital tool or internet navigation. Literacy digital includes skill, knowledge, and attitude (Ng, 2012; Sefton-Green dkk., 2016). In Indonesian context, digital literacy has been identified as one of essential competences in Independent Learning framework, which stressing the importance of critical evaluation for students in accessing information (Kemdikbud, 2020). Empirical evidence has shown that students' digital literacy practice often remains in surface level with low attention on the critical and deep evaluation (Deliany & Cahyono, 2020; Ramadhanti & Yanda, 2021).

The core of effective digital literacy is metacognition, which involve awareness and regulation of one's cognitive process during learning. Foundational model of metacognition proposed by Flavell (1979) identifies two main dimensions: metacognitive knowledge (the awareness of strategy, task, and individual skills) and metacognitive regulation (planning, monitoring and evaluating cognitive activities) _. In digital inquiry process, regulation function plays crucial rules: students should plan to search strategy, monitoring progress, and evaluating the reliability and relevance of the information received (Azevedo, 2005; Mokhtari & Reichard, 2002). Although the importance metacognitive strategy in digital learning environment has been admitted widely, studies also show that students often encounter challenges in consciously implementing this strategy especially in evaluating stage (Silvhiany & Huzaifah, 2021; Stanton, Sebesta & Dunlosky, 2021). Recent international studies have supported this gap. Santon et al., (2021) has found that students tended to overestimate their skill in evaluating online information that affects "illusion of competence" where the delf-report is not in line with actual performance. Similarly, Panadero (2017) highlights that although the learners may be familiar with the concept of planning and monitoring, the implementation in authentic assessment often lack depth and consistency. In Indonesian context, Currie, et.al. (2010) observed that although undergraduate

students show basic searching strategy, their critical evaluation towards online sources remains fragmented and underdeveloped. These findings show wider educational problem: while technical digital skill may be integrated with curriculum, explicit instruction and scaffolding of metacognitive strategies are often overlooked.

The importance of strengthening students' metacognitive awareness has been escalated along with the massive growth of AI technology. The tools like ChatGPT, and AI-assisted search tool, and algorithmic curation system both support and challenge students' digital practices. In another side, this phenomenon can increase students' reliance on the use of AI, decreases the critical engagement and obscure the source evaluation especially when students are lack of metacognitive regulation (Baskara, 2024). This dual roles of AI highlight the fundamental of preparing students with the ability to consciously plan, monitor and evaluate their thinking during digital use. Although the role of metacognition in digital learning has been widely admitted, the significant gap remains especially in studies focusing on the use of conscious metacognitive strategies by students during the authentic digital inquiry. Majority of existing studies are stressing on technical digital literacy skill (such as the skill to use software tool, access platform) or analyzing metacognition apart from the specific practice in searching and evaluating online information. In consequence, we have lack of knowledge and empirical studies on how students actively manage their ways of thinking in the complex and dynamic digital inquiry process, starting from initiating searches to making evaluation about the credibility and bias. This gap is primarily silent in Indonesia where massive and rapid digitalization has intertwined with the uneven educational preparation creating gap in students' competence or skills in interacting critically with online sources (UNESCO, 2022; Ramadhanti & Yanda, 2021).

This study addresses this gap by studying metacognitive strategies in digital literacy practices by of undergraduate students in Indonesia. Specifically, it investigates how students plan, monitor and evaluate their thinking during online information searches. This study is significant for : 1) it provides empirical evidence on metacognitive awareness of Indonesian students especially vocational undergraduate students, as an underrepresented population in current research; 2) this study also highlight which metacognitive strategy needs to be developed critically; and 3) this study offers an empirical practice for curriculum development especially in integrating metacognitive strategy in digital literacy instruction. Thus, this study has contributed to the global discourse on how higher education can prepare students not just to survive but also to develop in the era of rapid and massive information spread withing dynamic and complex algorithmic.

Literature Review

The Concept of Metacognition

Metacognition concept was popularized by Flavell (1979) which refers to self-awareness and regulation of cognitive process. Flavell differs between metacognitive knowledge (the knowledge of specific cognitive process, strategy and person-specific variable) and metacognitive regulation which includes planning, monitoring and evaluating. These regulation activities open spaces for learners to consciously control their mind to achieve their learning goals. Scholars have expanded and developed this foundational model. Schraw and Dennison (1994) have developed Metacognitive Awareness Inventory (MAI) to operate this concept, illustrating its practical use in educational research. Zimmerman (2002) situated metacognition within broader framework from self-regulated learning which stresses on cyclical interaction of forethought (planning), performance (monitoring) and reflection (evaluation). Pandero (2017) further articulated that metacognition underpins all process of self-regulated learning which allows learners to adjust strategy with context-specific demands. Thus, across these models, a consistent emphasize appears: successful learners are those who can predict cognitive demands, monitor their progress and assess the quality of their learning outcomes. In the digital learning environment where information is vast, complex and often unreliable, metacognitive skill becomes fundamental.

Digital Literacy: Beyond Technical Skill

The notion of digital literacy concept has developed significantly over the past two decades. Early definition stresses on functional skill cush as skill to operate computer and use application software (Giltser, 1997). However, recent framework admits digital literacy as a multi-dimensional (Ng, 2012; Sefton-Green, et al., 2016). In this expanded view, digital literacy involves: 1) Technical proficiency, using digital tools and platforms effectively; 2) cognitive and critical skills, searching, evaluating and synthesizing information; and Socio-emotional disposition, engaging responsibly and ethically in digital spaces. UNESCO (2018) has advocated a holistic framework of digital literacy which integrates critical and evaluative skills, particularly in the area which experiences rapid digitalization. The Indonesian Ministry of Education and Culture similarly underlines digital literacy as a core competency in the concept of *Merdeka Belajar* (Independent learning) policy. This has indicates s shift from viewing digital literacy as mere “ICT skills” to recognizing it as a higher-order competence which integrates with metacognition and critical thinking.

Besides the policy emphasis, research shows that many students remains to deal with digital task in surface level (Leu, et al., 2019) has revealed that in the context of advanced technology students often encounter difficulties in finding credible sources especially in open-ended inquiry tasks. In Indonesia, Deliany and

Cahyono (2020) university observed that students' online reading practices emphasizes more on quick information search rather than critically interrogating its quality. These findings highlights a persistent gap between ideal goals of digital literacy and the real practices of students.

Metacognitive Strategies in Digital Literacy

Metacognitive strategies are fundamental in digital inquiry process which usually involve three stages: 1) Planning, 2) Monitoring, and 3) Evaluating (Azevedo, 2005; Mokhtari & Reichard, 2002). Each stage reflect different dimensions of self-regulation and self-awareness.

Planning

Planning refers to activities done before or in the beginning of a task. These activities may include: setting goals, selecting appropriate strategies, predicting challenges and allocating resources (Schraw & Moshman, 1995). In digital inquiry, planning involve formulating search queries, identifying potential platform (e.g. database vs general search tools), and estimating time needed to finish the task. Researches show that although students often aware the importance of planning stage, strategies used tend to be superficial. Silvhiany and Huzaifah (2021) reported that students frequently rely on simple keyword search without considering advanced search techniques or special platform features. Similarly, Ramadhanti and Yand (2021) has also revealed that Indonesian university students rarely plan beyond identifying general topic which impacts on inefficient and unfocused searches. This shows that although planning is understood theoretically, the practical implementation remains limited.

Monitoring

Monitoring stage refers to real-time self-awareness and self-regulation during task performance. This includes monitoring progress, recognizing distraction, adjusting strategy and verifying relevant information (Nelson & Narens, 1990). In digital inquiry, monitoring may involve refining search terms, cross-checking different resources or identifying when a strategy is not beneficial. Stanton, Sebesta, dan Dunlosky (2021) highlighted that students frequently show an "illusion of monitoring" where they believe that critically monitor progress but fail to detect the gaps in their understanding. Panadero (2017) also noted that monitoring is one of metacognitive aspects which is least visible yet most fundamental as its effectiveness in directly influence evaluating evaluation quality. In Indonesian context, , Currie, et.al. (2010) observed that although students reported adjusting strategy during searching, actual behaviours (observed during think-aloud tasks) showed

minimal monitoring beyond retyping search keywords. This gap between self-perception and practice show the lack of monitoring skills in authentic digital task.

Evaluation

Evaluation is reflective process in assessing task outcomes, including the source quality, strategy adequacy, and conclusion validity. In digital literacy, evaluation is often the complex and challenging, that need critical analysis on credible sources, author expertise, bias potential, and evidentiary support (Wineburg & McGrew, 2017). Empirical studies consistently highlight the students' weakness in evaluating strategy. For example, Wineburg dan McGrew (2017) found that students, including those at alite universities, struggles to identify credible sources online, often prioritize surface features (i.e., website design) over deeper indicators of reliability. In Indonesia, Deliany and Cahyono (2020) underlined that although the students surely claimed to evaluate the authors credibility, their assessment often lack of systematic depth. Chen (2024) also emphasized that evaluation is not merely about awareness but it needs explicit instruction and repeated practice to develop.

Metacognition, Digital Literacy and AI Tools

The rise of AI-driven tools escalates new dimensions in the connection between metacognition and digital literacy. On the other side, AI can function as tool to regulate metacognition and digital literacy by providing the personalization advices, alternative perspectives or the motivation to reflection (Kasneci, et.al., 2023). For instance, intelligent tutoring system has proven to enhance the students planning and monitoring skills by guiding them through the inquiry process (Li, et.al., 2024). On the other hand, AI tools can also hinder the metacognition development if students rely on the use of AI tools without critical thinking skills. Baskara (2024) reminded that unreflected reliance on generative AI may lead to decrease of students evaluation skill because they might accept AI output without questioning or evaluating the accuracy and bias. An, et al. (2022) also highlights that although AI can accelerate information access, it cannot replace reflective assessment needed in academic evaluation. In Indonesian context, Alzubi (2021) observed that while students use AI-assisted tools enthusiastically, they lacked of awareness of the fundamental of critical evaluation towards AI outputs. This strengthens the importance of integrating AI awareness with metacognitive and digital literacy instruction, ensuring that students use the tools to help them doing their tasks rather than as replacement for critical thinking.

Empirical Studies in Indonesia

Some studies have provided insights about how Indonesian students interact with metacognition in digital literacy practice. Ramadhanti and Yanda (2021) researched students' metacognitive strategy in online reading tasks, finding that students showed their awareness off basic strategy, their skill to manage learning process remains uneven. Deliany dan Cahyono (2020) emphasize that critical evaluation is one of the weakest areas, often limited by surface-level judgement. Currie, et.al. (2010) further reported discrepancies between self-reported strategy and observed practice especially monitoring and evaluating. All of these studies suggest a consistent pattern: Indonesian students show certain level of planning and monitoring but it is difficult in implementing evaluation strategy deeper. This is in line with global findings but is compounded by the global challenges such as unequal access to training, variation in English proficiency (as so much online content is in English), and limited curricular which emphasizes on critical literacy.

Several studies have revealed critical gaps which highlighting the significances of deeply investigating university students metacognitive strategies (Currie, et.al., 2010; Deliany dan Cahyono, 2020; Ramadhanti and Yanda, 2021). Majority of the studies especially in Indonesian context, unproportionally focused on technical digital and ICT competencies, which often ignored how the learners consciously manage and control their cognitive strategy during online reading. Although some studies admitted that students recognized their metacognitive strategies, few of them have investigated how these strategies were consciously and systematically applied in the context of authentic learning. Moreover, study on this topic to vocational university students is still lack of number since most of them were conducted to high school students and general university students. To address this gap, this study aims at investigating how university students in Indonesia apply metacognitive strategies in all stages, namely planning, monitoring and evaluating during their digital literacy practice for academic purposes. Through these foci, this study can strengthen the significance of studying metacognitive strategy by providing relevant empirical insights to prepare students in participating in complex society, information-rich society.

Method

This study employed quantitative descriptive approach consisted of a structured questionnaire measuring students' self-reported metacognitive awareness in three dimensions: planning, monitoring, and evaluation. The participants of this study were 125 undergraduate students of public vocational university in Indonesia. They came from three study programs: Design Graphic, Publishing, and Broadcasting. These fields were considered relevant because they require students to engage intensively with digital platforms, both for academic learning and creative production. Of the 125 participants (Publishing 68 students; Graphic Design

24 students; and Graphic Engineering 33 students) with an age range between 18 and 22 years. All participants were students in first, second, and third year of study. They reported daily access to the internet and frequent use of digital platforms to support their academic activities, such as researching assignments, designing visual projects, and producing digital media. Participation was voluntary, and informed consent was obtained from all students prior to data collection.

The instrument was the Metacognitive Strategies in Digital Literacy Questionnaire (MSDLQ)**,** adapted from the Metacognitive Awareness Inventory (Schraw & Dennison, 1994) and the Metacognitive Awareness of Reading Strategies Inventory (Mokhtari & Reichard, 2002). It was revised to fit digital inquiry contexts and to emphasize higher-order evaluation skills. The questionnaire contained 15 items rated on **a** 4-point Likert scale (1 = Never, 2 = Seldom, 3 = Some of the time, 4 = Most of the time). The choice of a 4-point scale was deliberate, as it discourages neutral responses and encourages participants to lean toward frequency of practice, thus offering clearer insight into students' self-reflection. The questionnaire was organized into three dimensions. The planning dimension (5 items) measured students' abilities to set goals before searching, select relevant keywords, and anticipate challenges. The monitoring dimension (5 items) assessed strategies such as checking relevance, adjusting search approaches, and managing distractions. The evaluation dimension (5 items) focused on students' ability to assess source credibility, identify bias, and critically reflect on information gathered. Data collection was carried out in two phases. First, the questionnaire was administered online during a scheduled class, with all 122 students completing it under the supervision of the researcher. The quantitative data were analyzed using descriptive statistics. Mean scores were calculated for each metacognitive dimension (planning, monitoring, and evaluation). Scores closer to 4 indicated stronger metacognitive awareness, while scores closer to 1 indicated limited awareness. Data were also displayed in comparative tables and charts to highlight differences between dimensions.

Result and Discussion

Planning in Reading Digital Literacy

Item 1: Setting Clear Goals Before Searching Online

Item 1, *"Before searching for information online, I set clear goals about the information I need"*, received positive response with average score 104. It shows that majority of the participants admitted the importance of setting goals as a preparatory stage in digital reading. This awareness is in line with the framework of metacognitive awareness proposed by Mokhtari and Reichard (2002) which emphasized the fundamental of setting clear goals before interacting with text.

Table 1. Setting Clear Goals Before Searching Online

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q1. Before searching for information online, I set clear goals about the information I need.	208	204	4	0	104

Similarly, Afferback and Cho (2010) argued that goal orientation is the core of strategic digital reading for it guides the students to make decision during online reading. This study showed students had declarative awareness of planning. However, as noted by Azevedo (2005) and Cho (2015), learners often overestimated their strategic skill-reporting goal-setting behaviour that may not consistently manifest during digital literacy practice. Therefore, although students showed positive responses on planning, this might reflect self-awareness rather that consistent practice of metacognitive regulation.

Item 2: *Considering Keywords or Search Terms*

For question item 2, *"I think about keywords or search terms that can help find reliable sources,"* the response showed support with *average score 106*. It shows high degree of students' awareness of the role of keywords in searching information especially in maintaining efficiency of online search. Keyword formulation is admitted as one of procedural core strategy in digital reading and researching (Afflerbach & Cho, 2010; Mukhlif & Amir, 2017).

Table 2. Considering Keywords or Search Terms

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q2. I think about keywords or search terms that can help find reliable sources.	232	192	0	0	106

Digital readers with sufficient skill actively test and refine keywords to narrowing research results and increase relevance. This participants' agreement thus reflect their recognition on cognitive process as a vital stage in gathering and locating reliable information. However, as observed by Cho (2015), many learners can identify keywords but failed to apply advanced search logic such as term reformation. This gap between awareness and practice show that although students know what to do they may not fully understand how to perform complex keyword manipulation. Therefore, further instructional support is needed to develop procedural dimension of keyword planning into actual search competence.

Item 3: Planning Time Allocation for Online Searches

The third item of question, *"I plan how much time I should spend searching for information,"* received lower score compared to the first two items with mean 94.5. Although the majority of respondents recognized the fundamental of time planning, fewer showed strong belief in their competence to manage time effectively. This pattern is in line with Azevedo (2005) highlights that time management remains a major challenge in individual online learning and searching.

Table 3. **P**lanning Time Allocation for Online Searches

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q3. I plan how much time I should spend searching for information.	108	240	30	0	94,5

So digital reading and searching are open-ended process where information availability and relevance are not predictable that time management becomes challenging (Winne & Hadwin, 1998). The relatively lower practice on this item suggests that students may start searching without concrete time framework which potentially lead to cognitive fatigue or information overload. Data show that students' metacognitive planning is primarily content-oriented (focusing on the goal and keyword) rather than process-oriented (managing time and pacing). Instructional Intervention can integrate explicit training on time management strategies during online reading and research.

Item 4: Considering Appropriate Platforms or Databases

Item four, *"I consider which platform or database best suits my search needs," also received high mean score* 102.25. This indicates that the majority of students were aware of the importance of selecting platform as part of their digital reading preparation. Leu, et al. (2019), digital literacy extends beyond text comprehension to include platform awareness, understanding how to search not only what to search.

Table 4**.** Considering Appropriate Platforms or Databases

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q4. I am considering which platform or database best suits my search needs.	176	231	2	0	102,25

Students' perception reflected their competence and awareness to differ various online sources as academic data base, digital library, or general search tools. However, this awareness might be superficial as stated by

Rowlands, et.al. (2008) that many learners regularly use one platform (often Google of Wikipedia) rather that strategically choose data base which is suitable with their searching goals.

Item 5: Anticipating Potential Obstacles in Online Search

Item 5, *"I anticipate potential obstacles before starting my online search,"* revealed the weakest engagement among all items with mean score 90. This score shows that most of the respondents did not regularly anticipate the challenges or difficulties such as unreliable sources, misinformation, technical issues, or access limitation before starting their search.

Table 5. Anticipating Potential Obstacles in Online Search

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q5. I anticipate potential obstacles before starting my online search.	80	231	48	1	90

The anticipation level on the potential challenges represents the higher level of metacognitive planning which requires reflective and predictive thinking skill (Azevedo, 2005; Mokhtari & Reichard, 2002). Mukhlif & Amir (2017) argued that this anticipative regulation differentiates expert learners from novices in online reading. The relatively low engagement on this item shows that students planning strategy relatively reactive rather than proactive, in which they responded to the problems as they arise instead of anticipating them in advance.

Overall, all five items illustrated relative consistent pattern of students' planning in reading digital sources. Participants showed relative strong awareness in goal setting, keyword selection, and platform consideration which reflects well-developed declarative knowledge of planning strategies. However, lower responses in time management and anticipatory awareness reflected limited procedural and conditional metacognitive control. This finding is in line with Azevedo (2005) and Cho (2015), who discovered that learners often possess partial metacognitive awareness, knowing what strategy they can perform but not how or when to perform them effectively. In general, this finding indicates that effective digital reading demands more than just awareness; it demands continuous monitoring, adjustment, and anticipation during search process.

Monitoring in Reading Digital Literacy

Item 6: Regularly Checking Relevance of Information

Item 6, *"When searching for information online, I regularly check whether the information I find is relevant to my purpose,"* received responses with mean 105. This finding indicates that majority of learners show active contributions in monitoring relevant information they encounter.

Table 6. Regularly Checking Relevance of Information

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q6. When searching for information online, I regularly check whether the information I find is relevant to my purpose.	212	204	2	0	105

Mokhtari and Reichard (2002), revealed that this attitude reflected students procedural metacognitive awareness in which they consciously evaluate their understanding and information appropriateness during reading. This high agreement supports Azevedo's finding (2005) that effective digital learners often evaluate and reevaluate their reading goals to maintain the alignment with search objectives. Similarly, Cho (2015) emphasized that relevance checking differentiates strategic online readers from passive browsers. However, this high self-awareness may not completely represent consistent practice as self-assessment often inflates perceived monitoring ability *(*Winne & Hadwin, 1998). Therefore, although the data highlight strong awareness on the relevance monitoring, further empirical study (think-aloud or trace data) is necessary to confirm its actual occurrence during digital reading (will be investigated in the next research).

Item 7: Adjusting Keywords or Search Strategies

Item 7, *"I adjust keywords or search strategies if the results are not relevant enough," shows similar engagement with mean 103. This finding shows that students were aware of the dynamic digital search where strategies should develop as response to the search feedback. This adaptive attitude is essential for self-regulate online reading, aligning with the concept proposed by* Afflerbach dan Cho (2010) arguing that proficient readers iteratively modify searching strategy to enhance the relevance and reliability.

Table 7. Adjusting Keywords or Search Strategies

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q7. I adjust keywords or search strategies if the results are not relevant enough.	188	222	2	0	103

In addition, Leu, et al. (2019) pictured this flexibility as a key indicator of digital reading maturity. This finding is in line with Romly et.al., (2017) that ESL students in Malaysia with high metacognitive strategy frequently reconstruct keywords. However, although students show strong perceived adaptability, previous study conducted by Silvhiany and Huzaifah (2021) revealed that students often relied on surface adjustment such as adding one or two keyword without reformulate deeper semantic. Therefore, this data may reflect awareness of the need for adjustment, but not necessarily comprehensively mastery digital iterative search process.

Item 8: Recognizing and Refocusing After Distraction

Item 8, *"I realized when I got distracted while searching for information and tried to refocus on the task,"* received significant decline in agreement compared to first two items of monitoring, mean 99. This decreases score highlights the area of metacognitive vulnerability. Maintaining focus during digital reading demands inhibitory control and sustainable focus in the middle of competing online stimuli (Leu et al., 2019).

Table 8. Recognizing and Refocusing After Distraction

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q8. I realized when I got distracted while searching for information and tried to refocus on the task.	144	234	16	0	99

Azvedo (2005) emphasized that monitoring attention is one of the most cognitively demanding aspects in self-regulated learning as obstacles may emerge from the hyperlinks, advertisements, or social media notifications. This lower engagement reflects that students may experience difficulties in maintaining concentration in open digital environment, this finding supports the theory of Winnie and Hadwin (1998) that attention monitoring often decreases under information overload. Different from Q6 and Q7, which represent cognitive monitoring of task progress, this item spotlights affective and behavioural regulation. This finding indicates that students were cognitively aware of task goals but they demand further scaffolding in managing self-focus and control during online reading.

Item 9: Comparing Sources to Check Consistency

Item 9 *"I compared several sources to monitor the consistency of the information I found,"* received relative strong agreement with mean 103. This pattern shows that students were aware of the importance of comparing various resources to verify consistency and credibility.

Table 9. Comparing Sources to Check Consistency

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q9. I compared several sources to monitor the consistency of the information I found.	188	222	2	0	103

This comparison reflected advanced monitoring behaviour which integrates evaluative reasoning, high order metacognitive function identified by Afflerbach and Cho (2010) and further discussed by Leu, et al., (2019). In the digital context, where various content in reliability and ideological stance, cross-source validation is fundamental to develop critical digital literacy (Rowlands*, et.al., 2008).* This finding is in line with Romly, et al. (2017), who observed that students with higher metacognitive awareness actively triangulate information in various online resources. However, as noted by Cho (2015), students may over-report this practice, often assume that visiting various sites means comparing, even though they do not perform synthetical analysis. Therefore, although they showed strong agreement on comparing sources to check consistency, their depth of qualitative comparing process demand further study to examine whether they involve critical evaluation or just surface-level corroboration.

Item 10: Noting the Credibility of Websites

Item 10, *"I note the credibility of the websites I visit during my search,"* received the lowest score among all items of questions with mean 91. This study shows students' lack of critical monitoring strategy in digital reading, a limited tendency to evaluate the credibility of digital resources.

Table 10. Noting the Credibility of Websites

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q10. I note the credibility of the websites I visit during my search.	100	216	48	1	91

Evaluating this credibility requires critical thinking and literacy skills as the readers should evaluate the authority of the authors, publication intent, and evidence supports (Leu et al., 2019). Azevedo (2005) and Mokhtari and Reichard (2002) emphasized that this evaluation represents the higher order monitoring strategy which needs integration between cognitive and epistemic awareness. The relatively low response in this study supports Silvhiany and Huzaifah (2021), which reported that many digital learners believed in online information based on visual attraction or popularity rather than resources legitimation. It shows that although students may effectively monitor the relevance and consistency (see Q26-Q9), they lacked critical epistemic

lenses to evaluate the originality and credibility. Therefore, explicit instruction in digital resource evaluation, such as fact-checking protocols and bias analysis, remains a fundamental pedagogical need.

Overall, students showed relative strong cognitive awareness in monitoring strategy, especially in maintaining relevancy (Q6), adjust the keywords (Q7), and rechecking information (Q9). This finding is in line with study conducted by scholars (Afflerbach & Cho, 2010; Leu et al., 2019) who identified these attitudes as characteristic of competent online readers. However, lower response in managing obstacles (Q8) and evaluate resource credibility (Q10) reflected persistent challenges in affective and critical monitoring. These domains, focus control and evaluation, represents deeper layers from metacognitive regulation which are often underdeveloped among university students' (Azevedo, 2005; Silvhiany & Huzaifah, 2021). Thus, this study found that students with procedural awareness in monitoring information, but lack of epistemic vigilance needed to evaluate obstacles and maintain cognitive focus in digital environment. Digital literacy intervention should emphasize on critical dimension and reflective monitoring to develop balanced metacognitive competence.

Evaluating in Reading Digital Literacy

Item 11: Assessing Source Reliability

Item 11, *"after gathering information, I critically assess whether the source is reliable"* received low agreement with average mean 100, namely 95. Yet, this item received the highest score in terms of evaluation compared to other items.

Table 11. Assessing Source Reliability

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q11. After gathering information, I critically assess whether the source is reliable.	84	282	14	0	95

This shows that most students assessed source reliability after searching. It indicates that students were aware of the importance of evaluating resources credibility as an essential part of reading in digital environment. This awareness reflects their evaluative reasoning and epistemic monitoring which are emphasized in the concept of online reading proposed by Afflerbach and Cho (2010), where readers critically evaluate reliability as part of monitoring phase. As supported by Leu, et al. (2019) who highlights that this skill is core competence in digital literacy. However, as Romly et al., (2017) and Cho (2015) studies, high self-reported evaluation may not always represent students' real practice. Many students tend to rely on the surface cues such as website appearances or its popularity, rather than systematically evaluating reliability. Therefore, although this data

shows relatively high agreement, it demand further study to reveal whether students' evaluations are based on analytical evaluation or superficial heuristics.

Item 12: Checking the author's background or credentials

Item 12, *"I check the author's background or credentials before using their work.",* obtained a moderate level of engagement even lowest compared to other items in all dimensions. It shows that although students were generally aware of the importance of evaluating the sources of information, they rarely verified the authors' qualification.

Table 12. Checking The Author's Background or Credentials

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q12. I check the author's background or credentials before using their work.	20	207	96	0	81

Checking the originality of authors' work is an evaluative process which is more complex and needs procedural knowledge and higher cognitive integration (Leu et al., 2019). Afflerbach and Cho (2010) pictured this as a part of advanced metacognitive regulation where readers do not only interpret information but also evaluate and check the epistemic origin. This finding is in line with Romly et al., (2017) and Cho (2015) who reported that students often assume institutional website credibility or well-designed websites without verifying authors' expertise. Therefore, although students show their awareness of evaluating the resources, their limited involvement in verifying the origin of information shows a gap between declarative knowledge and procedural practice. Instructional intervention focusing on author verification strategy can bridge the gap and strengthen their evaluative digital literacy.

Item 13: considering the possibility of bias in online sources

Item 13 *"I am considering the possibility of bias in online sources"* received mean score 82 which shows relative low practice. It indicates that while some students recognized that online sources might contain bias or ideological framing, this recognition was not spread or implemented widely and systematically.

Table 13. Considering the possibility of bias in online sources

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q13. I am considering the possibility of bias in online sources.	16	228	84	0	82

Limited recognition manifests initial stage of critical digital literacy, where students have not internalized their epistemic vigilance as a regular reading habit *(Rowlands*, et.al., 2008). In the model of Afferbech and Cho (2010), evaluating bias sources does not only demand students' comprehension but also epistemic monitoring, the capacity to interrogate author's goals, stance and evidence. The low mean score implies that students tended to process the online text on the surface, accepting information based on the nominal value rather that questioning ideological construction. This pattern reflected Cho's finding (2015) that many digital readers "recognize the concept of bias" theoretically but rarely implement critical scrutiny during actual reading practice. Compared to previous dimensions such as planning and monitoring, this finding shows a gap between students' procedural reading awareness and critical-analytic evaluation.

Item 14: *Assessing the quality of the evidence*

Item 14, *"I assess the quality of the evidence used in the source before accepting the claim."* recorded mean score of 84 which reflects moderate practice of assessing the quality of evidence used in the source before accepting the claim, but the value remains below mean score in monitoring and planning dimensions.

Table 14. Assessing *The Quality of Evidence*

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q14. I assessed the quality of the evidence used in the source before accepting the claim.	36	219	80	0	84

Even though this mean is slightly higher that item 13, the value remains below the other mean values in planning and monitoring which shows that student's habit in verifying claim through evidence was not yet internalized significantly. Evaluating the quality of the evidence provided by the author is a process of higher order metacognitive skill, which Afflerbach dan Cho (2010) defined as evaluative monitoring that involves logical reasoning, synthesize and validation. Leu, et al. (2019) articulated that in the context of digital reading, evaluating evidence plays crucial roles in differentiating reliable information in the middle of misinformation threats. However, this finding shows that students often relied on surface indicators such as the appearance of authority or technical formation rather that analysing the argument power systematically. It is in line with Cho (2015) who reported that students tended to equate evidence with the presentation cues rather than empirical support. Thus, while students strongly admitted the evaluation of evidence, their evaluative process might remain at a recognition level not critical analysis level.

Item 15: Reflecting on strategies in selecting information

Item 15, *"I reflect on whether I have used reliable strategies in selecting information"* obtained mean 83 which shows relative low practice of participants reflection on the use of reliable strategies in selecting information. Reflection is a manifestation of advanced metacognitive regulation (Azevedo, 2005; Winne & Hadwin, 1998), where learners evaluate not just what they know but how effectively they implement the strategy. This finding implies that although students occasionally reflect their reading strategy, this process was not systematic or not a habit as stated by Romly et al., (2017), students rarely perform post-evaluative reflection unless they were guided explicitly through structural learning intervention.

Reflection requires cognitive effort and metacognitive maturity, and its low frequence limits students' competence to transfer their evaluative habit leading to a successful new reading situation. Therefore, although students realized that importance of reflection, their practice remains reactive, activated only when prompted rather than as a self-directed evaluative cycle.

Table 15. Reflecting on Strategies In Selecting Information

Question Item	Most of the time	Some of the time	Seldom	Never	Mean
Q15. I reflect on whether I have used reliable strategies in selecting information.	28	219	82	1	83

Overall, findings in evaluation dimension show students' declarative awareness of critical evaluation in online reading; however, the practice of procedural engagement is varied. Relatively high mean scores in items 11, 13, and 14 show that students admitted the importance of reliability, bias awareness and evidence-based evaluation in evaluating digital information. It is in line with higher level of metacognitive regulation described by Afflerbach and Cho (2010) in which readers critically evaluate the quality of epistemic text. However, low mean score in item 12 and 15 showed that students lack consistency in verifying authorship or reflecting their evaluative strategy. This finding echoes Cho (2015) and Romly, et.al. (2017) findings that learners showed partial or surface-level evaluation skill.

Compared to planning and monitoring dimensions, participants showed relatively significant practice in setting goals, selecting search strategy and tracking information. However, in reflective evaluation which demands deeper critical reasoning and epistemic awareness, the participants practice remained low. This gap supports framework of online reading comprehension proposed by Leu, et.al., (2019) which develops from the stage of locating and monitoring information to evaluating and synthesizing critically. As stated by Celik, et.al. (2021), evaluative phase represents epistemological dimension of digital literacy where readers negotiate the truth,

ideology and perspective in the complex media environment. Thus, this finding reaffirms that although students were strategic in digital information management, explicit pedagogical emphasis remains required to develop critical digital epistemology, the capacity to evaluate, compare and reflect the online information with reasoned skepticism and analytical depth.

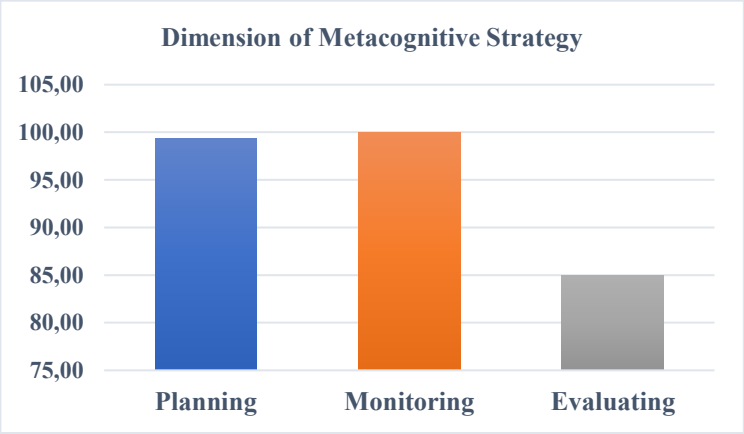

Figure 1. Data Distribution of Dimensions of Metacognitive strategy

The results of this study (as presented in Figure 1) showed that vocational university students demonstrated varied levels of metacognitive engagement in digital literacy practice. Higher level of awareness was reported in the dimension of planning, followed by monitoring, while for evaluation dimension remained the least practiced. This pattern shows students' tendency in preparing their digital task by setting goals and selecting keywords, but their ability to evaluate source credibility, bias and evidence remained lack. This finding is consistent with previous study showing that although students had declarative knowledge of metacognitive strategy, procedural and conditional practice were often underdeveloped (Azevedo, 2005; Panadero, 2017).

In *planning* dimension, students showed relative high awareness in selecting goals and formulating keywords, which confirms that many learners understood initial cognitive process in online search. It is in line with Afflerbach and Cho (2010), who revealed that digital readers frequently started their digital search with clear goals and topic boundaries, however they were lack in deeply anticipating search issues and challenges. Relative low score in allocating time and anticipating the challenges show their limited proactive control. It is in line with Cho's study (2015) which uncovered that majority of the students reactively plan their digital reading practice, adjusting only when they encounter the problems rather than anticipating them beforehand.

Monitoring dimension showed moderate awareness, especially in checking the relevance and adjusting the search term, which implies that students can involve in iterative information refinement. However, their lower responses in maintaining their foci and verifying the credibility of website confirmed the existence of persistent

cognitive challenges. Leu, et.al. (2019) reported that digital environment presents distraction which demands higher level of self-regulation. Similarly, Coiro and Dobler (2011) emphasized that monitoring in hyperlinked reading required executive control to maintain students' focus amid multiple stimuli, a skill that novice online reader often struggle to maintain.

The weakest performance appeared in evaluation dimension where students' practice in verifying authorship, identifying bias, and evaluating the evidence quality, was limited. It reflects global finding that students' evaluative reasoning in the digital environment tended to be superficial (Wineburg & McGrew, 2017). Even when students claimed their awareness of the credibility criteria, they often relied on surface cues such as website design or its popularity, rather than epistemic indicators. In Indonesian context, Deliany and Cahyono (2020) also reported that although students acknowledged evaluation as an important stage, they rarely practiced their critical verification habit. This suggests that evaluation is a threshold competence, the most cognitively demanding component of metacognitive regulation (Winne & Hadwin, 1998).

Overall, these findings spotlight the presence of continuum metacognitive maturity. Students in this study appeared to operate effectively in the procedural planning and monitoring level but showed underdeveloped epistemic evaluation. As proposed by Azevedo, et.al. (2010), metacognitive regulation develops and evolves gradually through gradually guided reflection and feedback. Therefore, explicit pedagogical scaffolding is fundamental for students to internalize evaluative reasoning as a part of digital reading habit. Considering the massive use of AI tools, the need of conscious regulation becomes more important because uncritical reliance on generative system can decrease evaluative vigilance (Kasneci et al., 2023).

Conclusion

This study concludes that while participants showed metacognitive strategy awareness in digital literacy, the practice remains uneven across stages and domains of metacognition across dimensions: planning, monitoring and evaluation. In planning strategy, students show declarative awareness by setting goals, selecting keywords and choosing the best platform that suits their purpose, but their strategy remained surface-level because they struggled with time management and anticipating challenges. In monitoring dimensions, students checked the relevance, adjusted search terms and compared information but they lacked foci maintenance and critical evaluation of website credibility, the area which needs affective and epistemic regulation. In evaluation dimensional, although students recognized the fundamental of reliability, bias awareness and evidence-based evaluation, the score showed the least practiced among all items in al metacognition strategies, especially in verifying credential authorship and reflecting their strategy. It shows surface-level of critical metacognitive and epistemic engagement. Collectively, this finding shows that students know what strategy they should use but

often lack how and when to use it effectively. Therefore, further study to investigate actual practice of metacognitive strategy in authentic digital reading, such as think-aloud or trace data, to verify whether the reported-engagement and awareness correspond to real practice. This study will provide broaden insights into how learners manage and control their metacognitive strategy in complex digital environment and guide the development of targeted digital instructional.

Recommendations

To enhance students' metacognitive practice in digital literacy, students and institutions should systemically integrate explicit metacognitive strategy instruction in classroom practice. Teachers need to strengthen students' awareness and control in learning process through guided activities which involve planning, monitoring and evaluation. For example, thinking aloud modelling and reflective questions can help students recognize how strategies were implemented in digital reading (Coiro & Dobler, 2011; Panadero, 2017). Besides, authentic inquiry tasks should be designed to require learners to compare, verify, and reflect digital resources to strengthen evaluative reasoning and critical evaluation (Kiili, et.al. 2019). Professional development programs for teachers should also focus on their capacity building to diagnose students' metacognitive need and implement teaching strategy that fosters self-regulated learning. By implementing these practices in digital literacy instruction, schools can foster students' competences to plan their digital reading purposefully, monitor their reading comprehension actively, and evaluate information critically. It will create autonomous and reflective digital learners for more complex information environments.

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