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A Metacognitive Information Literacy Model for Enhancing Critical Thinking in EFL Learners: A Quasi-Experimental Study[1]

โมเดลการรู้สารสนเทศเชิงอภิปัญญาเพื่อส่งเสริมทักษะการคิดอย่างมีวิจารณญาณของนักศึกษาไทยที่เรียนวิชาภาษาอังกฤษเป็นภาษาต่างประเทศโดยใช้การวิจัยกึ่งทดลอง

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Chanida Phongnapharuk [2]
ชนิดา พงศ์นภารักษ์

Piansin Pinchai [3]
เพียรศิลป์ ปินชัย

Abstract

The objective of this study was to evaluate the effectiveness of a Metacognitive Information Literacy (MIL) model for enhancing learners' critical thinking skills. Furthermore, the study assessed learners' satisfaction with the model as it was incorporated into the learning experience. To this end, a one-group pretest–posttest design using purposive sampling was employed. Data was collected from 83 English-major undergraduates enrolled in the Digital Media Literacy course. Critical thinking assessments were conducted before and after the implementation of the MIL model. The test scores were calculated for mean, standard deviation, and p-value. Additionally, the satisfaction survey collected feedback about teaching instruction, student engagement, and collaborative activities through the ratings on a five-point scale. The findings indicate that the MIL model significantly enhances critical thinking as evidenced by the comparison of pre-test (M = 40.41, SD = 10.9) and the post-test (M = 52.77, SD = 8.73) scores statistically significant (p<.00). The survey results also reveal high levels of satisfaction with the model's strategies for fostering a cooperative learning environment (M = 4.25), promoting metacognition (M = 4.41), and developing critical thinking abilities (M = 4.33). The result of this study suggests that the MIL model can be valuable, particularly

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[2-3]***Affiliation:*** Research Unit in Linguistics, Literature and Language Education for Sustainability (LLLES), School of Liberal Arts, Mae Fah Luang University, Thailand

หน่วยงาน: หน่วยวิจัยภาษาศาสตร์ วรรณกรรม และการศึกษาด้านภาษา เพื่อความยั่งยืน สำนักวิชาศิลปศาสตร์ มหาวิทยาลัยแม่ฟ้าหลวง ประเทศไทย

Corresponding Author: Piansin Pinchai
E-mail: piansin.pin@mfu.ac.th

for supporting learners as they develop their capacity to evaluate online sources, a necessary competency for university education and lifelong learning.

Keywords: information literacy, critical thinking, CRAAP test, metacognitive strategies, formative assessment

บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์เพื่อประเมินประสิทธิผลของโมเดลการรู้สารสนเทศเชิงอภิปัญญา (Metacognitive Information Literacy: MIL) ในการส่งเสริมทักษะการคิดอย่างมีวิจารณญาณของผู้เรียน รวมถึงประเมินความพึงพอใจของผู้เรียนที่มีต่อการใช้โมเดลดังกล่าวเมื่อถูกนำไปประยุกต์ใช้ในการจัดการเรียนรู้ งานวิจัยนี้ใช้รูปแบบการทดลองแบบกลุ่มเดียววัดผลก่อนและหลัง (One-Group Pretest–Posttest Design) โดยใช้การสุ่มตัวอย่างแบบเจาะจง (Purposive Sampling) กลุ่มเป้าหมายคือนักศึกษาระดับปริญญาตรีสาขาภาษาอังกฤษจำนวน 83 คน ที่ลงทะเบียนเรียนในรายวิชาความรู้เท่าทันสื่อดิจิทัล การวิจัยนี้มีการวัดผลทักษะการคิดอย่างมีวิจารณญาณก่อนและหลังการใช้โมเดล MIL โดยวิเคราะห์ค่าคะแนนเฉลี่ย ค่าเบี่ยงเบนมาตรฐาน และค่าระดับนัยสำคัญทางสถิติ (p-value) นอกจากนี้ยังมีการสำรวจความพึงพอใจของผู้เรียนที่มีต่อการจัดการเรียนการสอน การมีส่วนร่วมของผู้เรียน และกิจกรรมการเรียนรู้แบบร่วมมือโดยใช้มาตรวัดห้าระดับ ผลการวิเคราะห์ทักษะการคิดอย่างมีวิจารณญาณก่อนและหลังการใช้โมเดล MIL พบว่าคะแนนทดสอบก่อนเรียน (M = 40.41, SD = 10.9) และคะแนนหลังเรียน (M = 52.77, SD = 8.73) มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ (p<.00) แสดงให้เห็นว่าโมเดล MIL สามารถเสริมสร้างทักษะการคิดอย่างมีวิจารณญาณได้อย่างมีประสิทธิผล นอกจากนี้ ผลการประเมินความพึงพอใจแสดงให้เห็นว่าผู้เรียนมีความพึงพอใจในระดับสูงต่อกลยุทธ์ของโมเดลในการส่งเสริมการเรียนรู้แบบร่วมมือ (M = 4.25) การส่งเสริมการรู้คิด (M = 4.41) และการพัฒนาทักษะการคิดอย่างมีวิจารณญาณ (M = 4.33) ผลการวิจัยนี้ชี้ให้เห็นว่าโมเดลนี้สามารถส่งเสริมให้ผู้เรียนพัฒนาทักษะการประเมินแหล่งข้อมูลออนไลน์ได้อย่างมีประสิทธิภาพ ซึ่งเป็นทักษะสำคัญในการศึกษาระดับมหาวิทยาลัยและการเรียนรู้ตลอดชีวิต

คำสำคัญ: การรู้สารสนเทศ การคิดอย่างมีวิจารณญาณ การวิเคราะห์แหล่งข้อมูลตามหลัก CRAAP กลวิธีการคิดเชิงอภิปัญญา การประเมินระหว่างการเรียน

Introduction

Technological advancements have changed the way we teach English as a Foreign Language (EFL), with classrooms now filled with digital natives who do not know life without digital technologies. The latest disruptive innovations present a double-edged sword for learners; they provide extensive information resources and an overabundance of unreliable knowledge from the internet, social media, and big data. Information Literacy (IL) is essential for learners to navigate the complex information landscape and make informed decisions about the resources they find. The Association of College and Research Libraries (2016) emphasizes the importance of IL as information resources expand rapidly. It not only helps learners access information effectively but also demonstrates how to utilize resources judiciously and

transform them into valuable assets for personal, professional, and social development in a dynamic information environment.

Developing IL skills helps EFL learners gain access to global information and transform it into usable knowledge, truly promoting learning freedom. In higher education—particularly in the Thai context, where research-based learning is emphasized—learners must acquire a range of research competencies, such as critically evaluating the credibility and relevance of online resources, synthesizing, and contextualizing information (Fieldhouse & Nicholas, 2008). Examples such as Mahidol University's English for Digital Literacies course (Faculty of Liberal Arts, 2023) and Silpakorn University's Information Literacy course (Faculty of Arts, 2021) reflect the recognition of IL's importance in EFL education across the country. However, Thai EFL learners often face difficulties with reading comprehension and critical analysis, which are essential for evaluating information sources effectively (Apairach, 2023). Additionally, the limited emphasis on critical thinking and analytical skills in most secondary schools means that incoming university students can only achieve a superficial level of reading comprehension, where they rely on simple heuristics rather than deep analysis (Imsa-ard & Tangkiengsirisin, 2023). Furthermore, challenges in digital literacy among Thai EFL teachers may also contribute to gaps in IL instruction, as instructors with low digital literacy struggle to integrate effective online source evaluation strategies into their teaching (Karanjakwut & Sripicharn, 2024).

In 2006, the International Federation of Library Associations and Institutions (IFLA) established IL standards, which included frameworks for accessing, evaluating, and using information. These basic components were later developed into a five-stage IL process: identifying, finding, evaluating, applying, and acknowledging. This represents a constructivist learning procedure for seeking valid information and drawing conclusions (Khatun, 2013; Landøy et al., 2020). Among these stages, evaluation plays a crucial role in developing critical thinking. Learners must assess the reliability, authority, and purpose of information sources. For the purposes of this study, IL practice was incorporated into the Digital Media Literacy course at Mae Fah Luang University (MFU). This course is part of the English-major curriculum for undergraduates. The IL framework serves as a core instructional component that aligns directly with the course's objective for learners to discern reliable information sources appropriate for both academic and professional contexts. In addition, the course specifically emphasizes source evaluation using the CRAAP Test, which assesses Currency, Relevance, Authority, Accuracy, and Purpose of information sources (Muis et al., 2022), in the Evaluating stage of the five-stage IL process.

IL instruction and the CRAAP Test have been integrated into the Digital Media Literacy course for over two years previous to this study. Course evaluations indicate that learners still struggle to clearly demonstrate their critical thinking and information analysis skills. This was evident in their written work and project presentations, where they had difficulty applying CRAAP Test criteria to evaluate the credibility and relevance of information sources effectively. Certain CRAAP Test components, particularly those related to bias and authority, can be highly subjective and might overwhelm learners, resulting in a mechanical application to meet assignment criteria rather than being an engaging, meta-cognitive tool (Lowe et al., 2021). Instructors have recommended developing a clearer understanding of the Evaluation component to engage learners in deeper critical analysis, focusing on authentic sources like

academic websites and scientific studies. Key IL components might be too broad in practice, requiring adaptation or modification to better support critical thinking and information analysis. Research supports this concern, emphasizing that the development of effective IL and critical thinking skills is a complex and dynamic process (Kani et al., 2020).

To respond to this feedback, this study explores the potential of a Metacognitive Information Literacy (MIL) model, which integrates metacognitive strategies and formative assessment into IL instruction. The current IL framework, supplemented with the CRAAP Test, provides structured guidelines for evaluating information, but it often fails to engage learners in deep, reflective thinking.

Liu (2021) claimed that incorporating metacognitive strategies, such as self-monitoring, self-questioning, and reflection, help learners become more conscious of their thought processes and more adaptable, thoughtful consumers and producers of information. Similarly, Denke et al. (2020) found that metacognitive practice and constructivist activities increased recognition of learners' IL skills through active learning and knowledge construction since they allowed learners to demonstrate their IL abilities more clearly as they could recognize the sample actions and strategies that helped them to engage in classroom tasks and to read critically. Their findings also suggest that adjusting teaching strategies and scaffolding learners through constructivist activities can increase metacognitive skills, including critical thinking, which improves their IL. Additionally, the use of reflection evokes insights into how they might achieve learning tasks more effectively. It is important to establish a visible connection between metacognition and IL skills in learners so that they can understand the methodology and outcomes explicitly.

Alongside metacognitive strategies, formative assessment plays a key role in reinforcing continuous learning and critical self-assessment in IL instruction, unlike summative assessments, which do not allow for reflection and improving performance (French et al., 2024). Learning processes with strategically timed formative assessment tasks foster deeper interest and enhance capacity to analyze, evaluate, and synthesize information more efficiently (Stanley & Moore, 2010). This process-oriented approach shifts IL instruction from a checklist-based application to a deeper, iterative learning experience. Also, formative assessment supports a more interactive and dynamic approach to IL development, helping learners improve their analytical, interpretative, and evaluative skills.

Therefore, this study aims to promote learners' critical thinking skills and learning experience through an adapted version of the MIL model intervention, which combines the five key strategies of Formative Assessment (FA) (Leahy et al., 2005) with the five-stage IL process (Landøy et al., 2020). The CRAAP Test is also used for evaluating the quality of information sources. The findings will provide insights into the efficacy of the adapted MIL model as a pedagogical procedure that fosters critical thinking through metacognitive engagement.

Research Questions

To explore whether the MIL model with critical perspectives could offer alternatives to learners, we devised the following two research questions:

1. To what extent does the MIL model enhance English-major learners' analytical, interpretative, and evaluative skills as facets of critical thinking?

2. What is the level of learner satisfaction on the teaching instruction, engagement, and collaborative activities toward the IL model intervention?

Literature Review

1. Information Literacy (IL)

Julien and Genuis (2011) view Information Literacy (IL) as crucial for academic success. Individuals with IL skills are those who not only obtain technology skills, but can also analyze, evaluate, and apply IL knowledge to decide and think critically, which are essential in the 21st century. The Association of College and Research Libraries (2016) has outlined five standards of IL in higher education, including identifying the extent of needed information; finding needed information effectively and efficiently; evaluating selected information and its sources critically; applying collected information to create and communicate ideas effectively; and acknowledging information sources ethically with proper referencing information per copyright guidelines. Therefore, IL skills are vital for university-level learners because many assignments, such as term papers and presentations, all involve these critical processes of research-based learning.

2. Information Literacy: CRAAP Test

Developed by Sarah Blakeslee (2010, as cited in Tardiff, 2022) at California State University, the CRAAP Test has become a widely adopted tool for evaluating information sources due to its simplicity, adaptability, and effectiveness. The CRAAP Test consists of five criteria as follows (Blakeslee, 2010): Currency indicates the timeliness of the information, such as publication dates. Relevance involves the suitability of the information and alignment with intended purposes and needs. Authority refers to the credibility of the information source, such as authors' qualifications and expertise. Accuracy focuses on the reliability and correctness of the information, and Purpose refers to an intention behind the creation of the information. Overall, this convenient packaging of IL concepts makes the CRAAP Test suitable for teaching in diverse contexts and for learning at different levels, enabling learners or researchers to make informed decisions about the quality and suitability of various online information for academic or research purposes (Esparrago-Kalidas, 2021; Ruleman et al., 2017).

3. Critical Thinking Strategies in IL Classroom Practice

Typically, a class that integrates IL offers learners exercises in critical thinking and processing skills because learners have to go through several stages of IL to find suitable information sources, especially at the Evaluating stage. This IL stage requires analysis, problem-solving, or critical thinking processes to evaluate and choose information sources intelligently. However, in an EFL classroom, learners might not be able to go through these higher-order thinking skills due to difficulties with language comprehension. Metacognitive interventions for language comprehension, such as for text comprehension or for reading skills, are not well understood and need to be addressed in IL classroom practice (Blummer & Kenton, 2014).

3.1 Effective Metacognitive Instruction: Shifting IL Class Management From Product-Oriented to Process-Oriented

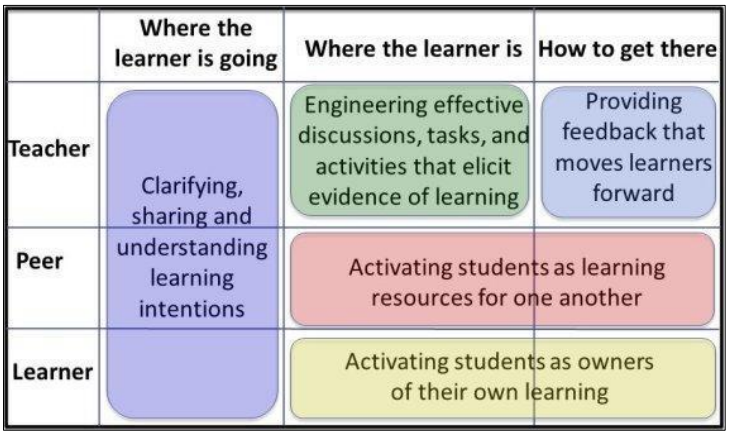
To foster metacognitive skills in the IL classroom, shifting from a product-oriented approach to a process-oriented approach is essential (AASL, 1998). According to Flavell (1979), learners must be aware of their own cognitive processes when processing information and actively reflect on whether the information is credible, and aligns with their goals. For EFL learners who face language and cultural barriers, this approach might need adaptation with more support, engagement, and interaction to achieve IL development, particularly in the source evaluation stage. Similar to Vygotsky's (1978) Constructivist Learning Theory, learning can be enhanced through guidance from peers and the instructor's scaffolding to internalize metacognitive processes. Additionally, managing a process-oriented classroom through formative assessments could be more effective in the EFL context, allowing learners to demonstrate their understanding throughout the learning process (Lam, 2015). Halpern's (2008) study on applying metacognitive strategies in elementary education found that integrating collaborative activities and problem-solving tasks enhanced students' abilities to think critically and apply metacognitive thinking strategies in real-life situations. By adapting assessment strategies to the specific needs of EFL learners, instructors can create more effective and supportive learning environments for developing IL skills.

Leahy et al. (2005) proposed five key strategies of Formative Assessment (FA) for an effective implementation that can significantly improve learning outcomes and develop metacognitive skills through learner-focused assessment. In this study, the lesson plan applies the CRAAP Test, emphasizing reading comprehension and analyzing the author's writing, with a focus on critical reading strategies that help learners understand the information they read and to consider what the author intended to communicate. The FA strategies, serving as significant guidelines for supporting this learning objective, start with clarifying and understanding learning intentions and criteria for success where instructors ensure all students understand learning intentions and success criteria (William, 2013). Furthermore, the strategy of engineering effective classroom discussions and tasks that elicit evidence of learning helps instructors design classroom activities to engage individual learners, rather than just collect right or wrong answers. Then, providing feedback that moves learning forward is when instructors give constructive feedback that is action-oriented and outlines a series of scaffolded steps to support the learner to improve their thinking. Additionally, activating learners as learning resources for one another through peer activities adds valuable feedback rather than from an authority, supporting a collaborative learning environment. Lastly, in activating learners as owners of their own learning, learners practice self-regulation with a range of metacognitive strategies, enabling them to regularly plan, monitor, and evaluate their own learning (William & Leahy, 2015).

The FA strategies unite formative assessment processes with the role of three key agents: teacher, peers, and learners as seen in Figure 1. By implementing these strategies, it is believed that educators can foster a culture of critical thinking and metacognitive practice in the classroom. Each strategy is essential in promoting educators' ability to assess learners during learning, which helps them set learning goals. It also empowers learners as owners of their own learning.

Figure 1

Five Key Strategies of Formative Assessment (Leahy et al., 2005)



Therefore, placing greater emphasis on learner interaction with both the instructor and classmates (especially in Step 3) strengthens learners' understanding of the task during the IL evaluation process. Greater interactivity gives learners a chance to exchange ideas and engage in critical thinking skills while working on tasks. Table 1 shows the comparison between a regular IL classroom practice, which is frequently product-oriented, and metacognitive integration, which is more process-oriented. It outlines the steps involved in both approaches and contrasts their strategies.

Table 1

Metacognitive Integration for Shifting to the Process-Oriented Class Management

	Former IL classroom practice	Current IL classroom practice
Step 1: Identify your topic	Brainstorm and a group discussion	Clarify learning goals and discuss assessment criteria
Step 2: Find the information	Practice keyword strategies individually	Foster effective classroom discussion on how to access information
Step 3: Evaluate the sources	Practice on source evaluation for writing an expository essay on Factors that Affect Gender Identity using the **CRAAP** question list individually	- Foster effective classroom discussion on how to evaluate sources - Empower learners to take ownership of their learning - Activate learners as instructional resources of different arguments and perspectives
Step 4: Apply the information	Practice creating verbal citations individually	Provide further feedback to advanced learners

	Former IL classroom practice	Current IL classroom practice
Step 5: Acknowledge the originality	Practice on source citations for a written report individually	Provide further feedback to advanced learners

3.2 Metacognitive Intervention: Integrating Critical Reading Strategies Into IL Classroom Practice

When shifting from a product to a process-oriented classroom, there should be directed reading strategies deployed when evaluating sources with the instructor's feedback and a strategic prompt to help learners perform group discussions. In terms of critical reading strategies, instructors normally employ pre-while-post-reading stages in the regular reading classroom. However, when critical thinking is considered, especially when evaluating information sources in an IL classroom, five critical reading steps should be considered (Yu, 2015):

1) **Pre-reading:** A quick scan to find relevant details that support understanding and a brief skim on overall content, organization, and the text's purpose.
2) **Reading in context:** Learners engage with the text as if conversing with the author to grasp the fundamental meaning and underlying ideas.
3) **Further the understanding by asking questions and answering them:** Questioning employed in reading instruction helps learners comprehend and respond to the text more thoroughly.
4) **Further thinking and reflections after reading:** An additional time to deliberate and restructure the concepts helps learners develop further understanding of the text after reading.
5) **Outlining and summarizing:** Differentiating main ideas, supporting details, and examples helps learners to understand the text's structure.

When evaluating sources, questioning the author's purpose and critiquing the structure of the text are crucial. This exercise enhances text comprehension and allows learners to determine the text's main idea and relevance to their purpose in the class. Utilizing the cognitive domain of Bloom's Taxonomy, particularly the three higher-order skills of analyzing, evaluating, and creating, is beneficial for developing questions aimed at teaching critical reading in EFL classes and helps instructors plan objectives and design assessment items (Anderson et al., 2001). Similarly, Paul and Elder (2006) presented eight Elements of Reasoning: Purpose, Point of View, Assumptions, Implications, Information, Inferences, Concepts, and Questions, that enhance understanding and critical thinking skills. These elements illustrate how learners critically evaluate the quality of information, investigate questions, and develop personal viewpoints. Synthesizing these two frameworks provides a sophisticated and structured approach for formulating questions that exercise critical thinking skills. Adding this metacognitive practice of guided questions with the CRAAP test helps enhance the depth and breadth of learning experiences. Table 2 presents the alignment of critical reading strategies with Bloom's Taxonomy and the Paul-Elder Critical Thinking Models in IL classroom management.

Table 2

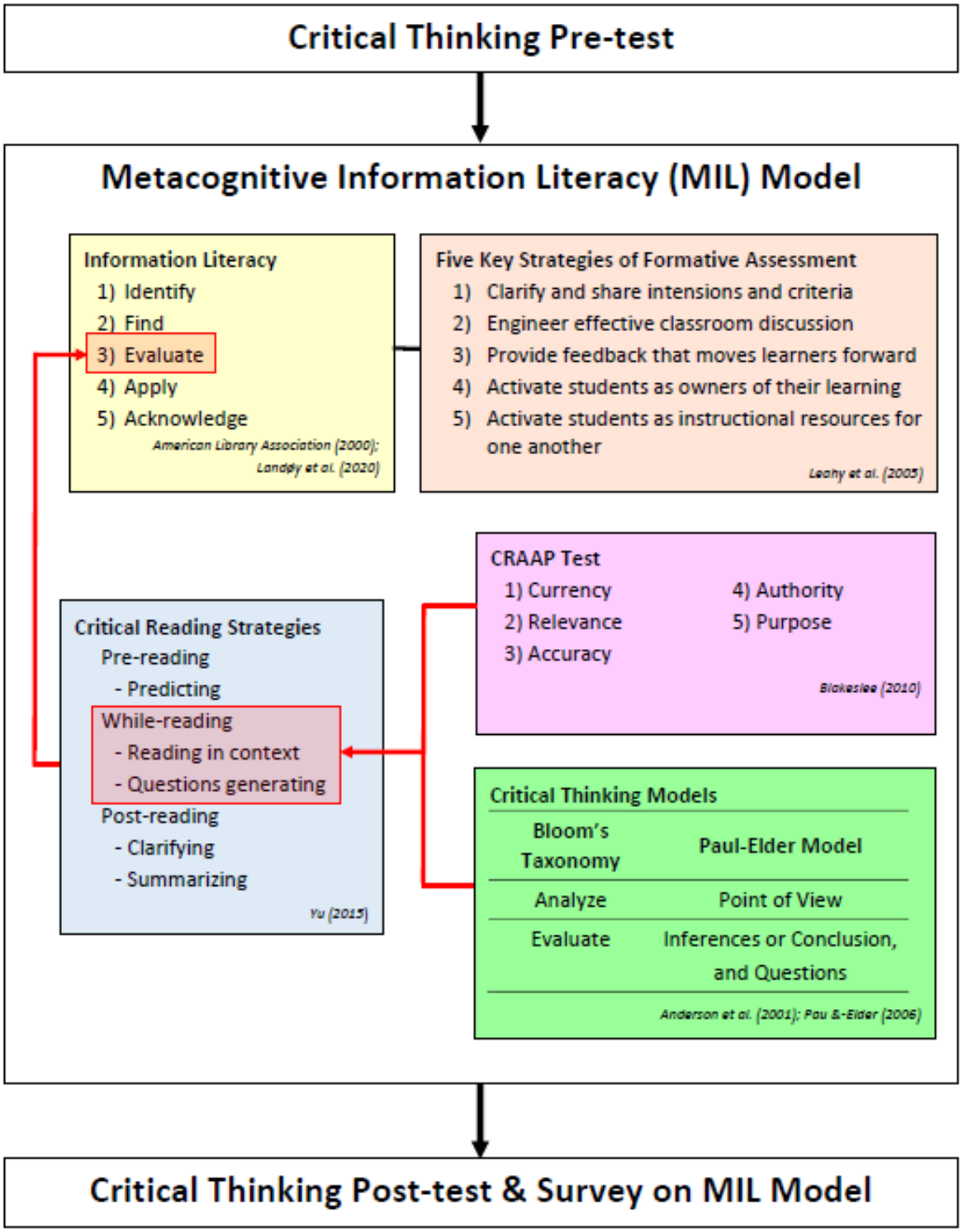
Comparison Between Former IL Classroom Practice and a Metacognitive Intervention

Former IL classroom practice	Metacognitive intervention	
	Critical reading strategies	Bloom's Taxonomy and the Paul-Elder Critical Thinking Models
Step 1: Identify your topic.		
Step 2: Find the information.		
Step 3: Evaluate the sources. *No specific reading strategies for the CRAAP Test	Pre-reading - Predicting	What patterns of text organization are used?
	While-reading - Reading in context: **CRAAP Test** - Questions generating: Further the understanding by asking questions and answering them	What is the overall main idea of the text? Is the information fact or opinion-based? How do you know? Please give an example from the text.
	Post-reading - Clarifying: Further thinking and reflections after reading - Summarizing: Outlining and summarizing	Is the overall information convincing? Why or why not? Would you choose this text as a source of information? What can be concluded from the information?
Step 4: Apply the information.		
Step 5: Acknowledge the originality.		

The information gathered in the literature reveals a strong correlation between several vital elements. Firstly, a five-stage IL process is critical for learners to detect the information characteristics they require, strategize searching techniques, evaluate information qualities, and leverage such information efficiently. Complementing IL with the CRAAP Test enables learners to investigate quality and appropriateness of online sources for academic purposes. Moreover, critical reading strategies aid insightful understanding and perceiving authors' intentions through pre-reading, contextual comprehension, questioning, reflection, and summarization. Additionally, the FA strategies foster an environment conducive to learning. These strategies, which include setting learning objectives, facilitating discussions, offering feedback, promoting peer collaboration, and empowering student autonomy, have all been shown to enhance critical thinking skills significantly. Therefore, integrating the ideas of metacognitive approaches and critical reading processes into the IL process, as seen in Figure 2, nurtures independent thinking, problem-solving abilities, and the capacity to construct knowledge autonomously.

Figure 2

Framework of the Study



Research Methodology

1. Research Design

This study employed a one-group pretest-posttest design as part of a quasi-experimental research approach, as it is appropriate for evaluating ongoing instructional programs or interventions integrated into the regular classroom activities. It enables teachers to assess the effectiveness of new teaching methods without disrupting instruction or needing extra resources for control groups (Johnson, 1986). The research project focused on measuring changes within a single cohort. The study used a pretest to establish a baseline for each participant's knowledge before the intervention in the initial stage. Then the MIL model was implemented, followed by a post-test to analyze score differences at the individual level, rather than assuming uniform improvement across all students. Additionally, a satisfaction survey covered areas related to the FA strategies, such as engagement in classroom discussions and feedback, and was administered to gather data about the model from the participants. Data was collected over a 4-month period, with classes running 3 hours per week. The duration of contact-intervention was 48 hours.

2. Participants

The site of this study was the School of Liberal Arts, Mae Fah Luang University in Thailand. The participants were 83 English-major undergraduates who enrolled in the *Digital Media Literacy* course in the first semester of 2023. Students at this level were capable of reading and writing both Thai and English and generally had basic to intermediate English proficiency, ranging from A2 to B1 according to the Common European Framework of Reference (CEFR). They had over nine years of English language learning experience in Thai educational settings. The participants were selected through purposive sampling as all participants belonged to the same class. Every subject participated in this study voluntarily and anonymously, and they were informed that they could withdraw if they wished.

3. Research Instruments

3.1 MIL Model Development

Before developing the MIL model, the content and learning outcomes of the *Digital Media Literacy* course were reviewed. The model, integrating key components from various frameworks as shown in Figure 2, was developed through a comprehensive review process to equip the participants with enhanced critical thinking abilities. Combining all crucial elements, the MIL model emphasizes reflection and critical thinking in classroom practice. The teaching instructions were then carefully designed to align with each stage of the model, ensuring a seamless integration of the various components and a consistent focus on developing critical thinking skills. Table 3 illustrates the implementation of selected frameworks that pertain to critical thinking skills within the course.

Table 3

MIL Model

Five components of information literacy	Intervention of five FA strategies, critical reading strategies & CRAAP Test in instructions
Class 1 Identify: Task - Recognize the task, information need, purposes of information.	**Clarify and share intentions and criteria.** - Classroom discussion to clarify the learning goal of the assigned task - Work samples circulation to establish success criteria and prompt a discussion about quality
Class 2 Find: Task - Find needed information effectively and efficiently.	**Engineer effective classroom discussion.** - Exit Passes to review and use the responses to shape the next lessons **Activate learners as instructional resources for one another.** - A small group activity to share and propose effective searching techniques
Class 3 Evaluate: Task - Analyze and evaluate information and its sources critically.	**Critical reading skills for information selection.** - Reading comprehension questions to summarize main ideas and evaluate an argument of the assigned reading - CRAAP Test to evaluate academic and non-academic sources **Activate learners as owners of their learning.** - A self-regulated task to further the source evaluation
Class 4 Evaluate: Task - Share information and its sources critically.	**Engineer effective classroom discussion.** - General critical reading questioning to encourage brainstorming and sharing about how to evaluate the assigned information sources **Activate learners as instructional resources for one another**. - A small group discussion to share and give feedback to each other
Class 5 Apply: Task - Integrate information and a direct quotation from sources into an oral presentation.	**Provide feedback that moves learners forward**. - A small group activity to share ideas for the project and receive some detailed comments from the instructor
Class 6 Acknowledge: Task - Cite an information source in the written report.	**Provide feedback that moves learners forward**. - Turnitin program to receive constructive feedback on grammatical usage of their report - Written feedback on content development from the instructor

3.2 Critical Thinking Pretest and Posttest Design

The critical thinking pre-test and post-test were administered to assess changes in participants' critical thinking abilities before and after using the MIL model. The test featured two sets of a reading passage and ten questions that assessed higher levels of critical thinking skills. Some questions were adapted from the CRAAP test, as the participants were set to encounter the question sets through the MIL model. For each question, the participants were asked to respond in English. The test was administered in a print format, and the time taken to complete the test was recorded.

Additionally, the pre and post-test aligned with class activities, namely selecting and using appropriate online sources of information for the group project (infographic). The work process in the classroom required analysis, synthesis, and evaluation of online sources; therefore, the test questions on analysis, interpretation, and evaluation skills closely aligned with the class activities.

Table 4

Connections of Critical Thinking Levels

Bloom's Taxonomy	Paul-Elder Model	Critical thinking pre-posttests	
Analyze	Point of view	**Analysis Asks:**	**Interpretation Asks:**
		Q1. Text organization	Q3. Author's point of view
		Q2. Main idea	Q4. Fact VS opinions
Evaluate	Inferences or conclusion, and questions	**Evaluation Asks:**	**Information Literacy Asks:**
		Q5. Conclusion	Q8. Validation
		Q6. Reference	Q9. Selection
		Q7. Argument	Q10. Judgment

In the test, the critical thinking skills assessed started at the level of Analyze, which was considered the critical thinking stage of Bloom's Taxonomy (Anderson et al., 2001). The first two questions ("Analysis Asks") focused on analyzing the text organization and the overall main idea. Similarly, questions 3 and 4 ("Interpretation Asks") were aimed at assessing learners' abilities to distinguish between facts and opinions, as well as to identify the author's point of view. Next, learners were assessed on their interpretation of inferences, conclusions, and arguments drawn from the passage in questions 5 to 7 ("Evaluation Asks"). Finally, questions 8 to 10 ("Information Literacy Asks") required learners to present and defend opinions by making judgments about information, the validity of ideas, or the quality of work based on the criteria in the questions.

The same test was administered before and after the intervention. To evaluate the content validity and reliability of the test, three experts in English instruction were asked to complete evaluation forms to determine the index of Item-Objective Congruence (IOC). Items with an IOC index greater than 0.50 were considered valid, while those below this standard were modified based on the experts' feedback. The reliability analysis result of the test was 0.96, indicating high reliability. Even though the test could be considered valid overall, some items were modified based on the experts' feedback to ensure accuracy and consistency.

3.3 Participants' Satisfaction Survey

The satisfaction survey consisted of 11 items, all scored on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The survey was administered online through a Google Form with five main sections based on the Five Key Strategies of Formative Assessment (FA).

To evaluate the content validity and reliability of the survey, three experts in English instruction were asked to complete evaluation forms to determine the index of Item-Objective Congruence (IOC). Items with an IOC index greater than 0.50 were considered valid, while those below this standard were modified based on the experts' feedback. The reliability analysis result of the survey was 0.93, indicating high reliability. Even though the survey could be considered valid overall, some items were modified based on the experts' feedback for accuracy and consistency.

4. Data Collection

The data collection process began in the first week of the course with the administration of the pre-test for about two hours to measure the participants' critical thinking abilities. Then, the MIL model interventions were implemented across two distinct course periods. The first intervention was before a formative assessment to familiarize participants with key components of the model's structure and instructions, providing the groundwork for developing critical thinking skills. Meanwhile, the second intervention before a summative assessment was intended to reinforce the learning process and solidify the model's application. Revisiting the strategies and activities at this stage was done to strengthen the participants' ability to engage with the course content critically. The specific intervention procedures, including the teaching instructions and activities used to enhance critical thinking skills, are presented in Table 5.

Table 5

The Interventions of the MIL Model

Weeks 2 – 7 1st intervention	Week 2 - **Identify**: Classroom discussion on understanding university's assignments and choose a topic with suitable types of information for the 20% Individual Assignment
	Week 3 – **Find:** Exit Passes to review effective use of keyword techniques and university's library resources to locate needed information for the 20% Individual Assignment
	Week 4 - **Evaluate:** Answering critical reading questions and CRAAP Test to discern false, biased information and analyze information sources for the 20% Individual Assignment
	Week 5 - **Evaluate:** Sharing individual analysis based on the self-regulated task in a 30-minute group discussion on analyzing information sources and evaluating the arguments of others
	Week 6 - **Apply:** Sharing progress of the 20% Individual Assignment and gain feedback on in-text citations in oral presentation from the instructor

Weeks 2 – 7 1st intervention	Week 7 - Acknowledge: Integrating *Turnitin* program to gain feedback on grammatical usage of the 20% Individual Assignment report and gain feedback on content development from the instructor
Week 10 – 15 2nd intervention	Week 10 - **Identify:** Classroom discussion on understanding the 50% Final Project and choose a topic with suitable types of information
	Week 11 - **Find:** Sharing and proposing effective searching techniques in a small group discussion for the 50% Final Project
	Week 12 - **Evaluate:** A self-regulated task to further the source evaluation through critical reading questions and CRAAP Test to discern false, biased information and analyze information sources for the 50% Final Project
	Week 13 - **Evaluate:** Sharing individual analysis based on the self-regulated task in a 30-minute group discussion on analyzing information sources and evaluating the arguments of others
	Week 14 - **Apply:** Sharing progress of the 50% Final Project and gain feedback on in-text citations in oral presentation from the instructor
	Week 15 - **Acknowledge:** Integrating *Turnitin* program to gain feedback on grammatical usage of the 50% Final Project presentation and gain feedback on content development from the instructor

On the sixteenth week, the participants took the critical thinking post-test with the same time allocation, and an additional 30 minutes for the satisfaction survey. Later, the researchers compared the pre- and post-test scores to determine the effectiveness of the MIL model intervention in developing the participants' critical thinking skills.

5. Data Analysis

In the data analysis and interpretation phase, the researchers utilized two primary data sources: the critical thinking pre- and post-tests and the satisfaction survey. These test scores were analyzed using the SPSS program, which calculated the mean, standard deviation, and probability value (p-value) to determine the statistical significance of any observed improvements. Moreover, for better result interpretation, the effect size analysis (Cohen's d) was used to demonstrate the strength of improvements. To analyze the data from the satisfaction survey, the researchers employed arithmetic means to interpret the ratings on a 5-point scale to gauge the participants' overall level of satisfaction with the model and its implementation. With the quantitative data from the pre- and post-tests and the satisfaction survey, the researchers were able to develop a well-rounded understanding of the model's impact on critical thinking skills and the participants' perceptions of its effectiveness.

Findings

1. RQ1: To What Extent Does the MIL Model Enhance English-Major Learners' Analytical, Interpretative, and Evaluative Skills as Facets of Critical Thinking?

This section includes quantitative analysis of pre- and post-test scores, showing a statistically significant increase in critical thinking skills. Table 6 below shows the effectiveness of the MIL model in enhancing students' critical thinking.

Table 6

Pre-Posttest on Learners' Critical Thinking Skills

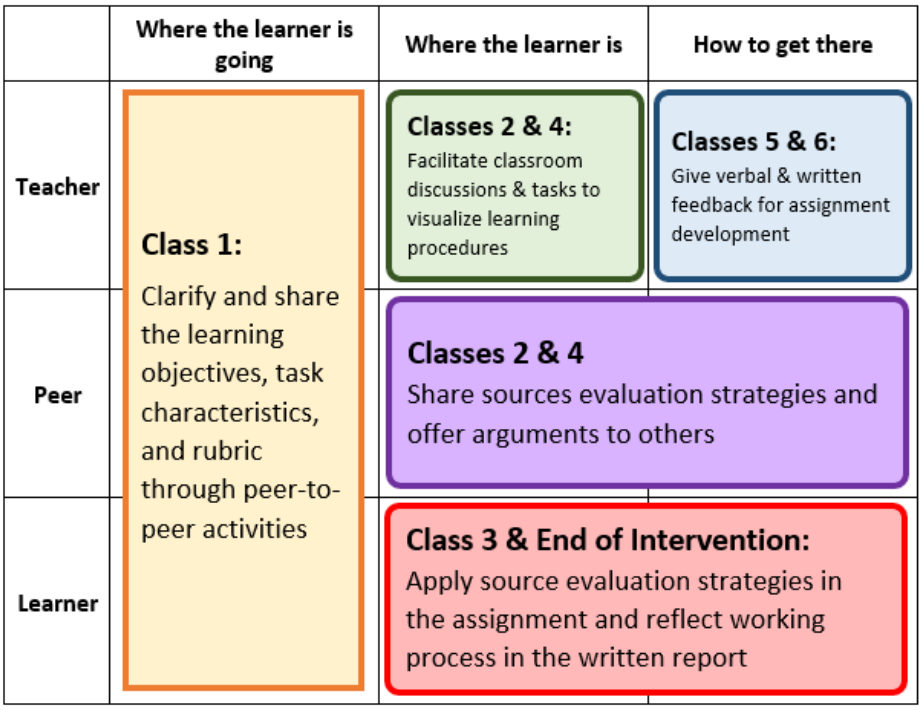
Group	Participants (n=83)	*p*	*Cohen's d*
	M (SD)		
Pre-test	40.41 (10.9)	.00*	0.88
Post-test	52.77 (8.73)		

When comparing the pre-test (M = 40.41, SD = 10.9) and the post-test (M = 52.77, SD = 8.73) scores, the difference in critical thinking skills was statistically significant ($t(82) = 12.42$, $p<.00$. This revealed that the MIL model intervention enhanced the participants' critical thinking skills. While the standard deviation (SD) in the post-test was slightly lower than in the pre-test, the first observation was that the model had a more uniform impact on students. This suggests that regardless of the similarity or varying levels of initial ability in critical thinking of the students, the model reduced the disparities in critical thinking skills that were present before the intervention to a similar degree after the intervention. Moreover, the model increased students' confidence and engagement, particularly those who initially struggled, which resulted in a more equal distribution of performance by the end of the intervention. In addition, the effect size (Cohen's $d \approx 0.88$) indicated a statistically and practically significant difference between the pre and posttest based on Cohen's d interpretation (a value of $d>0.8$ indicates a large effect). It was evident that the MIL model intervention had a large effect on enhancing students' critical thinking skills.

The results suggest that the MIL model is a valuable tool for educators seeking to enhance EFL learners' critical thinking skills by refining the five key components of information literacy. These enhanced features include the critical reading strategies and the CRAAP test in the evaluation stage, as well as the five key strategies of Formative Assessment (FA) embedded in all five stages of the IL components. These enhancements facilitate learners' discussions, interactions, and collaborations with classmates and instructors, which is essential for cognitive achievement as shown in Figure 3.

Figure 3

The Enhancement of MIL Model



At the beginning of the course, learners were informed of the objectives and assessment criteria to ensure they understood their progress and areas for improvement. After learners have gone through all five stages, they can then identify, find, and evaluate the information, and make intelligent decisions about the sources of information that they intend to use for a particular topic. This demonstrates that learners develop critical thinking skills through the MIL model, reflecting a shift from summative to formative assessment.

2. RQ2: What Is the Level of Learner Satisfaction on the Teaching Instruction, Engagement, and Collaborative Activities Toward the IL Model Intervention?

The section addressing RQ2 provides findings on student satisfaction with the model, using results from a structured satisfaction survey.

Table 7

Survey on Learners' Satisfaction With the MIL Model

Items	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	M*	SD
1. Clarifying and sharing intentions and criteria							
1.1 You felt that the objectives of the course were clearly communicated to you.	0	0	9	27	47	4.07	0.56

Items	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	M*	SD
1.2 You understood what was expected of you in terms of learning outcomes and assessment criteria.	0	0	11	17	55	4.13	0.58
2. Engineering effective classroom discussions							
2.1 Your participations in discussions were valuable.	0	0	2	24	57	4.25	0.50
2.2 You felt encouraged to share your ideas and opinions during discussions.	0	0	0	14	69	4.41	0.50
2.3 You found these discussions engaging and relevant to the subject matter.	0	0	2	17	64	4.33	0.53
3. Providing feedback that moves learners forward							
3.1 You received timely and constructive feedback on your assignments and assessments.	0	0	4	19	60	4.26	0.54
3.2 The feedback helped you understand your strengths and areas for improvement.	0	0	3	20	60	4.27	0.52
4. Activating learners as instructional resources for one another							
4.1 You were allowed to collaborate with your peers for group projects or study sessions.	0	0	0	16	67	4.38	0.49
4.2 You found these collaborative experiences beneficial in enhancing your	0	0	7	25	51	4.13	0.66

Items	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	M*	SD
understanding of the subject matter.							
5. Activating learners as owners of their learning							
5.1 You felt that you had autonomy over your learning process.	0	0	6	24	53	4.16	0.64
5.2 When doing assignments, you were able to set personal learning goals and engage in activities that matched your interests and learning style.	0	0	7	24	52	4.14	0.64

**Cronbach's alpha for internal consistency of the survey items is approximately 0.92.*

Table 7 presents the survey results of 83 participants who rated their level of satisfaction with the MIL model. Most participants strongly agree that the model effectively achieves several functions. These include clarifying the intentions and objective criteria, provoking effective classroom discussions, providing feedback that moves learners forward, activating students as instructional resources for one another, and empowering students as owners of their learning. Regarding the items related to classroom discussion, most participants agree that the model effectively engineered practical classroom discussions, and their participation in discussions is valuable (M = 4.25). They feel encouraged to share their ideas and opinions during discussions (M = 4.41), and they find them to be engaging and relevant to the subject matter (M = 4.33). Additionally, the high mean scores for each item suggest strong satisfaction with the MIL model, and the 0.92 Cronbach's alpha value indicates that the survey items consistently measure the students' perceptions of the MIL model's effectiveness. This shows the internal consistency of the survey items.

Discussion

The integration of metacognitive strategies, formative assessment, and the CRAAP test strengthens key components of information literacy, and thereby fosters critical thinking development in four key ways.

First and foremost, learners could detect the characteristics of information needed for the task, and they developed an ability to search, evaluate, and leverage such information efficiently. It fosters learners' skills in identifying, finding, evaluating, applying, and acknowledging relevant information. This is considered a baseline for the analytical skills necessary for critical reading

and metacognitive strategies, thus serving as an essential skill for EFL learners learning in the modern era (Blummer & Kenton, 2014).

Secondly, learners demonstrated insight and understanding of the quality and appropriateness of online sources for academic purposes (Kani et al., 2020). The addition or modification of strategies within the IL framework of the CRAAP test, according to learners' circumstances and context, such as the added criterion for metacognition by Tardiff (2022) in a new set of CRAAP criteria, helped learners think critically and enhanced their metacognition, resulting in improved information literacy awareness.

Thirdly, learners achieved a depth of understanding of the selected information and could interpret the genuine intentions of the writers. This was shown through techniques like outlining and summarizing the main idea, analyzing the author's point of view, evaluating the author's facts and opinions in an argument, and drawing conclusions from the reading texts. These skills are a frequent crutch for EFL learners, and this model demonstrates some promising results for facilitating the improvement of learners' critical thinking.

Fourthly, shifting from a summative to a formative assessment approach fosters a cooperative learning environment conducive to constructing knowledge. These strategies, which encompass emphasizing learning objectives, facilitating classroom discussions, offering peer feedback, promoting group work collaboration, and empowering individual student autonomy (Leahy et al., 2005) are all valued by students, as shown in the satisfaction survey. The model effectively facilitated classroom discussions throughout the IL process, as it embedded group, peer, and teacher discussion activities that allowed learners to take on various roles and work on their individual tasks. Learners appreciated timely and constructive feedback and found it helpful for understanding their strengths and areas for improvement. They acknowledged their role in peer collaboration and group projects in enhancing understanding and critical thinking. They also felt a sense of autonomy over their learning process and could set personal learning goals. This is important as learners are expressing a desire to construct knowledge and understanding independently, and to engage in discussion with the teacher and peers. In other words, students do not want instructions to follow but actually appreciate the critical thinking process.

In summary, the MIL model demonstrates an innovative approach to teaching critical thinking by integrating the CRAAP test, metacognitive practices, and critical reading processes into a structured, process-oriented IL framework. This approach leads to statistically significant and pedagogically meaningful outcomes that have not been systematically implemented in EFL education before, particularly in the Thai higher education context. It signals new directions for adapting IL instruction to help students better evaluate digital sources and construct knowledge autonomously, preparing EFL learners for success in critical thinking.

Conclusion and Implications

In conclusion, the MIL model significantly improves EFL learners' critical thinking skills. This model provides educators and instructional designers with a critical thinking skills development framework by integrating metacognitive practice, critical reading strategies, and the CRAAP test.

1. Practical Implications for Educators and Instructional Designers

For educators, this study offers a combination of a learning tool set from the IL model, the CRAAP Test, and the Five Key Strategies of Formative Assessment (FA) for Higher Education EFL learners. The study highlights the importance of learners' involvement in their learning and responsibility for their learning process, as well as the scaffolding from peers and teachers in the classroom through a tool set that develops their metacognition. The process underneath the IL model strengthens students' metacognition while interacting with the teacher and peers, for it synthesizes various strategies for critically evaluating information. Moreover, the study has also shown that summative assessment tasks alone are inadequate for metacognitive development. Educators and instructional designers should apply group activities, instructions, scenarios, or individual assignments such as the ones integrated into this study for developing EFL learners' cognitive and metacognitive skills. Students obtain skills in evaluating online sources and materials for their classroom assignments, and it sets them up to be lifelong learners.

Additionally, educators and instructional designers may find the pre- and post-test and metacognitive information literacy satisfaction survey beneficial in evaluating learners' critical thinking skills development and satisfaction with the formative assessment process, although it will need adaptation to fit the unique needs of their students and context.

2. Limitations and Areas for Future Research

While this study contributes to improving critical thinking skills in the EFL context, its first limitation is the research design. This study was implemented with one group of learners using a one-group pre-and post-test purposive sampling research design. Therefore, future research could compare the MIL model with the regular IL components or other models using a true experimental research design. This would ensure that the teaching practices are constantly evolving to be process-oriented, constructivist, and encouraging of collaborative learning.

Moreover, our context was limited to the IL course for higher education; therefore, future research could explore or implement the model in other courses, such as a research and seminar course for either undergraduate or graduate students, or some other non-degree course, evaluating the critical thinking skills for learners of different levels and disciplines. Addressing these aspects will help to refine and broaden the pedagogical role of the MIL model in education.

Additionally, the MIL model has certain limitations regarding its scope and technology integration that require further attention. While it aims to enhance critical thinking and digital literacy, it may not fully accommodate the fast-evolving digital environment. Adapting newly emerging digital trends might better the model's relevance and effectiveness. Moreover, a lack of flexibility in accommodating diverse cultural and local contexts should be considered. Therefore, the model might require adjustment to reflect cultural variance in information processing and media consumption for its wider applicability.

Another limitation of this study is that it solely rests on quantitative research methods. While quantitative data provides certain important statistical information, this kind of data, at times, is missed with respect to subtle perspectives and subjective experiences of participants. It would be more holistic to integrate qualitative approaches, such as in-depth interviews or focus groups, into this subject matter. This would not only deepen the findings but also enrich the investigation of participants' underlying motivations, attitudes, and the contextual factors that shape their responses. Qualitative dimensions may be incorporated in future studies as one way to enhance validity and applicability by offering a more holistic view of the investigated topic.

Lastly, this study did not collect direct data on the effectiveness of the intervention in terms of the reinforcement gap or self-regulated learning nor did it include any open-ended feedback. Future study could investigate student participation trends, academic performance, and responses to open-ended questions. More qualitative study could uncover external factors that may have influenced the results.

Acknowledgement

The authors would like to declare that we used two AI tools, Perplexity and Grammarly, solely for proofreading and language editing purposes. Specifically, Grammarly was used to address grammatical issues, while Perplexity assisted with word choices to enhance readability. Additionally, we would like to emphasize that all content in our paper is entirely our original work. No AI tools, software, or services were used to create the content. Data derived from previous studies has been acknowledged in the text, and all references used are cited appropriately.

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