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Systematic Review

Systematic Literature Review on the Elements of Metacognition-Based Higher Order Thinking Skills (HOTS) Teaching and Learning Modules

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Abstract: Contemporary educational approaches which enculturate higher order thinking skills (HOTSs) through teaching and learning have become the latest trend in teaching. Knowledge clarity, understanding mastery, and teaching readiness are the catalysts for successfully implementing HOTS elements in teaching. However, even though HOTS learning is inextricably linked to metacognitive skills, teachers frequently underutilize metacognitive skills as an effective method of teaching HOTSs. Therefore, teachers face difficulties regarding their skills in integrating HOTSs into their teaching. Numerous studies on HOTS teaching and learning modules to guide teachers in applying these have been conducted; however, only a few researchers have conducted systematic literature reviews on the same subject. This article aims to produce a systematic literature review on the elements of a metacognition-based HOTSs teaching and learning module. The systematic literature review (SLR) writing process was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) framework. Using 2 databases, namely, Web of Sciences (WoS) and Scopus, 15 articles were extracted out of 252, from 2017 to 2021, with exclusion and inclusion criteria taken into consideration. Based on the study's thematic analysis, 3 main themes were identified: (1) HOTS, (2) metacognitive, and (3) inquiry. This study suggests that these three elements should be included in the contribution element of metacognition-based HOTSs teaching modules in school. This study contributes knowledge and guidelines to the construction of metacognition-based HOTSs teaching modules in schools, teachers' preparedness to plan, monitor, and evaluate students' higher order thinking skills, and opportunities for students to learn through HOTSs learning elements, as suggested in metacognition-based HOTS teaching modules.

Keywords: metacognitive; higher order thinking skills (HOTSs); module

Citation: Hamzah, H.; Hamzah, M.I.; Zulkifli, H. Systematic Literature Review on the Elements of Metacognition-Based Higher Order Thinking Skills (HOTS) Teaching and Learning Modules. *Sustainability* **2022**, *14*, 813. https://doi.org/10.3390/su14020813

Academic Editor: Antonio P. Gutierrez de Blume

Received: 8 December 2021
Accepted: 4 January 2022
Published: 12 January 2022

1. Introduction

Higher order thinking skills (HOTSs) are globally emphasized aptitudes that have become a core focus of instruction in a growing number of classrooms. HOTS is a foundation skill that teachers must master to foster students' thinking and improve classroom learning through its application in teaching and learning. Scholars and academicians define HOTSs in a variety of ways. For instance, ref. [1] defines HOTSs as the ability to apply knowledge, skills, and values through reasoning and reflection to solve problems, make decisions, innovate, and successfully create something. Meanwhile, in some studies, HOTSs are referred to as the level of thinking required to shape the 21st century generation that has the potential to compete globally, with the intelligence, creativity, and innovation that are necessary [2]. Additionally, thinking skills are known as mental activities consisting of the active involvement of the thinker to solve a problem [3].

Teaching and learning are core mediums for the application of HOTSs [4]. As such, teachers employ HOTS teaching methods by incorporating pedagogy strategies that assist students in developing HOTSs. This is prior to the direct effect of the implementation of

HOTS on student achievement [5]. There are various teaching strategies that teachers can cultivate to inculcate HOTS, including metacognition-based HOTS teaching strategies [5,6], which are believed to improve the mastery of HOTS among students. Metacognition is defined as an understanding of cognitive phenomena and the awareness of one's own thinking process [7]. Meanwhile, metacognitive strategies are techniques for increasing the awareness of one's own thinking and learning processes. The design of metacognitive activities focuses on the cognitive and social development of students, while also posing theoretical and practical challenges [8]. When this awareness is present, students will think more [9] because they can control their minds through the processing of information, which has been obtained to be interpreted [10].

Teachers play a crucial role in successfully implementing HOTSs in schools to produce a generation fit for the 21st century, a generation capable of improving the Malaysian education system on the international stage and competing globally [11]. Teachers are the backbone in educating students to attain excellent levels of achievement in all subjects; therefore, they must have a thorough understanding and mastery of HOTSs for the HOTS teaching process to run smoothly and effectively, especially given the challenges which arise when implementing HOTS-based instructions [11]. However, previous studies have found that some teachers are still hesitant to implement HOTSs in their classrooms due to a lack of exposure [12], knowledge, and the burden of various other tasks that prevent the implementation of HOTS-based teaching [2,7,11,13–18]. Such factors have affected the implementation of HOTSs [14].

According to [14,19,20], a need has been identified among teachers to access HOTS teaching modules to develop a clearer understanding of HOTS and to boost their confidence in implementing HOTSs in classrooms [14]. Teachers need alternative material resources to support HOTS teaching and to reduce pedagogical burdens [13]. For instance, the production of modules based on subject content standards make HOTS instructions more interesting and effective [21]. The lack of knowledge and exposure among teachers, and their awareness of the need to improve and create effective HOTS instructions, must be addressed; this contributes to the limitations in diversifying the methods and strategies of introducing HOTSs into classrooms [19]. Therefore, there is an initiative to develop HOTS teaching modules containing elements of effective HOTS teaching strategies as guidelines for teachers to apply thinking skills during the teaching and learning process [17]. Due to the growing interest in HOTSs, researchers have compiled and conducted systematic literature reviews to identify elements in HOTS teaching and its adaptation in learning modules.

Numerous previous studies [13,14,19,20,22] have summarized HOTS elements in teaching modules. These studies necessitate a systematic literature review to collect and better understand the findings, as opposed to a traditional literature review, to avoid issues with transparency, author bias, selection bias, and publication bias; systematic literature reviews offer a more comprehensive, transparent, structured, and systematic literature review technique. Although there is a need for systematic literature reviews (SLRs), currently, their number and scope remain limited in the HOTS study area. For instance, in [20], the focus was limited to the use of the I-Think module for thinking. Limited studies have discussed the elements of metacognition-based approaches in HOTS teaching and learning modules; thus, there has been less emphasis on conducting a systematic literature review on the subject.

In addition, based on an examination of prior research, there are gaps in HOTS teaching research studies. The first gap identified was that in terms of study issues. Previous HOTS research has focused on teachers' problems, knowledge, skills, and challenges in implementing HOTSs [16,23–25], but HOTS teaching research issues focusing on metacognitive-based HOTS teaching module elements are limited. Similarly, there is a study gap from the theoretical aspect; the theory of metacognition only has three components, namely, planning, monitoring, and evaluation. Inserting an inquiry element can fill the gaps [26,27]. In addition, previous studies have frequently mentioned the awareness of metacognitive

research from the perspective of teachers and students, but little research has been carried out on systematic literature reviews on metacognitive elements [6,28]. Accordingly, in this study, we conducted a systematic literature review of previous related studies pertaining to the elements in a metacognition-based HOTS teaching module.

2. Research Question

This study conducts a systematic literature review of past studies on the elements in the HOTS teaching module. The research question for this systematic literature review is as follows:

- What are the elements of a metacognition-based higher order thinking skills (HOTS) teaching and learning module?

3. Research Objective

The main objective of this systematic literature review is as follows:

- To identify the elements of the metacognition-based higher order thinking skills (HOTS) teaching and learning module.

4. Method

This study used PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis). Although PRISMA is a publication standard, widely used in medicine and public health, its use was still appropriate in this study because it aided in the formulation of clear research questions and allowed us to conduct systematic searches through its 27 items [29]. In addition, PRISMA minimizes various biases and helps in effectively synthesizing a study [30] by requiring a systematic search strategy comprised of four distinct processes: identification, screening, eligibility, and article quality evaluation.

4.1. Identification

Identification is a process that involves identifying and diversifying appropriate keywords for an article search. Keywords are required during the search process to increase the accuracy of the articles. In this study, three main keywords were selected, namely, metacognitive, higher order thinking skills, and modules. To diversify the keywords, synonyms, related words, and variations of the main keywords were also searched on an online thesaurus, past research keywords, and the Scopus database, as well as in expert views. Table 1 presents the results of the identification process of this study.

Table 1. Search string for searching database articles.

Database	Search String
Web of Sciences (WoS) (n = 175)	TS = ((“metacognitive *” OR “meta intellectual *” OR “cognitive *”) AND “higher order thinking” OR “higher-level thinking” OR “higher cognitive thinking” OR “critical thinking”) AND (“module” OR “booklet”)
Scopus (n = 77)	TITLE-ABS-KEY ((“metacognitive *” OR “meta intellectual *” OR “cognitive *”) AND “higher order thinking” OR “higher-level thinking” OR “higher cognitive thinking” OR “critical thinking”) AND (“module” OR “booklet”)

*: Search String.

Using the selected keywords, an article search was conducted in two main databases: the Web of Science and Scopus. Both databases were selected based on some advantages. First, according to [31], databases such as Web of Science and Scopus possess strengths in terms of comprehensive searches, more stable search results, and more advanced search functionality compared with other databases. Additionally, in [32], the advantages of Web of Science and Scopus in terms of quality control and a systematic indexing system are emphasized.

The search technique used to find articles in this database (Web of Science and Scopus) was advanced searches using basic functions, such as Boolean Operator (AND, OR), phrase searching, truncation, wild card, and field code's function (refer to Table 1). In addition to this technique, manual searches using handpicking methods in Google Scholar and Science Direct, as well as snowballing methods on selected articles, were adopted. Based on the keywords, databases, and search techniques used, 175 Scopus and 77 WoS articles were successfully obtained, and all these articles went through the second stage in the systematic search strategy, which was screening.

4.2. Screening

Screening is a process in which inclusion or exclusion criteria is set to select suitable articles to form the systematic literature review [33]. A total of 252 articles that were successfully gathered in the identification process were subjected to the screening process. The first criterion was the year of publication being within the last 5 years (2017–2021). This period selection was based on several justifications. Firstly, it was in line with the concept of study maturity in [34], as many related articles have successfully obtained reliable data during this period.

Considering the searches on major databases showed a significant surge of publications relating to the elements of the HOTS module in teaching and learning from 2017; for quality control, only articles published in Bahasa Malaysia and English were selected to avoid confusion in reading and understanding. Review articles were also excluded because the main objective of this systematic literature review was to identify past research findings instead of past research reviews. Therefore, only articles with relevant empirical data were considered in this study.

This study included inclusion criterion in this process. Inclusion is important to ensure all selected articles contribute relevant findings to the systematic literature review (refer to Table 2). In this study, the selected articles contained findings that focus on the elements of the HOTS module in teaching and learning. Therefore, the articles on the teaching of high order thinking skills that do not explicitly state the elements of the HOTS module were removed. After the screening process, 149 articles were eliminated, leaving 84 articles for the next process.

Table 2. The inclusion criteria.

	Inclusion Criteria
Year of publication	Within past 5 years (2017–2021)
Publication type	Journal articles
Language	Malay and English
Types of findings	Empirical
Focus of findings	Data related to the elements of the HOTS module in teaching and learning

4.3. Eligibility

The remaining 84 articles were subjected to a second screening process, known as eligibility. The eligibility screening process is carried out to ensure that all selected articles are relevant and could be used in an SLR. This process is accomplished by consulting the title and its abstract. If no decision is reached after reading a study's title and its abstract, its methodology, results, and discussion sections are consulted.

In this process, a total of 63 articles were excluded because they did not focus on the elements of the HOTS module in teaching and learning at the school level. The 63 articles were eliminated as some studies focused on university lecturers instead of school teachers, contained duplicated records, were not fully accessible, or were written in the form of a scoping review. Following this process, 21 articles were subjected to the next process, which

was the quality assessment. The systematic search process, using PRISMA, in this study, is shown in Figure 1.

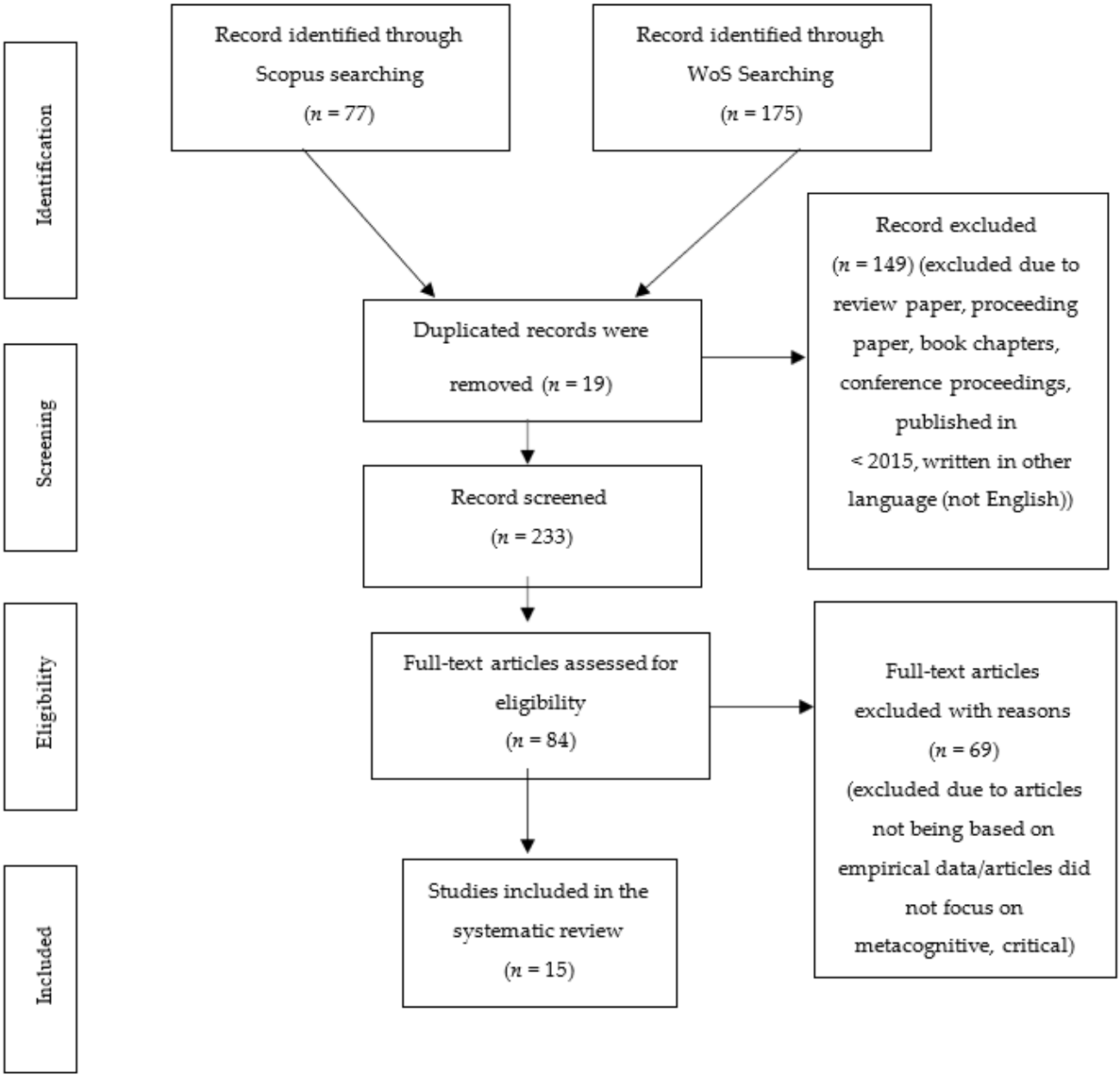

Figure 1. Flow diagram of the SLR [30].

4.4. Quality Assessment

Selected articles were then evaluated for quality. This minimized bias and helped identify articles that might have flaws in terms of methodology [9]. Two evaluators were selected among the researchers for the evaluation purpose. Because the systematic literature review combined articles and documents from various research designs, which were quantitative, qualitative, and mixed methods, the MMAT (Mixed Method Appraisal Tool) was referred to assist in the evaluation process [35].

Each article was evaluated based on two general criteria and five specific criteria. The first step was to evaluate the quality of the article based on two general criteria, as follows: (1) Are the research questions clearly stated? (2) Is the data obtained capable of answering the stated research questions? Articles in this study were required to meet both aspects before proceeding to the separation stage.

During the separation stage in the quality assessment process, the research design of an article was identified, to clarify whether it was qualitative, quantitative, or mixed method. The articles and documents were then evaluated based on five specific criteria. Each criterion came with three response options: 'Yes', 'No', or 'Cannot tell'. To agree on an article, a mutual agreement among evaluators was required. If an agreement could not be reached, the evaluators were required to seek a second opinion.

Of the total 21 articles evaluated, 15 articles met at least 3 criteria, and hence were included in this systematic literature review; meanwhile, 6 articles, namely ref. [36–41] were excluded due to their failure to meet the minimum criteria. The article quality assessment which was performed is summarized in Tables 3 and 4.

Table 3. Quality evaluation of quantitative articles.

Basic/Study Criteria	[36]	[37]	[38]	[41]
Are the research questions stated early?	Y	C	C	C
Can the obtained data answer the stated research questions?	Y	C	C	C
Quantitative Studies				
Is the sampling strategy used relevant the research question?	C	C	C	C
Is the selected sample representative of the studied population?	Y	C	C	C
Is the measurement used appropriately?	C	C	C	C
Is the risk of nonresponse bias low?	C	C	C	C
Is the statistical analysis used appropriate to answer the research question?	Y	C	C	C
Results	Excluded	Excluded	Excluded	Excluded

Y—Yes; C—Cannot tell.

Table 4. Quality evaluation of mixed method articles.

Basic/Study Criteria	[39]	[40]
Are the research questions stated early?	N	Y
Can the obtained data answer the stated research questions?	N	Y
Mixed Method Studies		
Is the sampling strategy used relevant to answer the research question?	N	Y
Is the selected sample representative of the studied population?	N	C
Is the measurement used appropriately?	N	Y
Is the risk of nonresponse bias low?	N	C
Is the statistical analysis used appropriate to answer the research question?	N	C
Results	Excluded	Excluded

Y—Yes; C—Cannot tell; N—No.

4.5. Data Extraction and Analysis

Next, the process of extracting data from the articles in which high quality had been determined was carried out. This process was performed by two researchers. Since the focus of this SLR was to review the findings from previous research on metacognition-based higher order thinking skills teaching and learning modules, the data extraction process concentrated on three the main parts of each article, namely the abstract, the results, and the discussion. If necessary, other sections of the article, offering relevant data, would be read. The extracted data were then placed in a table to facilitate the analysis process. Once the relevant data were extracted, data analysis was conducted. Since the SLR is an integrative review, combining multiple research designs, a qualitative synthesis is considered the best analysis [42]. While numerous analyses could be used in a qualitative synthesis, thematic analysis has been found to be among the most effective qualitative synthesis techniques

for analyzing findings from various types of research designs [43] because the method identifies patterns based on the similarity and association between the extracted findings.

In this study, to develop an appropriate theme, the extracted findings were examined. Data with similarities or associations were combined into a single data set. The set was assigned an appropriate theme. Three themes emerged from this process, namely: (1) higher order thinking skills, (2) metacognitive, and (3) inquiry. Then, the findings from each of these themes were examined again to form subthemes. Through this process, three subthemes were identified. All the themes and subthemes were re-examined and retained as they were relevant to the research questions. Lastly, two experts—one in the field of SLR and another in the field of module development—validated all the themes and subthemes. Both experts agreed that all the three main themes and the three subthemes, as shown in Table 5, were appropriate and relevant to the research questions.

Table 5. The main themes and subthemes.

Study	Research Design	HOTS			Metacognitive	Inquiry
	Sub-Themes	HOTS	Critical Thinking	Cognitive		
[1]	MX	/	/			
[2]	QN	/	/			
[3]	QN					/
[4]	QN				/	
[5]	QN		/	/		
[6]	QN		/			
[7]	QN		/			
[8]	MX			/	/	
[9]	QN				/	
[10]	QL				/	/
[11]	QN				/	
[12]	QN	/	/			
[13]	QN		/	/		
[14]	MX		/			
[15]	MX				/	

QN—quantitative QL—qualitative MX—mixed-methods.

5. Findings

Of the 15 articles selected, 1 was published in 2021, 3 were published in 2020, 6 were published in 2019, 3 were published in 2018, and the remaining 2 were published in 2017. From the 15 articles, 3 articles were published in *The International Journal Of Emerging Technologies*, while 1 was published in each of the following, respectively: *The Journal of Language and Teaching*; *The Malaysian Journal of Mathematical Sciences*; *The European Journal of Contemporary Education*; *The International Journal of Learning, Teaching, and Education*; *Educational Technology Research and Development*; *Thinking Skills and Creativity*; *The Khazar Journal Of Humanities and Social Sciences*; *The Journal of the Pakistan Medical Association*; *The Journal of Chemical Education*; *The International Journal Of Sciences Education*; *The International Journal of Teaching Education*; *The Defense Life Science Journal*; *The Korean Journal Of Medical Education*; *The Indonesian Journal of Science Education*.

A thematic analysis was conducted to identify the themes and subthemes. To develop an appropriate theme, the 15 findings from the extracted articles were examined individually, and any findings that were shared or relevant were placed in 1 data set. The group was then given an appropriate theme. In this process, 3 themes were identified, namely: (1) higher level thinking skills (2) metacognitive, and (3) inquiry. The findings collected from each of these themes were re-examined for the process subthemes formation, resulting in a total of 3 subthemes: (1) critical thinking, (2) cognitive, and (3) HOTS. Subsequently, all themes and subthemes were examined again to ensure their relevance to the discussion of the research question of this study.

The first subtheme was critical thinking. Critical thinking is one of the learning strategies that significantly impacts students' academic performance. According to [44], the use

of critical thinking positively affects students' language vocabulary learning in argumentative essay writing. There is also an increase in students' cognitive performance [45] and collaborative learning [45] following critical thinking activities. Nevertheless, on the role of HOTS-based modules on critical thinking, ref. [46] demonstrates that active involvement in a module had no effect on thinking or motivation for learning in critical thinking performance. Next, under the cognitive subtheme, a positive relationship between cognitive and metacognitive learning strategies among students [47], and significant differences in cognitive performance after critical thinking activity, have been discovered [45]. However, according to [48], the proof of cognitive learning is more apparent in female students than male students. Meanwhile, the final subtheme under the thinking skills theme is HOTS. Teachers have a positive perception of HOTS teaching [24]. However, while some studies find that the HOTS approach in mathematics teaching is more effective than traditional teaching [49], according to [49], no significant difference was found in the mathematics performance of year 5 pupils following the use of the HOTS module approach, especially in rural schools.

Next, the second theme generated in this SLR was metacognitive. From teachers' perspectives, thinking skills modules incorporating metacognitive elements, such as the Metacognitive Skills Training Module (M-PA21), could help teachers improve their metacognitive knowledge, metacognitive regulation, and metacognitive skills in student-centered teaching through the application of the characteristics of cooperative learning and 21st century basic skills [50].

Similarly, ref. [18] state that the incorporation of metacognitive elements into thinking skills modules could improve their effectiveness in terms of metacognitive learning and efficacy in terms of facts, objectives, materials, and student learning activities—bringing positive influences in student learning [27,47]. According to [51], student satisfaction levels and understanding, particularly in Chemistry [52], increase when metacognitive scaffolding elements are used in modules.

The last theme identified was inquiry. Based on the findings of [26], the use of the 5E Inquiry Learning Model in students' secondary school mathematics learning could improve students' thinking skills. This finding is in line with [27], who also found that the inquiry approach is prominent as it aids students to understand concepts and instrumentation at a deeper level when metacognitive skills are used in their learning process.

In conclusion, the systematic literature review of this study on 15 articles revealed that the primary elements of HOTS in teaching and learning modules are higher order thinking skills, metacognitive skills, and inquiry. These elements need to be adopted to produce students capable of mastering thinking skills and must be expanded to allow teachers to incorporate the elements more effectively into HOTS teaching and learning. See Table 6 bellow.

Table 6. Summary of findings for the 15 selected SLR articles.

No	Study	Title	Aim	Methodology/Sample	Findings
1.	Assaly, I.; Jabarin, A. (2021)	Arab Israeli EFL teachers' perceptions and practices vis à vis teaching higher order thinking skill: A complicated relationship	This study aimed to investigate and examine the cognitive level of questions and perceptions of 13 Israeli Arabic teachers about the teaching of higher-order thinking skills.	Observations and semistructured interviews on 13 Israeli Arabic teachers.	Israeli Arabic teachers tend to emphasize low-level questions over high-level questions. While Israeli Arabic teachers have a positive perception of the teaching of higher-order thinking skills, at the same time they have challenges and constraints to implement such teaching.

Table 6. *Cont.*

No	Study	Title	Aim	Methodology/Sample	Findings
2.	Ibrahim, N.N.; Ayub, A.F.M.; Yunus, A.S.M.; Mahmud, R.; Bakar, K.A. (2019)	Effects of Higher Order Thinking Module Approach on Pupils' Performance at Primary Rural School	This study aimed to examine the effectiveness of a module based on higher-order thinking skills in mathematics teaching and learning on the performance of rural year 5 primary school students.	Quasi-experimental studies, pre, and post-tests on control and treatment groups. The study sample involved 127 Year 5 students in rural primary schools.	There was no significant difference in mathematics performance for the two groups of year 5 students although the module approach was used mainly for students in rural areas. More time should be given for teachers in rural schools to familiarize themselves and practice using the modules.
3.	Ramlee, N.; Rosli, M.S.; Saleh, N.S. (2019)	HOTS Mathematical Cultivation via Online Learning Environmental and 5E Inquiry Model: Cognitive Impact and the Learning Activities	This study aims to exam ine the cognitive effects of the 5e online learning environment and activities that can increase interest in mathematics among secondary school students.	Questionnaire/survey on 33 high school students.	The findings showed that the use of 5e inquiry model materials integrated into online environmental care technology can improve the level of human thinking and other cognitive skills.
4.	Giacumo, L.A.; Savenye, W. (2020)	Asynchronous discussion forum design to support cognition: effects of rubrics and instructor prompt on learner's critical thinking, achievement, and satisfaction	This study aimed to test two metacognitive scaffolds on students' cogni tion by assessing higher- order thinking skills and students' achievement in blended learning.	In a quasi-experimental study, the sample involved 257 students.	The findings showed a higher level of student satisfaction with module use when presented with a metacognitive scaffold.
5.	Mierdel, J.; Bogner, F.X. (2019)	Is creativity, hands-on modeling, and cognitive learning gender-dependent?	This study aimed to examine whether creativity, hands-on modeling, and cognitive learning depend on gender.	Survey on 114 secondary school students.	The findings showed that cognitive learning depends on female students.
6.	Dwyer, C.P.; Walsh, A. (2020)	An exploratory quantitative case study of critical thinking development through adult distance learning	This study aimed to ex amine the development of critical thinking through adult distance learning.	Case studies.	The findings indicated that there was no effect of active involvement of module propensity on thinking and motivation towards learning in critical thinking performance.
7.	Ahmad Pour, Z.; Khaasteh, R. (2017)	Writing Behaviors and Critical Thinking Styles: The Case of blended Learning	To examine whether the online writing modules in a blended learning environment would facilitate the active involvement of EFL students with different critical thinking styles in completing writing assignments.	The survey was conducted on 30 second-year students majoring in TEFL at Mazandaran University.	The study found that using critical thinking as one of the learning strategies had a significant effect on students' language vocabulary learning in writing argumentative essays.

Table 6. *Cont.*

No	Study	Title	Aim	Methodology/Sample	Findings
8.	Imran, M. (2019)	Analysis of learning and teaching strategies in surgery module: A mixed methods study	The study aimed to explore students' and teachers' perceptions of the teaching and learning strategies used in the delivery of surgical modules in medical colleges.	Mixed method study. The qualitative parts involved 2 focus group discussions and 3 interviews on students and teachers. Meanwhile, the quantitative parts used a survey on 47 students of the Medical Faculty, University of Jeddah.	The findings showed that there was a positive relationship between learning, cognitive and metacognitive strategies among students.
9.	Karnain, R.; Rahman, S.; Surat, S.; Ali, M.T. (2019)	Usability of M-PA21 Module to Improve Teachers' Metacognitive Regulation in Teaching and Application of 21st Century Basic Skills	This study aimed to develop training modules to improve teachers' meta-cognitive skills in applying the basic 21st century skills through student-centered teaching strategies and cooperative learning with the application of its characteristics.	This study used a design and development research methodology based on the ADDIE model involving 3 phases. Phase 1—observations on 10 teachers and interviews on 3 teachers. Phase 2—involved the evaluation of field experts. Phase 3—involved 16 teachers through observation, document analysis, and interviews.	This study produced a metacognitive skills training module (M-PA21) to improve metacognitive knowledge, metacognitive regulation, and metacognitive skills of teachers in student-centered teaching through cooperative learning application with its characteristics and basic 21st-century skills.
10.	Bowen, R.S.; Picard, D.R.; Verberne Sutton, S.; Brame, C.J. (2018)	Incorporating Student design in an HPLC Lab Activity Student Metacognition and Argumentation	This study explored the approaches that influence and promote metacognitive skills among students toward thinking like a scientist.	Observations and interviews on 6 students majoring in chemistry.	The findings showed that the inquiry approach was more influential and encouraged students to understand concepts and instrumentation at a deeper level and encouraged the use of metacognitive skills.
11.	Dori, Y.J.; Avargil, S.; Kohen, Z.; Saar, L. (2018)	Context-based learning and metacognitive prompts for enhancing scientific text comprehension	This study aimed to develop a module that integrated metacognition to guide students to monitor and improve their understanding of scientific texts. In addition, this study also investigated the metacognitive effects on the comprehension of scientific texts.	Pre and Post Tests.	This study found that high-intensive CBL combined with metacognition could improve students' chemical understanding of scientific articles tailored to their ability to control their learning.
12.	Ibrahim, N.N.; Ayub, A.F.M.; Yunus, A.S.M.D. (2020)	Impact of Higher Order Thinking Skills (HOTS) Module Based on the Cognitive Apprenticeship Model (CAM) on student's performance	This study aimed to examine the differences in student performance in terms of measurement and geometry between urban and rural schools using the HOTS module based on the Cognitive Apprenticeship Model (CAM) on students' performance.	Pre and Post Tests.	The findings indicated that the HOTS approach in mathematics teaching was more effective than the conventional teaching approach for students in urban schools. However, the results of rural schools showed no significant differences in both pre and post-tests.

Table 6. *Cont.*

No	Study	Title	Aim	Methodology/Sample	Findings
13.	Kaur, G.; Awasthy, S.; Syed, U.G. (2019)	Effect of critical thinking on cognitive enhancement	This study aimed to examine the effect of critical thinking on performance improvement.	Survey into 36 participants who worked in government organizations in Delhi.	The results showed that there were significant differences in cognitive achievement after critical thinking activities.
14.	Sahoo, S.; Mohammed, C.A. (2018)	Fostering critical thinking and collaborative learning skills among medical students through a research protocol writing activity in the curriculum	This study aimed to analyze the impact of academic writing and journal criticism as an educational approach in enhancing critical thinking and collaborative learning among undergraduate medical students.	Qualitative—explore students' perceptions of critical thinking improvement through the writing of research protocols in small groups. Quantitative—survey on 188 students.	The findings indicated that there was an improvement of students' critical thinking and collaborative learning skills as a result of the research protocols writing.
15.	Khasanah, A.N.; Sajidan, S.; Widoretno, S. (2017)	Effectiveness of critical thinking indicator-based module in empowering student's learning outcome in respiratory system study material	This study aimed to develop and study the effectiveness of a HOTS-based module on respiratory system materials with teaching materials in schools based on student learning outcomes.	Teacher interviews and questionnaires on students.	This study found that the thinking skills module developed could improve the effectiveness in terms of metacognitive learning and efficacy in terms of facts, materials, objectives, and student learning activities.

6. Discussion

Three main themes emerged from this study, namely, higher order thinking skills, metacognition, and inquiry. The higher order thinking skills theme is subdivided into three subthemes: critical thinking, cognition, and HOTS. According to the findings of this study, HOTS, critical thinking, and cognition are all important elements of the metacognitive-based HOTS teaching module and are extremely helpful to teachers when it comes to teaching metacognition-based HOTS [17,24,44–46]. Furthermore, the incorporation of the three elements in learning activities has significantly improved students' mastery of high-level thinking skills [13].

The second theme is metacognitive. The metacognitive theme is identified as one of the elements in the HOTS teaching module [18,27,47,50,51] that helps and influences students in developing high-level thinking skills [5]. In addition, according to [17], metacognitive skills are seen to be effective in improving students' thinking skills and can motivate students to review classroom lessons.

Nevertheless, according to [17], metacognitive skills are not practiced at the school level. Therefore, these metacognitive skills need to be expanded at school levels through the development of modules because they can be used as a systematic thinking process to improve thinking skills among students. Given that all these themes are incorporated into previous HOTS teaching modules, it is appropriate to propose that metacognition-based HOTS be included in teaching modules to address the difficulties of students in HOTS. Metacognition-based HOTS modules can be adopted through metacognitive skills strategies by stimulating students to monitor what they know and what they do not yet know, talk about thinking, plan, and organize their learning, as well as review their thought processes [17]; these are in addition to other elements, such as critical thinking, logic, and metacognitive skills, which are all directly involved in the teaching of HOTS [5,53]. Thus, the theme can be applied as an element in the metacognition-based HOTS teaching module, especially in the context of improving HOTS among students.

Additionally, this study has identified a third theme, which is inquiry. This element of the inquiry-based approach needs to be integrated into the teaching and learning module

of HOTS because it will make learning more enjoyable and exciting for students. However, according to [54], teachers face problems when implementing inquiry-based approaches because they fail to design appropriate questions. To address this issue, a detailed explanation of the element of inquiry-based approaches in questioning techniques can be found in a developed HOTS teaching module. There is a need for an inquiry-based approach to be used in the metacognition-based HOTS teaching module because it can help students build their knowledge through investigation and questioning activities in the classroom [26,27]; in addition, it will allow students to build inquiry skills to learn lifelong knowledge and acquire various HOTS, such as scientific skills, soft skills, information technology skills, problem solving skills, and decision-making skills [54]. The inquiry-based learning process values student's experience by allowing them the opportunities to create stimulating and enjoyable learning experiences [55].

Modules that are developed play roles in enhancing the knowledge, skills, and practices of teachers in metacognition-based HOTS teaching. Moreover, according to [14], teachers' theoretical and practical development on metacognition-based HOTS teaching modules requires attention and reflective action. Thus, the construction of metacognitive-based HOTS teaching modules, based on the themes and subthemes obtained in this study, is deemed critical and should be prioritized, as this study has confirmed that all the themes and subthemes gathered in this systematic literature review are appropriate as elements for metacognition-based HOTS teaching modules.

Besides, this study makes significant contributions to the field of HOTS practice and knowledge. By referring to this SLR, stakeholders, such as educators, can implement various teaching methods in classrooms, and researchers can contribute to the body of knowledge by broadening the scope of this study. Additionally, this study contributes new knowledge to metacognition theory by including the inquiry stage in the planning, monitoring, and evaluation processes.

7. Recommendation

The findings of this systematic literature review on the elements of metacognition-based HOTS teaching and learning modules suggest that future researchers consider and incorporate the mentioned elements into the production of HOTS teaching and learning modules. This SLR has also shown that elements such as critical thinking, cognition, higher order thinking skills, inquiry, and metacognition help students in developing higher order thinking skills. Therefore, it is recommended to combine all these elements to create more interesting and impactful HOTS teaching and learning module and learning activities.

Additionally, it is recommended that future systematic literature reviews focus on the activities in the HOTS teaching and learning modules. This is because research on the activities suggested in the HOTS teaching and learning modules can provide an overview and guidance to develop more effective and robust activities.

A more comprehensive systematic literature search in other databases, such as the Educational Resources Information Center (ERIC), to obtain relevant articles from a more diverse journal, is also recommended.

This study also recommends a separate search for articles in journals related to education and learning only. By limiting the review to journals on education and learning, the result will be more relevant, focused, accurate, and aligned with the educational issues studied.

8. Conclusions

The aim of this study was to conduct a systematic literature review on the elements of metacognition-based HOTS teaching and learning modules. The elements discussed include higher order thinking skills, critical thinking, cognitive, metacognitive, and inquiry approaches. These elements are relevant for implementation into metacognition-based HOTS teaching and learning because they are proven to help improve and influence the level of student achievement in higher order thinking skills.

This study also found that teachers need to act as a catalyst for students to develop thinking skills when implementing these elements into the metacognition-based HOTS teaching and learning. Therefore, this systematic literature review can give awareness to teachers that HOTS teaching and learning processes are about more than cognitive skills and achievement, because they also emphasize metacognitive aspects. It can be concluded that the elements of the HOTS teaching and learning modules discussed here are not only important in influencing students' mastery of thinking skills but can also affect the formation of students' attitudes and behaviors towards the subjects they study.

Author Contributions: Conceptualization, H.H., M.I.H. and H.Z.; methodology, H.H. and M.I.H.; software, H.H.; validation, H.H. and M.I.H.; writing—original draft preparation, H.H.; writing—review and editing, H.H. and M.I.H.; visualization, H.H.; supervision, M.I.H. and H.Z. All authors have read and agreed to the published version of the manuscript.

Funding: The research was funded by the Universiti Kebangsaan Malaysia, grant number GG-2020-030.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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