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Empowering High-School Students in the Digital Era: Integrating Constructivist and Metacognitive Approaches to Learning

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Abstract

The study developed and evaluated a constructivist and metacognitive learning management model (CMLMM) to enhance Thai students' digital-era cognitive skills. Through document analysis and expert review, a four-stage model was created. Subsequently, the model was reviewed by a group of nine experts. The study found that the constructivist and metacognitive learning management model (CMLMM) to promote students' digital era cognitive skills consisted of four stages. These included the (1) Introduction and Reflection, (2) Reviewing and Planning, (3) Investigation and Knowledge Application, and (4) Summary and Evaluation. The experts opined that the model was highly suitable (mean=4.41, SD =0.64) and could serve as a prototype for teaching and learning management for secondary school students.

Keywords: *Digital Literacy; High School Students; Secondary-School Students; Thailand.*

Introduction

Constructivist Learning

Constructivism, defined as the process by which students actively construct knowledge based on their own experiences and understandings (Kayii & Akpomi, 2022), is a fundamental concept in educational theory. This theory emphasizes the importance of interpreting and creating meaning from information, grounded in personal beliefs and prior knowledge (Suhendi et al., 2021). By building upon existing knowledge, constructivism promotes the application of acquired knowledge in real-world contexts (Voon et al., 2020). Moreover, it plays a crucial role in facilitating individual learning development and fostering scientific inquiry (Voon et al., 2020). However, it is important to acknowledge that students' beliefs and perceptions about learning and teaching can pose significant obstacles to their learning experiences (Du Plessis, 2020).

According to Holt-Reynolds (2000), constructivist pedagogies have become indispensable in teacher education coursework. By empowering students to perceive themselves as active learners who engage in diverse learning methods, constructivist approaches enable them to set

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learning goals, plan their learning processes, and exercise control over their learning with purpose (McCardle et al., 2017). Furthermore, students learn to utilize reasoning to evaluate and analyze various factors contributing to successful learning outcomes, ultimately becoming proficient learners (McCardle et al., 2017). Therefore, fostering metacognitive skills, which aid in understanding one's thinking processes, is essential for promoting effective learning across all domains of life (Lumpkin, 2020).

Yakar et al. (2020) suggest that constructivist learning theory emphasizes the construction of meaning through authentic experiences and social interactions. Additionally, in the contemporary learning landscape characterized by ubiquitous access to mobile technologies, the concept of 'mobile constructivism' has emerged (Zurita & Nussbaum, 2004). Furthermore, Karataş et al. (2023) propose that self-directed learning (SDL), 21st-century skills, and metacognition are predictive factors for online learning readiness.

By synthesizing these insights, it becomes evident that constructivist learning theory offers a robust framework for understanding how individuals actively engage in the construction of knowledge. Moreover, it underscores the importance of metacognitive skills in facilitating effective learning experiences, particularly in today's technologically mediated learning environments.

Metacognition

Metacognition, a term gaining increasing recognition in educational psychology and other related fields, is fundamentally about understanding, controlling, and being aware of one's own cognitive processes. Winne (2021) describes it as the systematic self-regulation of brain processes. Dörrenbächer-Ulrich et al. (2023) expand this definition, highlighting its facets such as understanding, controlling, and being aware of one's own thinking. In essence, metacognition is about 'thinking about thinking' (Mahdavi, 2014) and understanding one's learning processes (Padmanabha, 2020), encompassing how knowledge is acquired, retained, and utilized, as well as recognizing one's strengths and abilities.

This concept has garnered international attention due to its empowering potential for students in navigating the complexities of the information society. Metacognition is not merely a theoretical construct but a practical tool for promoting autonomous, reflective, and self-regulated learning (Loaiza et al., 2022). It has been studied extensively in educational psychology and second language learning, where it has been found to significantly impact academic achievement (Katyal & Fleming, 2023). Through metacognition, students are able to plan, monitor, and evaluate their own learning processes, thus fostering self-regulated learning (Agbenyegah, 2022; Singh & Allers, 2022). Teachers play a pivotal role in facilitating the development of metacognitive awareness among students by modeling metacognitive strategies (Teng, 2023).

Furthermore, metacognitive skills are not limited to general learning processes but have found applications in specific academic domains such as chemistry, mathematics, and arithmetic (Gamby & Bauer, 2022). Particularly in mathematics and arithmetic, the implementation of metacognitive practices has shown promising results in improving learning outcomes. Hence, metacognition is increasingly recognized as an invaluable tool for enhancing learning across various academic disciplines (Silver et al., 2023).

In light of this, educators must recognize that teaching should not solely focus on delivering content but also on nurturing students' cognitive processes. Teaching should adopt a process-

oriented approach, drawing from various learning theories to enhance students' learning efficacy (Artuz & Roble, 2021). For instance, cognitive learning theory emphasizes the importance of changing thinking processes and prioritizing brain processes (Nurhuda et al., 2023). This enables students to effectively interpret and organize information, thereby enhancing their overall learning experience.

In summary, metacognition encompasses a range of cognitive processes aimed at understanding, controlling, and being aware of one's own thinking. It has significant implications for learning and is instrumental in fostering students' autonomy and self-regulation. By integrating metacognitive strategies into teaching practices, educators can empower students to become more effective learners across various academic disciplines.

Revolutionizing Education in the Digital Era

In the contemporary digital age, education is experiencing profound shifts driven by the integration of information and communication technologies (ICT) into learning environments (Haji et al., 2023). Criollo-C et al. (2021) highlight the revolutionary potential of these technologies, empowering students to take active roles in their learning processes. Traditional methods reliant on rote memorization are giving way to more interactive learning approaches, where skills such as reading, sharing, listening, and doing are cultivated through the abundance of online knowledge.

Furthermore, Sophonhiranrak (2021) underscores the multifaceted role of mobile devices in modern education. Beyond serving as communication tools, mobile devices contribute to economic development (Rotondi et al., 2020), facilitate mass communication, and importantly, support learning (Haleem et al., 2022). As the prevalence of mobile devices and internet access continues to rise, their integration into educational practices expands, necessitating exploration of their potential applications in learning.

In this context, the design of learning experiences becomes crucial. Kukulska-Hulme and Traxler (2019) advocate for leveraging mobile learning technologies to enhance student learning outcomes. Designing learning experiences in the digital age entails several key considerations:

1. Learner-Centered Content: Content should be curated to promote self-directed learning, ensuring its relevance and engagement for students.
2. Activity Design: Activities should blend behaviorist and constructivist learning approaches, encouraging active participation and knowledge construction.
3. Communication Design: Effective communication design is essential for presenting information in various formats and optimizing student engagement.

Moreover, the widespread availability of smartphones has facilitated connectivity between students and teachers, extending beyond formal educational settings. UNESCO (2023) observes the increasing integration of mobile devices into education systems across Southeast Asia, underscoring their significance in both formal and informal educational contexts.

In conclusion, navigating the digital landscape necessitates educators to carefully craft content, activities, and communication strategies to create enriching and effective learning experiences for students in the digital age.

Following the introduction, the authors present the research methodology detailing the study's development process. Subsequently, the research results, expert quality assessment process,

and discussion are outlined. Finally, the conclusion summarizes the study, while addressing limitations and offering suggestions for future research to guide subsequent authors.

Research Methodology

The research methodology employed for the development of the Constructivist and Metacognition Learning Management Model (CMLMM) involved a systematic review process (SRP) to gather relevant concepts and theories from various sources, including books, online materials, and related research works (Khan et al., 2003; Sankofa, 2023). This analysis aimed to provide foundational knowledge for the creation of the CMLMM, specifically aimed at enhancing students' digital literacy skills (Satha & Langka, 2022; Thima & Chaijaroen, 2021). The primary research tool utilized was content analysis, complemented by feedback from faculty academics.

The proposed CMLMM was structured into four main steps:

1. Introduction and Reflection: This phase outlined the research objectives and context (Cortés Orduña et al., 2020; Cromley & Kunze, 2020).

2. Review and Planning: Existing theories and literature were critically reviewed and reflected upon to inform the model's development (Nguyen, 2023).

3. Investigation and Knowledge Application: The research actively sought and applied relevant knowledge and theories to design the learning management model. Higher-order thinking skills, metacognitive strategies, and inquiry-based learning were emphasized as crucial components (Hamzah et al., 2022).

4. Summary and Evaluation: The model was summarized, and its effectiveness was evaluated based on predefined criteria. This iterative process aimed to foster collaborative learning and promote critical thinking skills among students, aligning with constructivist and metacognitive theories integrated into the model (Rodrangsee et al., 2022).

Focus Group Expert Evaluation

Following the model's development, a Focus Group consisting of nine qualified participants, comprising university-level educators with expertise in various educational fields, reviewed the draft CMLMM to provide feedback for refinement (Prommun et al., 2022). Based on their recommendations, the researchers improved and finalized the CMLMM to promote digital-era cognitive skills.

Evaluation of the Quality of the CMLMM

The quality of the CMLMM was assessed using descriptive statistics, including means, standard deviations (SD), and percentages, with a five-level Likert scale agreement scale to evaluate each expert's input. Scale levels, numerical values, and interpretation for each level were as follows: 5 = strongest agreement (4.50-5.00), 4 = strong agreement (3.50-4.49), 3 = moderate agreement (2.50-3.49), 2 = somewhat agree (1.50-2.49), and 1 = minimal agreement (1.00-1.49). Content and structural validity were examined by three experts using an index of Item Objective Concordance (IOC) value ranging from 0.66 to 1.00.

Meta-Evaluation and Criteria for Assessing Evaluations

Meta-evaluation, guided by criteria outlined by the Joint Committee on Standards for Educational Evaluation (JCSEE), assessed the utility, feasibility, propriety, and accuracy of the

evaluation process (Stufflebeam, 2015; Yarbrough et al., 2010). This meta-evaluation aimed to provide descriptive and judgmental information regarding the evaluation's effectiveness.

Finally, the refined CMLMM and its assessment form were evaluated by the same group of nine qualified participants from January 22-31, 2024, with the collected data analyzed using average statistics and standard deviations (SD).

Research Results

CMLMM Development

As depicted in Figure 1, the CMLMM to promote students' thinking skills in the digital age consisted of four steps, which are:

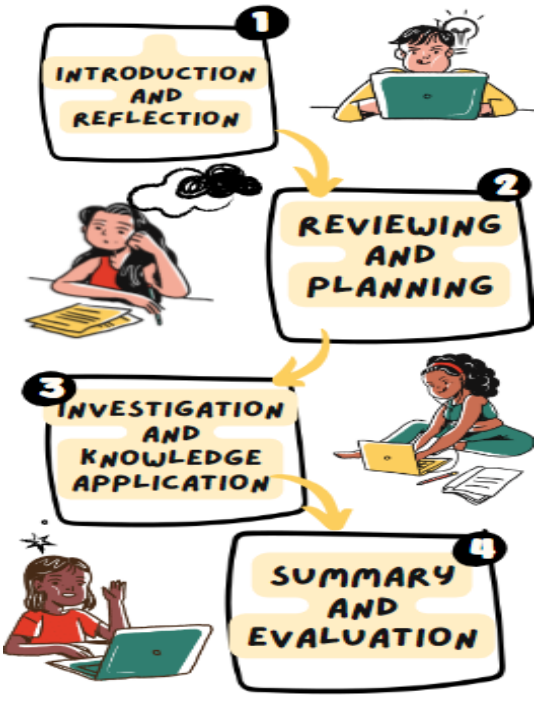

Fig. 1. The CMLMM to Promote Students' Thinking Skills in a Digital Age.
Source: The Authors.

Step 1: Introduction and Reflection

In Step 1 the teacher plays a role in presenting problem situations, issues, and relevant case studies to stimulate interest (Shandomo, 2010), while also encouraging students to gradually think and consider their existing knowledge and understanding until they can adapt their knowledge to the encountered problem situation. Simultaneously, students reflect on past experiences related to what they have learned or connect what they have learned with similar knowledge or experiences.

This is similar to Taylor who reported that an educator's success is determined by how well they activate learners, invite them to talk, and successfully engage their participation (Holt-Reynolds, 2000). Students test themselves to see if they remember what they have learned, and

reflection is one way for students to retrieve knowledge from long-term memory to working memory (Sprenger, 2018). Doing so helps students understand new concepts better because when retrieving information, students see the relationships between various topics learned or identify what they know, don't know, and want to know.

Step 2: Stage of Reviewing and Planning

Students set their learning goals and objectives, select and determine learning techniques and methods, sequence and plan their learning steps on their own, set expectations or predict what will happen in advance, and select and determine various paths to complete the work (Hwang et al., 2021). The teacher plays a role in recommending activity methods, guiding research sources, guiding students to think independently, stimulating students to design their learning, achieve their desired goals, plan their learning, and solve problems independently, enabling students to perform activities on their own.

Step 3: Investigating and Apply Knowledge

Students study and interpret the content of knowledge, understand what they need to perceive, and demonstrate that they have learned through various methods. Students' learning activities include searching for knowledge, interacting with information, and interpreting information to create knowledge for themselves. Students review activities they have done and exchange knowledge with others through the information they have sought, to discuss, analyze, and synthesize in line with the objectives. The teacher uses questions to stimulate the display of data relationships to verify the alignment of success with objectives.

Step 4: Summary and Evaluation

Students explain the methods of seeking knowledge, describe the problems encountered during learning, link old knowledge with new knowledge, and reflect on their learning outcomes. The teacher assesses students' learning development by evaluating students' work. Students self-assess and evaluate the work of group members. When completing each unit of study, students take performance assessment tests and tests of thinking skills about knowledge.

CMLMM Quality Assessment Results

The assessment of the CMLMM was conducted using criteria derived from studies by Stufflebeam (2015), and the evaluation followed the guidelines outlined by JCSEE (Yarbrough et al., 2010). The findings from Table 2 indicate that experts view the CMLMM favorably in terms of promoting students' thinking skills in the digital age, with an overall assessment at a high level of appropriateness (mean=4.41, SD = 0.61). Upon closer examination of each aspect, it was noted that Feasibility received the highest rating, followed by Utility, while Accuracy received the lowest score. Table 1 presents the average ratings and appropriateness levels of the learning management model as assessed by the nine experts, categorized by aspect:

Table 1: Average and Appropriateness Level of the CMLMM as Evaluated by the Nine Experts Classified by Aspect.

Aspect	Experts (*n*=9)		Suitability Level
	Mean	SD	
Utility	4.47	0.61	Significant
Feasibility	4.61	0.56	Most significant
Propriety	4.33	0.64	Significant
Accuracy	4.22	0.73	Significant
Averages	4.41	0.64	Significant

Utility

Experts rated Utility with a mean score of 4.47, indicating a significant level of appropriateness. This aspect pertains to the practicality and usefulness of the learning management model in real-world educational settings. A high rating suggests that experts found the model to be highly practical and beneficial for enhancing students' learning experiences.

Feasibility

Feasibility received the highest mean score of 4.61, signifying its utmost significance. This aspect evaluates the feasibility and viability of implementing the learning management model in educational contexts. The high rating suggests that experts believe the model is highly feasible and can be effectively implemented in diverse educational settings.

Propriety

With a mean score of 4.33, Propriety was rated at a significant level. This aspect concerns the ethical and moral appropriateness of the learning management model. A high rating indicates that experts found the model to align well with ethical principles and standards in education.

Accuracy

Accuracy received the lowest mean score of 4.22 among the evaluated aspects, though still significant. This aspect evaluates the precision and correctness of the learning management model in achieving its intended outcomes. While the rating is slightly lower compared to other aspects, it suggests that experts still perceive the model as largely accurate in achieving its goals.

The Results of the Expert Assessment on the CMLMM

Assessment of the appropriateness of the integrated CMLMM (Prommun et al., 2022; Wongrugsa et al., 2022) was undertaken by adopting precepts laid out from extensive research and writings from D. L. Stufflebeam (1983, 1986, 2008, 2015) who suggested that in education program evaluation, it was more essential to improve rather than to prove (Prommun et al., 2022).

Firstly, the experts rated Utility and Feasibility as the most significant aspects of the model, indicating that it aligns well with teachers' needs and is practical for implementation in diverse educational settings. This suggests that the model is not only theoretically sound but also highly applicable in real-world teaching contexts, which is crucial for its successful adoption and integration into educational practices.

Furthermore, the experts rated Propriety and Accuracy as significant aspects, though slightly lower than Utility and Feasibility. Propriety assesses the alignment of the learning management model with stated objectives, the suitability of theories applied, and the appropriateness of methods for student contexts. Accuracy evaluates the precision and comprehensiveness of the model's components, methods of measuring and evaluating learning outcomes, and the use of precise techniques and tools.

It's notable that while Propriety and Accuracy received slightly lower ratings, they still play essential roles in ensuring the effectiveness and quality of the learning management model. Propriety ensures that the model meets educational objectives and is suitable for supporting student learning, while Accuracy ensures that the model's components are accurate and its evaluation methods are comprehensive and aligned with principles.

Table 2 results suggest that while the model excels in its practicality and feasibility, attention may be needed to further refine its alignment with stated objectives and the accuracy of its components and evaluation methods. Additionally, the findings can be linked to previous studies such as those by Prommun et al. (2022) and Wongrugsa et al. (2022), which may provide further context and support for the effectiveness of the CMLMM. These studies could offer additional insights into the model's applicability and potential areas for improvement, further enriching the analysis of the expert results.

Table 2: Average and Appropriateness Level of the CMLMM as Evaluated by the Nine Experts Classified by Item.

Questionnaire Item	Experts (n=9)		Suitability Level
	Mean	SD	
1. Utility	**4.47**	**0.61**	S
1.1 The developed CMLMM aligns with teachers' needs in utilizing constructivist and metacognition theories for learning management.	4.56	0.53	MS
1.2 The developed CMLMM effectively enhances students' learning outcomes.	4.33	0.71	S
1.3 The developed CMLMM promotes student learning in line with constructivist and metacognition learning approaches.	4.67	0.50	MS
1.4 The developed CMLMM fosters students' thinking skills about knowledge.	4.33	0.71	S
2. Feasibility	**4.61**	**0.56**	MS
2.1 The developed CMLMM is practical and applicable in current teaching contexts.	4.67	0.50	MS
2.2 The developed CMLMM is suitable for different student grade levels.	4.67	0.50	MS
2.3 The developed CMLMM is feasible with available school resources.	4.56	0.73	MS
2.4 The developed CMLMM facilitates the effective use of available resources.	4.56	0.73	MS
3. Propriety	**4.33**	**0.64**	S
3.1 Each step of the CMLMM aligns with the stated objectives.	4.33	0.71	S
3.2 The theories applied are suitable for supporting student learning.	4.44	0.53	S
3.3 The method of developing the CMLMM is appropriate for student contexts.	4.22	0.67	S
3.4 The theories applied are suitable for promoting students' thinking skills about knowledge.	4.56	0.53	MS
3.5 The methods of measuring and evaluating learning outcomes are appropriate for the learning model format.	4.11	0.78	S
4. Accuracy	**4.22**	**0.73**	S
4.1 The CMLMM is developed synthetically and integrally according to objectives.	4.33	0.71	S
4.2 The components of the learning model are accurate, specifying the theories used comprehensively.	4.11	0.60	S
4.3 The methods of measuring and evaluating learning outcomes specified in the learning model align with principles and are comprehensive.	4.11	0.78	S
4.4 The methods of measuring and evaluating skills specified in the learning model align with principles and are comprehensive.	4.22	0.83	S
4.5 The development of the CMLMM uses precise techniques and tools, systematically collecting, analyzing, and reporting data.	4.33	0.71	S
Average	**4.41**	**0.64**	S

Note: S = Significant, MS = Most Significant.

Overall, the findings suggest that the learning management model based on constructivist theory and metacognition theory is well-received by experts, particularly in terms of its feasibility and utility. However, attention may need to be given to enhancing the accuracy

aspect to further optimize the model's effectiveness in promoting students' thinking skills in the digital age.

Conclusion

In conclusion, the findings of the expert assessment shed light on the effectiveness and applicability of the constructivist and metacognitive learning management model (CMLMM). The model demonstrates strengths in its practicality and feasibility, aligning well with teachers' needs and being suitable for diverse educational contexts. Additionally, while there are areas for improvement in terms of alignment with objectives and accuracy, the model shows promise in promoting student learning outcomes and fostering critical thinking skills about knowledge. These findings underscore the importance of continued research and refinement to enhance the model's impact on student learning and its integration into educational practices.

Limitations

Despite the valuable insights gained from the expert assessment, it's important to acknowledge certain limitations. Firstly, the assessment relied on a relatively small sample size of nine experts, which may limit the generalizability of the findings. Additionally, the assessment focused primarily on expert opinions and may benefit from incorporating feedback from a wider range of stakeholders, including teachers, students, and educational administrators. Furthermore, the assessment was conducted under specific conditions and may not fully capture the variability of real-world educational contexts. Future research could address these limitations by expanding the sample size, incorporating diverse perspectives, and conducting assessments in varied educational settings.

Suggestions for Future Research

Based on the findings and limitations identified, several suggestions for future research emerge. Firstly, further investigation could explore the long-term effects of implementing the CMLMM on student learning outcomes and academic performance. Longitudinal studies could provide valuable insights into the sustained impact of the model over time. Additionally, future research could delve into refining the model's alignment with stated objectives and enhancing the accuracy of its components and evaluation methods. This could involve iterative cycles of development and evaluation to continually improve the model's effectiveness and quality. Moreover, exploring the transferability of the model to different educational contexts and cultural settings could offer valuable insights into its scalability and adaptability. Overall, continued research and refinement of the CMLMM are essential for maximizing its potential to support student learning and enhance educational practices.

Declaration of Interest

The authors declare that they have no conflict of Interest.

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