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Promoting Analytical Thinking Through Learning Models: Systematic Literature Review

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Abstract: The integration of analytical thinking in teaching is essential to improving the quality of education and preparing students to face the challenges of the 21st century. Various learning models can be applied to improve students' analytical thinking. This study aims to explore 1) Indicators of analytical thinking used. 2) Grand theory used. 3) Learning models used to improve analytical thinking. 4) A review of the methods and techniques of data analysis used. This Systematic Literature Review study uses the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). The literature review procedure includes searching, filtering, evaluating, and synthesising publications on Project-Based Learning in improving critical thinking. The articles reviewed were 37 articles obtained from Scopus, Science Direct, Google Scholar, and ERIC from 2015 to 2024. The results show that most studies confirm the significant influence of various learning models on analytical thinking. The most frequently used indicators of analytical thinking are differentiating, organising, and attributing. The grand theory most widely used to explain the relationship between variables is constructivism. Problem-based learning is the most widely applied learning model. The most widely used research method is an experiment to show the influence of learning models on analytical thinking.

Keywords: analytical thinking; learning models; systematic literature review

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INTRODUCTION

Analytical thinking is a skill that unites the initial process, plans solutions, produces solutions, and draws conclusions or correct answers (Anggoro et al., 2021). Analytical thinking is handling any object or event with different aspects, separating it into parts, detecting relations between parts, classifying, determining cause-and-effect relationships, understanding the reasons for established relationships, and associating with each other (Bloom, 1956). Analytical thinking is part of higher-order thinking skills (Yu et al., 2024). Analytical thinking is a cognitive skill that involves the methodical and systematic examination of complex information to gain a deeper understanding (Kwangmuang et al., 2021). Analytical thinking involves dividing items into components, such as statements, ideas, theories, arguments, situations, and practices (Rodrangsee et al., 2022). The analytical thinking process allows for better decisions by encouraging one to have choices

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and then focus more on the best alternative (Kocabaş & Yücel, 2022).

Analytical thinking skills are an inseparable part of education. Good education relies on technical skills and the ability to think deeply and analytically (Beňo, Pavel, (Beňo et al., 2020). Global studies also place analytical thinking skills as skills that must be developed in the 21st century (Theabthueng et al., 2022) and are the foundation of learning and life, and the basis of all thinking (Phurikultong & Kantathanawat, 2022). In education, this ability greatly helps students understand more complex concepts, develop critical thinking skills, and increase the effectiveness of decision-making in the teaching and learning process (Davis & Museus, 2019). According to Bloom's Taxonomy, analytical thinking is one of the high-level thinking skills along with synthesis and evaluation (Theabthueng et al., 2022).

Analytical thinking is one of the competencies that must be developed in the world of education in the 21st century. However, various studies show this skill is still relatively low in various countries. The process of developing analytical thinking in students in Thailand is still carried out at a reasonably low level and has not achieved the final goal required (Art-in, 2014). The logical and analytical thinking skills of Thai students are not well-formed. They are constrained because out of 6,235 students tested, only 2.09% could pass the exam in 10 provinces in Thailand (Phurikultong & Kantathanawat, 2022).

Various factors cause low analytical thinking skills. The education system is still too focused on mastering basic skills (lower-order thinking skills), while higher-order thinking skills, such as analytical, are still neglected (Abosalem, 2015). Students do not show significant development in critical and analytical thinking at the tertiary level during their studies (Huber & Kuncel, 2016). Students' low analytical thinking skills are caused by teaching methods that do not support the development of high-order thinking skills (Fuad et al., 2017). Teachers themselves have a low mastery of learning strategies that encourage analytical thinking (Retnawati et al., 2018).

Skills such as analytical, critical, creative, and problem-solving thinking are becoming increasingly important today. Among these skills, analytical thinking is critical (Amer, 2005). Analytical thinking is a life skill that is very important to develop, considering the learning process (Ramdiah et al., 2018). In an increasingly complex world, analytical thinking skills are becoming very valuable because understanding complex information is now more important than ever (Li, 2022). The World Economic Forum ranked analytical thinking and innovation as the most important skills in 2025 (Li, 2022). However, it was not included in the list of important skills in 2020 and 2015. Individuals who think more analytically are less likely to be influenced by fake news and disinformation. This shows the power of analytical reasoning in filtering information and distinguishing the truth in an era dominated by digital content (Pennycook & Rand, 2019).

Analytical thinking can help develop fundamental elements in the learning process that benefit all students. To produce the correct conclusions or answers, analytical thinking requires integrating the initial process, planning and implementing solutions, and finally drawing conclusions (Hidayat et al., 2024). One way to improve analytical thinking is to apply a learning model. There are many learning models that educators can use. This model's selection is adjusted to the objectives and expected learning outcomes.

This study uses a systematic literature review to synthesise research related to analytical thinking in the educational environment. Therefore, this study aims to analyse

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the application of learning models for analytical thinking. More specifically, this study wants to answer the following research questions: What indicators of analytical thinking are used? What theory is used? What learning model is used? What research design is used? Through this study, the gaps that still exist will be identified for further research.

METHOD

Search Literature

This study searches the literature follows Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) standards, including (1) identification, (2) screening notes, (3) assessment article For feasibility, and (4) determining whether the study will be included or excluded (Moher et al., 2009). Researchers use access to Google Scholar, ScienceDirect, Scopus, and ERIC databases to identify an article that examines analytical thinking. Selected articles are articles from journals that have undergone a peer review process. Keywords mainly used: “analytical thinking” OR “analytical thinking skill” AND “learning models”. A keyword search using AND and OR to expand the results. Researchers do not limit educational levels when selecting articles. Search results were 410 articles, with details of 204 articles in Google Scholar, 37 articles in ScienceDirect, 25 articles in Scopus, and 144 articles in ERIC.

Stage selection and criteria included articles.

This literature review research uses selected and fulfilling article conditions: (1) Journal articles (not books, book chapters). (2) Published between 2019 to 2024. (3) Written in English. (4) Analytical thinking and learning models are relevant to the study's focus. (5) Full text. After applying the inclusion and exclusion criteria, the selected articles in this literature review are 37. Detailed process collection articles according to PRISMA standards are presented as follows

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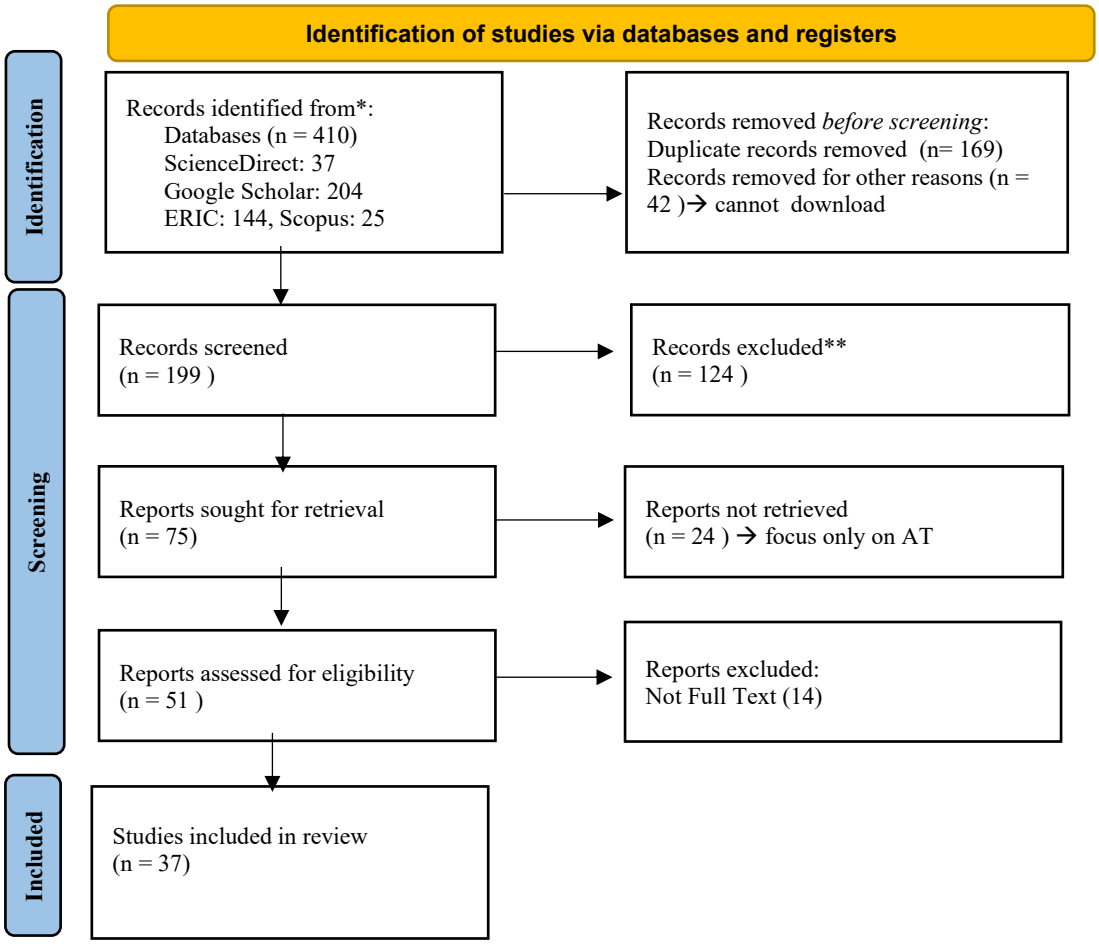

Image 1 . PRISMA of Analytical Thinking

Analysis and coding process

This study used 37 articles relevant to the topic. After the articles that meet the criteria are determined, the next step is to group and summarize the data into several aspects, namely: author name, analytical thinking indicators, theories used, independent variables, education level, research methods, samples and sampling techniques, data analysis techniques, research results, and research limitations. The researcher used MS Excel to process and code all information. After all, the researcher obtained and coded the data, sorted the results, and coded them for presentation.

Table 1. List of Articles on Analytical Thinking

Author/s	Indicators	Theory	Learning Model	Method

(Rodrangsee et al., 2022)	Truth-seeking, Problem-solving, Understanding development	Teori: Multiple Intelligence Theory (MIT)	Model PPICI	R&D
(Demir, 2022)	Internalization of data, Attention to detail, Analysis of data, Strategic approach			Correlational
(Phuseengoen & Singhchainara, 2022)		Constructivism	STEM	Experimental
(Kocabaş & Yücel, 2022)	Defining/Explainin, Graphic/Model Use, Comparing/Classifying, Problem-Solving, Establishing Cause–Effect Relationship		emergency distance dan face-to-face	Mixed-methods
(Phurikultong & Kantathanawat, 2022)	Analysis of elements, Analysis of relationships, Analysis of organizational principles	Learning Environment Theory	flipped classroom	Mixed-methods
(Anggoro et al., 2021)	Differentiating, Organizing, Attributing	Constructivism	Open-ended learning method	Experimental
(Theabthueng et al., 2022)	Element Analysis, Relationship Analysis, Organizational Principle Analysis:		Integrated Problem-Based Learning dan Think-Pair-Share	Experimental
(Fatimahtuzzahroh et al., 2018)	Distinguishing/ Differentiating, Organizing, Attributing		Inquiry-Based Learning	Experimental
(Chonkaew et al., 2016)	Analyzing scientific information, Connecting concepts (conceptualization), Using data and chemical laws to solve problems, Generating and testing hypotheses, Evaluating experimental results		STEM	Action Research
(Mayarni & Nopiyanti, 2021)	Distinguishing, Organizing, Connecting			Correlational
(Thaneerananon et al., 2016)	Analysis of elements, Analysis of relationships, Analysis of organizational principles			test development study
(Suyatman et al., 2021a)	Matching, Classifying, Organizing, Attributing		Problem-Based Learning	Mixed-methods
(Baghaei Lakeh & Ghaffarzadegan, 2015)		Dual Processing Theory		Experimental

(Chumsukon & Ruangsan, 2021)	Content analysis, Relationship analysis, Principle analysis		Research-Based Learning Dan Community Learning Resources	Experimental
(Spaska et al., 2021)		Constructivism	Parliamentary Debate	Experimental
(Suyatman et al., 2021b)	Differentiating, Organizing, Attributing		Research-Based Learning	Mixed-methods
(Puttasem, 2022)		Constructivism	Blended Learning	Experimental
(Kabatas Memıs & Ergun, 2023)	Identifying the main idea, Revealing relationships between main and side ideas, Finding principles for combining elements, Coming to a conclusion		Pendekatan Argumentation-Based Inquiry (ABI)	Mixed-methods
(Sasanti et al., 2024)	Differentiating, Organizing, Attributing		Inquiry-Based Learning	Action Research
(Yu et al., 2024)	Pre-analytical thinking, Analytical-partial, Semi-analytical, Analytical-complete	Sociocultural Theory	Collaborative Inquiry-Based Learning (CIBL)	Literature Review
(Dwi et al., 2024)	Distinguishing, Organizing, Assigning		Problem-Based Learning	Experimental
(Wijaya et al., 2023)	Differentiating, Organizing, Attributing			Kualitatif
(Fiolida & Rohaeti, 2021)	Differentiating, Organizing, Attributing		Research-Oriented Collaborative Inquiry Learning	Experimental
(Guo et al., 2024)	Knowledge Comprehension, Problem Analysis, Logical Reasoning, Application of Technology		Reflective and Collaborative Learning:	Experimental
(Andriani & Supiah, 2021)			Problem-Based Learning	Experimental
(Khamsaengmat & Kanjug, 2022)	Internalization of Data, Attention to Detail , Analysis of Data, Strategic Approach	Constructivism	flipped classroom	Experimental
(Ramadani et al., 2021)	Matching, Classification, Linking, Conclusion, Application	Constructivism	Inquiry-Based Learning	Library Research
(Anthonysamy et al., 2024; Fadly, 2021)	Distinguishing, Organizing, Attributing			Kualitatif
(Anthonysamy et al., 2024)	Identifying a problem, Finding and knowing relationship patterns, Identifying and	Social Cognitive Theory		Kuantitatif

	evaluating errors, Concluding main idea			
(Sujatmiko et al., 2021)	Problem Identification, Key Information Extraction, Workable Solution Development		Problem-Based Learning	R&D
(Kocaman, 2023; Wongpratoom & Sranamkam, 2019)	Differentiating, Organizing, Connecting	Constructivism		Experimental
Wongpratoom, W., & Sranamkam, T. (2019).	Sorting, Classification, Comparison, Evaluation:		Student Teams Achievement Division	Experimental
(R. Sari et al., 2019)	Differentiating, Organizing, Attributing		Problem-Based Learning	Experimental
(Yuenyong & Yuenyong, 2021)	Analytical thinking for key importance (I1–I4), Analytical thinking for relationship (R1–R5), Analytical thinking for principles (T1–T3)	Constructivism	Strategi pembelajaran POE (Predict–Observe–Explain)	Action Research
(Puti et al., 2024)	Thesis or statement, Evidence, Reasoning and clarity	Constructivism	Project-based learning	Mixed-methods
(Liline et al., 2024)	Analysis of model in action, Analysis of social system, Analysis of support system, Analysis of principles of reaction		Project-based learning	Experimental
(Syawaludin et al., 2022)		Constructivism	Project-based learning dan Problem-Based Learning	Experimental

RESULT AND DISCUSSION

Indikator Analytical Thinking

The first research question is related to the indicators used in the study. When analysed for each indicator, the most frequently used indicators (n=8) are differentiating, attributing, and organising (Anggoro et al., 2021; Fadly, 2021; Fatimahtuzzahroh et al., 2018; Fiolida & Rohaeti, 2021; R. Sari et al., 2019; Sasanti et al., 2024; Suyatman et al., 2021b; Wijaya et al., 2023). The following indicators (n=3) are classifying (Kocabaş & Yücel, 2022; Ramadani et al., 2021; Suyatman et al., 2021a), concluding (Anthonysamy et al., 2024; Kabatas Memıs & Ergun, 2023; Ramadani et al., 2021), and problem-solving (Chonkaew et al., 2016; Kocabaş & Yücel, 2022; Suyatman et al., 2021a). Eight researchers use differentiating, attributing, and organizing indicators together (Anggoro et al., 2021; Fadly, 2021; Fatimahtuzzahroh et al., 2018; Fiolida & Rohaeti, 2021; R. Sari et al., 2019; Sasanti et al., 2024; Suyatman et al., 2021b; Wijaya et al., 2023). Other studies use matching, classifying, and problem-solving indicators to measure analytical thinking (Suyatman et al., 2021a). In addition, research uses defining, classifying, comparing, problem-solving, and cause-effect indicators (Kocabaş & Yücel, 2022).

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The selection of differentiating, attributing and organizing indicators together is in line with Bloom's revised taxonomy by Anderson and Krathwohl which states that the three indicators are part of the cognitive domain of analysis which includes the ability to distinguish relevant information (differentiating), evaluate the attribution of meaning or sources of information (attributing), and systematically organize and organize information (organizing) (Anderson & Krathwohl, 2001). The theoretical validity of this indicator is strengthened by the opinion that these three components are at the core of developing critical and analytical thinking, especially in the context of information literacy and digital-based learning (Abuhassna et al., 2020). Therefore, the dominance of this indicator not only reflects methodological trends but also shows pedagogical accuracy in measuring students' analytical abilities.

Theories Used

The second research question is related to the basic theory used to explain the relationship between variables. Of the 37 articles reviewed, 15 mentioned the theory used. The theories used in the various articles include constructivism theory, dual processing theory, social cognitive theory, multiple intelligence theory, learning environment theory, and sociocultural theory. Ten studies use constructivism theory (Anggoro et al., 2021; Khamsaengmat & Kanjug, 2022; Kocaman, 2023; Phuseengoen & Singhchainara, 2022; Puti et al., 2024; Puttasem, 2022; Ramadani et al., 2021; Spaska et al., 2021; Syawaludin et al., 2022; Yuenyong & Yuenyong, 2021). Meanwhile, theories other than constructivism theory are used by one study each. Many articles do not explicitly mention the basic theory used.

Constructivist theory is widely chosen because it provides a strong foundation for explaining the relationship between learning variables, especially in encouraging students' active involvement in building knowledge through experience and reflection, which is very relevant to developing analytical thinking skills. Constructivism theory supports the development of critical and analytical thinking through a problem-based and contextual active and reflective learning approach (Almulla, 2023). In addition, constructivist theory effectively creates a learning environment that supports high-level thinking processes, including analysis, synthesis, and evaluation (Ayaz & Şekerci, 2015; Shadiev et al., 2021). Therefore, the dominant use of constructivism theory in this study shows the alignment between the conceptual framework and the needs of students' cognitive skill development in contemporary education.

Learning Models Used

The third research question concerns the learning model used to improve analytical thinking. Various learning models can be used by educators to improve analytical thinking skills. Based on the results of the analysis, the most widely used learning model is Problem-Based Learning, which was applied in six studies (Andriani & Supiah, 2021; Dwi et al., 2024; R. Sari et al., 2019; Sujatmiko et al., 2021; Suyatman et al., 2021a; Syawaludin et al., 2022). This model encourages students to solve real problems collaboratively and reflectively. Furthermore, Inquiry-Based Learning appeared in four studies, reflecting the importance of exploration-based Learning and open-ended questions (Fatimahtuzzahroh et al., 2018; Ramadani et al., 2021; Sasanti et al., 2024; Yu

et al., 2024). Project-Based Learning was used in three studies, emphasizing the development of analytical skills through contextual projects (Liline et al., 2024; Puti et al., 2024; Syawaludin et al., 2022). In addition, there are also models such as Collaborative Inquiry Learning (Yu et al., 2024), STEM-based Learning (Chonkaew et al., 2016; Phuseengoen & Singhchainara, 2022), and Flipped Classroom (Khamsaengmat & Kanjug, 2022; Phurikultong & Kantathanawat, 2022). Other contextual models, although with lower frequencies, were also found, such as Argumentation-Based Inquiry, Open-Ended Learning, Parliamentary Debate, and Think-Pair-Share. The diversity of these models shows that the development of analytical thinking skills can be facilitated through varied and flexible approaches according to the learning context. However, the most significant trend still leads to problem-based and inquiry approaches as the most dominant and effective strategies.

Research Design Used

The fourth research question is related to the research design used in the various articles reviewed. The most widely used research design is the experimental research design. This design was used by 18 researchers (Andriani & Supiah, 2021; Anggoro et al., 2021; Baghaei Lakeh & Ghaffarzadegan, 2015; Dwi et al., 2024; Fatimahtuzzahroh et al., 2018; Fiolida & Rohaeti, 2021; Guo et al., 2024; Khamsaengmat & Kanjug, 2022; Kocaman, 2023; Liline et al., 2024; Phuseengoen & Singhchainara, 2022; Puttasem, 2022; W. K. Sari & Nada, 2022; Spaska et al., 2021; Syawaludin et al., 2022; Theabthueng et al., 2022; Wongpratoom & Sranamkam, 2019). Another research design is mixed-method used by 6 researchers (Kabatas Memıs & Ergun, 2023; Kocabaş & Yücel, 2022; Phurikultong & Kantathanawat, 2022; Puti et al., 2024; Suyatman et al., 2021b, 2021a). Action research is used by 3 researchers (Chonkaew et al., 2016; Sasanti et al., 2024; Yuenyong & Yuenyong, 2021). Other research models used are R&D, correlational, qualitative descriptive, quantitative descriptive, and library research.

Experimental designs are often chosen because of their ability to test cause-and-effect relationships while controlling for variables that influence learning or cognition, making them ideal for research in education and psychology. In addition, the mixed-method designs used by the 6 researchers showed a tendency to combine quantitative and qualitative data to gain a more holistic picture of the phenomenon being studied. Action research designs focus on reflective and iterative improvement of teaching practices, positioning teachers as researchers who implement changes in their teaching. Other research designs, such as R&D, correlational, qualitative descriptive, quantitative descriptive, and library research, show the diversity of methodologies used in these studies to meet a variety of research purposes and contexts. The selection of these designs illustrates that education research is more often focused on controlled experiments and the achievement of objectively measurable outcomes. However, there is also an awareness of the importance of more flexible and reflective approaches, such as mixed-method and action research.

CONCLUSION

This research thoroughly examines analytical thinking and its incorporation into educational frameworks. It underscores the vital importance of analytical thinking in

improving cognitive abilities, especially in the context of 21st-century education. The results indicate that the indicators of differentiating, attributing, and organising are the most frequently used in educational research, according to Anderson and Krathwohl's updated Bloom's Taxonomy. Additionally, the study highlights the prevalent use of experimental research designs, valued for their capacity to test cause-and-effect relationships in controlled environments. The research also stresses the effectiveness of Problem-Based Learning and Inquiry-Based Learning models in nurturing analytical thinking, with mixed-methods research gaining traction as a preferred approach to address the complexities of cognitive development.

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