International Journal of Instruction
e-ISSN: 1308-1470 ● www.e-iji.net

July 2026 ● Vol.19, No.3
p-ISSN: 1694-609X
pp. 717-732

Article submission code: 20251212225019
Received: 12/12/2025
Revision: 18/02/2026
Accepted: 27/02/2026
OnlineFirst: 07/04/2026

A Needs Assessment for Enhancing Primary School Science and Technology Students' Analytical Thinking Skills as Reviewed by Teachers

Vorlasert Thanakhunsert
King Mongkut's Institute of Technology Ladkrabang, Thailand, *62603014@kmitl.ac.th*

Paitoon Pimdee
King Mongkut's Institute of Technology Ladkrabang, Thailand, *paitoon.pi@kmitl.ac.th*

Aukkapong Sukkamart
Corresponding author, King Mongkut's Institute of Technology Ladkrabang, Thailand, *aukkapong.su@kmitl.ac.th*

Punnee Leekitchwatana
King Mongkut's Institute of Technology Ladkrabang, Thailand, *klpunnee@gmail.com*

Chontawat Meedee
King Mongkut's Institute of Technology Ladkrabang, Thailand, *chontawat.me@kmitl.ac.th*

The study used a needs assessment to identify and prioritize areas for developing analytical thinking skills (ATS) in primary school students, based on the perspectives of their primary school science and technology (computing science) teachers (SCITECH Instructors). A quantitative cross-sectional survey was conducted among 311 teachers. The instrument used was a validated questionnaire with an excellent internal consistency (Desired state $\alpha = 0.96$; Actual state $\alpha = 0.88$). Descriptive statistics were used for data analysis, along with a dependent t-test, and the modified Priority Needs Index (PNImodified) to assess and rank the discrepancy between actual and desired skill levels. A significant difference was observed overall between Desired and Actual skill observations: the analytical thinking skill was at the Developing level among current students, whereas a proficient-to-mastery command was desired. A distinct order of needs was found, with the highest being the need to identify problem components (PNImodified = 1.09), followed by identifying issues related to problems, using reasoning/logic, and collecting/analyzing data. These results provide an empirical basis for informing the development of student-centered primary school curricula, specifically targeted teacher-training programs, and strategic resource allocation to build urgently needed ATS competencies from the earliest stages of education.

Keywords: pre-service teacher training, Priority Needs Index, science & technology teachers, student teachers, Thailand

Citation: Thanakhunsert, V., Pimdee, P., Sukkamart, A., Leekitchwatana, P., & Meedee, C. (2026). A needs assessment for enhancing primary school science and technology students' analytical thinking skills as reviewed by teachers. *International Journal of Instruction*, *19*(3), 717-732.

INTRODUCTION

The development of analytical thinking skills (ATS) has become a central pillar of 21st-century global education frameworks (Phurikultong & Kantathanawat, 2022), underscoring the need to prepare students for a complex, information-rich, and rapidly evolving landscape (Anthonysamy et al., 2024). The promotion of ATS has been recognized as a core educational demand of the 21st century within national frameworks and beyond, and has been advocated by international organizations such as the OECD.

In particular, the OECD's Future of Education and Skills 2030 project (Bast, 2019) identifies analytical and critical thinking as one of the key transformative competencies that enable individuals to face an uncertain future in a complex, rapidly changing world, amidst new and unknown challenges. Furthermore, UNESCO and the World Bank frameworks incorporate higher-order thinking skills (HOTS) into core educational demands for sustainable development, innovation, productivity, and adaptability to future challenges (Sugandi & Ruhimat, 2021). The promotion of analytical thinking is widely regarded as a universally pursued educational goal worldwide, aimed at maintaining economic competitiveness and increasing productivity by shifting away from rote learning toward higher-order cognitive processes, including analysis and creativity.

Thailand's national educational policy directly responds to this global priority by declaring, in its National Education Plan 2017-2037, its intent to ensure that citizens obtain education relevant to the development of 21st-century learners (Ministry of Education, 2017), with an integrated learning focus on analytical and creative thinking skills. The aim is incorporated within the Basic Education Core Curriculum B.E. 2551 (A.D. 2008), which seeks to develop learners' key competencies needed in a world where the rapid advancement of science and technology makes the ability to think analytically, synthetically, creatively, critically, and systematically a vital necessity for intelligent decision making and a meaningfully better society. The assessment and development of ATS are therefore not only a local pedagogical concern, but also an essential act in implementing a national strategy that responds to a definitive global educational agenda.

Analytical thinking – here defined as the ability to apply logical reasoning in breaking down complex information into parts in order to identify relationships and draw conclusions – is a cornerstone of success across academic, professional, and personal endeavors, forming the basis of higher-order thinking competencies such as critical thinking and problem-solving (Phurikultong & Kantathanawat, 2022). In Science, Technology, Engineering, and Mathematics (STEM) education contexts, analytical thinking is a particularly critical skill for engaging with inquiry-based learning and non-trivial problem-solving (Hidayat et al., 2024). While the ability to think analytically is broadly recognized as important, an enduring challenge in effectively fostering this skill amongst students is that it presupposes a systematic assessment of the most significant gaps between existing and target competencies for a given population.

One important tool for identifying differences between the current and desired states is a needs assessment, which provides a factual basis for recommendations regarding the design of specific interventions (Aroonsiwagool et al., 2025; Saraphol & Nuangchalerm, 2025). A needs assessment helps stakeholders in educational contexts determine the proper priorities and make effective curriculum and instructional decisions about everyday practice by identifying the existing knowledge and/or skills that align with the desired knowledge and/or skills. In terms of educational outcomes and the labor market, needs assessments also enhance the relevance and, therefore, the effectiveness of curricula, which is particularly significant for organizations as they attempt to align their outcomes with societal concerns. For example, the Institute for the Promotion of Teaching Science and Technology (IPST) in Thailand emphasized that contemporary teachers demonstrate competence in using technology for teaching and learning design, material and resource development, and the implementation of learner-centered activities (Julkaew & Buaraphan, 2025). This has become a key point for needs assessment in curriculum review.

A strong approach to quantitatively assessing and prioritizing such needs is the Priority Needs Index Modified ($PNI_{modified}$), which has been validated in the Thai context (Aroonsiwagool et al., 2025; Chanyawudhiwan et al., 2023; Ussarn et al., 2022). The method has been widely adopted worldwide across various fields, including education, medicine, information technology, and human resource development, as it has been proven to accurately reflect real-world needs and priorities (Al-Ismail et al., 2023; Aroonsiwagool et al., 2025).

Thailand studies have identified gaps in students' development, especially in higher-order thinking skills, and a misalignment between the skills promoted in curricula and those needed for Thai careers (Al-Ismail et al., 2023). One specific and important gap was the lack of a systematic, empirical analysis of ATS in Thailand's primary science and technology. Teachers as the primary agents of curriculum implementation, but limited research has examined teachers' perceptions of students' current and desired ATS.

Thus, the current study is important because it provides an essential, evidence-based foundation for curriculum development and instructional planning. To systematically assess and fill this knowledge gap, the current study will explore the current and desirable states of primary students' ATS, as reported by their SCITECH Instructors, and employ the $PNI_{modified}$ to pinpoint the most urgent aspects that require attention. It is expected that its findings will provide a sound basis for designing in-service teacher training, instructional models, and curricula that promote analytical thinking among primary students, thereby enhancing their ATS and ultimately advancing Thailand's education to meet the demands of the 21st century.

Research gap statement

Promoting students' ATS is an imperative educational goal in the 21st century, enabling them to cope with the complexities of problems and technological demands (Phurikultong & Kantathanawat, 2022). Most importantly, primary science and technology (computing science) education can foster mindsets in students who can

become innovators of the future and make the world a better place (Janpirom et al., 2025). Despite its importance and the many frameworks, such as IPST, that suggest the teacher competencies needed for these skills in science and technology (or computing science education) (Kotsis, 2025), there is a significant gap between the skills students currently possess and the higher-order thinking skills they will need for their future careers. In particular, conducting a systematic and empirical needs assessment specifically aimed at analytical thinking skills in science and technology subjects for primary teacher education in the Thai context is a notable gap. Without an empirically derived understanding of current-ideal discrepancies in specific skills, as perceived by teachers at the forefront of remedial endeavors, remedial efforts will be erratic and misplaced, lacking consensus on the objectives, content, and pedagogy of curriculum and teacher training for teaching primary science and technology.

Research Hypothesis

It is hypothesized that there is a considerable gap (discrepancy) between the current and ideal levels of ATS primary school students' science and technology knowledge, as perceived by their SCITECH Instructors. It is further hypothesized that specific ATS components (e.g., differentiating, organizing, attributing) and not others will be identified as higher-priority skill dimensions, to be developed on an urgent basis through concentrated developmental efforts.

Research Objectives (ROs)

RO1: To find out the actual (current) and ideal (expected) levels of their students' analytical thinking skills (or SCITECH Instructors' perceptions related to this issue).

RO2: To define the needs (gaps) of the development of ATS of students based on the $PNI_{modified}$ method.

RO3: To compare perceived needs ($PNI_{modified}$ scores) for ATS development among teachers with different teaching experiences.

Research questions (RQs)

RQ1: What is the state of primary school students' ATS, as SCITECH instructors reported, and what would be a desired state?

RQ2: What are the specific needs (Ideal-Current gaps) to develop students' ATS? What is the order of priority by $PNI_{modified}$?

RQ3: Is there a significant difference in the $PNI_{modified}$ values of ATS development across different numbers of years of teaching experience of SCITECH instructors?

METHODS

Research Design

This study employed a quantitative needs assessment approach to evaluate the gap between the actual (D) and desired (I) states of students' ATS as perceived by their teachers. Such a design followed everyday needs assessment protocols well-established in Thai educational research (Aroonsiwagool et al., 2025). A cross-sectional survey was

used to examine perceptions among primary school science and technology teachers, which utilized the $PNI_{modified}$ for gap analysis and prioritization. Dependent (paired) sample t-tests were also used to determine the statistical significance of the gaps between actual and desired states (Chicco et al., 2025).

Population and Sampling

The study's target population consisted of all 1,406 primary school science and technology (computing science) (SCITECH) instructors in Thailand's Nakhon Nayok Primary Educational Service Area Office for the 2025 academic year.

Sample Size Calculation

Yamane's formula was utilized to determined sample size, with a 95% confidence level (Aroonsiwagool et al., 2025; Dramani et al., 2025), which indicated that the minimum required sample size was 311. This method has commonly been used to determine representative sample sizes from target populations in previous educational research in Thailand (Aroonsiwagool et al., 2025).

Sampling Technique

A multi-stage random sampling method was employed to select the 311 teacher participants, ensuring broad representation across schools within the service area. The final dataset comprised 311 complete and valid responses, meeting the calculated sample requirement.

Instruments and Validation

A structured questionnaire was developed to assess the actual condition (D) and desired condition (I) of students' analytical thinking skills. The instrument used a 5-point Likert scale, with ratings from 1 (Totally Disagree) to 5 (Totally Agree). The mean scores were interpreted according to the following performance levels: 4.50–5.00 = Mastery; 3.50–4.49 = Proficient; 2.50–3.49 = Competent; 1.50–2.49 = Developing; 1.00–1.49 = Novice.

The 19-item questionnaire evaluated four core analytical thinking skill aspects:

1. ***Identifying problem components***: The ability to deconstruct a problem into its basic parts (5 items).
2. ***Identifying problem issues***: The ability to identify the core problem within a complex situation (5 items).
3. ***Collecting and analyzing data***: The ability to gather relevant information and examine it to identify patterns and relationships (4 items).
4. ***Using reasoning/logic to overcome problems***: The use of logical sequences and evidence-based reasoning to form judgments (5 items).

Ethics Compliance

This study was conducted in accordance with the ethical principles for research in the social sciences in Thailand (Techagaisiyavanit et al., 2025). According to Thailand Science Research and Innovation (TSRI)'s guidelines (Phuangsuwan et al., 2024),

research based on an anonymous survey, which neither collects identifiable private information nor allows for identification of participants either directly or indirectly, where no risk is presented to participants' physical or mental health, is exempt from formal ethics committee review. All data were collected anonymously via an online survey tool, and consent to participate in the study was assumed through the voluntary completion of the questionnaire. Such procedures are regarded as exempt from ethics review under the ethical guidelines for minimal-risk educational research in this context.

Content Validity and Reliability Content Validation

The questionnaire was reviewed by a panel of five experts in computer education, curriculum and instruction, and educational psychology to ensure content validity (Govindasamy et al., 2024). The Index of Item-Objective Congruence (IOC) for all items ranged between 0.60 and 1.00, indicating that all of the items were relevant and appropriate to be used as the instrument. We conducted a pilot test (McCoy et al., 2021), and we found that Cronbach's alpha coefficients for the four skill aspects in the desirable (I) and actual (D) conditions ranged from 0.88 to 0.98. This indicates that all measurements were well above the suitably acceptable level of 0.80. The overall reliability of the 19-item scale was 0.96 for the desirable state and 0.88 for the actual state, indicating excellent and good internal consistency, respectively (Table 1).

Table 1
Reliability coefficients of the ATS questionnaire

Group Skill Aspects	Total items	Reliability (α)
Identifying problem components	5	0.96
Identifying problem issues	5	0.92
Collecting and analyzing data	4	0.88
Using reasoning/logic to overcome problems	5	0.98 (I) / 0.88 (D)
Overview	19	0.96

Data Collection

Data were collected from October to November 2025 via an online questionnaire administered through Microsoft Forms. A total of 311 primary school science and technology teachers (SCITECH Instructors) from the defined population completed the survey.

Data Analysis

Data analysis proceeded in three stages:

1. Descriptive Statistics: Means (*M*) and standard deviations (SD) were evaluated to ascertain the levels of actual (D) and desired (I) states for each analytical thinking skill aspect.
2. Needs Assessment and Prioritization: The Priority Needs Index modified ($PNI_{modified}$) was calculated for each skill aspect using the formula:
3. $PNI_{modified} = (I - D) / D$ (1)

4. Where *I* is the mean score for the desired state and *D* is the mean score for the actual state. Higher PNI values indicate a greater magnitude of need for development, providing a clear ranking for intervention priorities.
5. Inferential Analysis: Dependent (paired) sample t-tests were conducted to determine if the differences between the desired (I) and actual (D) mean scores for each skill aspect were statistically significant ($p < .01$) (Cohen et al., 2017).

FINDINGS

Participants Characteristics

The sample in this study consisted of 311 primary school science and technology teachers from the Nakhon Nayok Primary Educational Service Area Office. Table 2 shows that most teachers were female (52.41%) and held a bachelor's degree (81.67%). Notably, most participants were over 35 years old (64.63%), with 10 years or more of teaching experience (63.02%). This suggests that the needs assessment evaluation was primarily based on the opinions of highly experienced teachers.

Table 2
SCITECH Instructors characteristics

Items	Number of SCITECH Instructors	%
Gender		
Female	163	52.41
Male	148	47.59
Highest Education Level		
Bachelor's Degree	254	81.67
Postgraduate Degree	57	18.33
Age		
Under 35 years old	110	35.37
Over 35 years old	201	64.63
Teaching Experience		
Under 10 years old	115	36.98
Over 10 years old	196	63.02

ATS Gap Analysis: Current vs. Desired States

The SCITECH Instructors' views on the current and desired levels of students' ATS indicate that the teachers have a significant and consistent opinion on the gap between the current (actual) and desired states of students' analytical thinking skills. In Table 3, we can see that the overall mean (M) of the actual (D) status was 2.24 (SD = 0.26) (i.e., Developing), while that of the desired (I) status *M* was 4.45 (SD = 0.52) (i.e., Proficient). This highlights a fundamental gap that needs to be bridged to achieve a certain level of student success.

Table 3
Mean, standard deviation, and ATS levels in actual and desired states

Group Skill Aspect	Condition	Mean	SD	Level
Identifying problem components	Desired (I)	4.27	.63	Proficient
	Actual (D)	2.04	.15	Developing
Identifying problem issues	Desired (I)	4.40	.57	Proficient
	Actual (D)	2.18	.27	Developing
Collecting and analyzing data	Desired (I)	4.63	.51	Mastery
	Actual (D)	2.48	.45	Developing
Using reasoning/logic to overcome problems	Desired (I)	4.52	.60	Mastery
	Actual (D)	2.31	.46	Developing
Total	Desired (I)	4.45	.52	Proficient
	Actual (D)	2.24	.26	Developing

Note. Interpretation Scale: 4.50–5.00 = Mastery; 3.50–4.49 = Proficient; 2.50–3.49 = Competent; 1.50–2.49 = Developing; 1.00–1.49 = Novice.

Needs Prioritization Using $PNI_{modified}$ and Statistical Significance

To determine the priority order for intervention, the $PNI_{modified}$ was calculated. Moreover, the results from the dependent t-test showed that all the gaps (the difference between the desired (I) and actual (D) states) were statistically significant at $p < .01$. Thus, as shown in Table 4, the skill aspect having the highest priority need was *Identifying Problem Components* ($PNI_{modified} = 1.09$) followed by Identifying Problem Issues ($PNI_{modified} = 1.02$), *Using Reasoning/Logic to Solve Problems* ($PNI_{modified} = 0.96$) and *Collecting and Analyzing Data* ($PNI_{modified} = 0.87$).

Table 4
Needs assessment and prioritization of ATS (PNIModified)

Group Skill Aspect	Condition	Mean	SD	Index of essential needs		Hypothesis testing (t-test)
				$PNI_{modified}$	Ranking	
Identifying problem components	Desired (I)	4.27	.63	1.09	1	62.35**
	Actual (D)	2.04	.15			
Identifying problem issues	Desired (I)	4.40	.57	1.02	2	70.57**
	Actual (D)	2.18	.27			
Collecting and analyzing data	Desired (I)	4.63	.51	0.87	4	81.37**
	Actual (D)	2.48	.45			
Using reasoning/logic to overcome problems	Desired (I)	4.52	.60	0.96	3	69.55**
	Actual (D)	2.31	.46			
Total	Desired (I)	4.45	.52	0.99		74.00**
	Actual (D)	2.24	.26			

**p <.01

Comparison of Needs between Teacher Experience Groups

A comparison was made between teachers with >10 years' classroom experience (n=196) and those with <11 years' experience (n=115) (Table 5). The priority order of

development needs was the same for both groups: 1) Id Problem Components, 2) Id Problem Issues, 3) Reasoning/Logic, and 4) Collect & Analyze Data. However, the PNImodified values are uniformly higher (for all aspects of analytical thinking skills) in the more experienced teacher group. This suggests that trainees with more than 10 years of classroom experience perceive a greater level of need, or a larger gap between the current and improved levels of students' capacity, than do less experienced teachers.

Table 5
Comparison of the assessment of needs by teaching experience

Group Skill aspect	≤ 10 years' experience (n=115)					> 10 years' experience (n=196)				
	Index of essential needs				t	Index of essential needs				t
	I	D	$PNI_{modified}$	Rank		I	D	$PNI_{modified}$	Rank	
Identifying problem components	3.91	2.03	0.93	1	35.54**	4.47	2.05	1.18	1	59.23**
Identifying problem issues	4.10	2.17	0.89	2	41.85**	4.58	2.18	1.10	2	64.61**
Collecting and analyzing data	4.45	2.50	0.78	4	50.69**	4.74	2.46	0.93	4	69.58**
Using reasoning/logic to overcome problems	4.28	2.35	0.82	3	43.48**	4.66	2.28	1.04	3	61.51**
Total	4.17	2.25	0.85		45.83**	4.61	2.23	1.07		67.01**

**p <.01

DISCUSSION

Overview of Key Findings

The study used a needs assessment approach to determine the actual and expected statuses of students' ATS as perceived by their Thai SCITECH Instructors (n = 311). The findings reveal a consistent and significant gap across all four measured skill aspects. The current state was uniformly rated at the *Developing* level (Overall M = 2.24), while the desired state was at the *Proficient* to *Mastery* level (Overall M = 4.45). Table 4 presents the $PNI_{modified}$ ranking of student ATS, indicating a clear order of needs that must be met, with the *Identification of Problem Components* ($PNI_{modified}$ = 1.09) receiving the greatest assessment need. This was followed by the *Identification of Problem Issues* ($PNI_{modified}$ = 0.98), *using reasoning and logic to Solve Problems* ($PNI_{modified}$ = 0.94), and *Collecting and Analyzing Data* ($PNI_{modified}$ = 0.88). The discussion interprets the key findings in direct response to the research questions, explores their theoretical and contextual implications, and proposes actionable recommendations.

Addressing RQ1: The Reported Current and Desired States of Analytical Thinking Skills

The first research question sought to understand students' current and desired proficiency levels in ATS. The findings reveal a consistent and substantial discrepancy. Instructors reported the current state across all analytical thinking sub-skills—problem decomposition, identifying the main problem, logical thinking, and data collection/analysis—to be at a "Developing" level. In stark contrast, the desired state for each skill was uniformly at the "Expert" level. This significant quantitative gap, validated by extremely high paired-sample t-values (all > 60, *p* < .01), confirms a widespread perception among frontline educators that student competency is critically deficient relative to the standards necessary for 21st-century STEM learning. This aligns with the broader literature and national assessments, which indicate systemic challenges in cultivating higher-order thinking within the Thai educational context (Aroonsiwagool et al., 2025; IPST, 2020).

Addressing RQ2: The Prioritized Needs for Developing Analytical Thinking Skills

The second research question focused on identifying and ranking the specific developmental needs. The PNImodified analysis provided a transparent, evidence-based prioritization, moving beyond merely confirming a gap to offering a strategic sequence for intervention.

Highest Priority Need - Problem Decomposition: The foremost need identified was the ability to deconstruct complex issues into manageable components ($PNI_{modified}$ = 1.07). This aligns with foundational literature on analytical and computational thinking, which positions decomposition as the critical first step in problem-solving (Hidayat et al., 2024). The finding suggests that students often engage with science and technology problems superficially, lacking the structured methodology to break them down, which subsequently hampers subsequent analytical processes.

Subsequent Priority Needs: The prioritized sequence that followed—Identifying the Main Problem (0.99), Logical Thinking (0.94), and Data Collection & Analysis (0.85)—outlines a logical developmental pathway. This order implies that effective intervention should first equip students with frameworks for deconstruction and focus, then build logical inference skills, and finally, hone technical data skills. This hierarchy is crucial for efficient curriculum design and resource allocation, ensuring that foundational sub-skills are secured before addressing more complex ones.

Addressing RQ3: Differences in Perceived Need by Teaching Experience

Differences in Perceived Need by Teaching Experience

The third research question asked whether the perceived urgency of these needs differed by instructor experience. The comparative analysis revealed a consistent pattern: while both groups (≤10 years and >10 years' experience) agreed on the order of priority, the more experienced instructors consistently reported larger PNImodified values across all sub-skills. This indicates that veteran educators perceive a greater magnitude of deficiency and thus a higher urgency for intervention.

This disparity may stem from several factors. Teachers with over a decade of experience possess a broader historical frame of reference for student capabilities and a deeper understanding of the skill demands in subsequent grades or real-world applications. Their heightened perception of need could reflect a more critical appraisal grounded in longitudinal observation, aligning with studies that find that teacher expertise shapes the diagnosis of learning gaps (Phillips et al., 2016). This insight underscores the value of incorporating veteran teacher perspectives into curriculum reform efforts.

Interpretation of the Analytical Thinking Gap

Current vs. Desired Levels and Prioritization

The substantial gap between the actual (*Developing*) and desired (*Proficient/Mastery*) levels underscores a systemic challenge in cultivating higher-order thinking skills within the studied context. This is consistent with other international research on learners' ability to transition from understanding proficiency to applying that understanding analytically (Brown et al., 2014) The needs prioritization elaborated by the PNI*modified* is particularly informative as the top-ranked need, *Identifying Problem Components* ($PNI_{modified}$ = 1.09) is the primary bottleneck in analytical thinking, which includes breaking down a problem into its constituent parts. This indicates that students are unable to undertake the initial, deconstructive process that leads to setting (*Identifying Problem Issues*), subsequent reasoning (*Using reasoning and logic to Solve Problems*), and data processing (*Collecting and Analyzing Data*). Without an explicit process for systematically unpacking complex systemic phenomena, students will face perpetual barriers to higher-order thinking (Kwangmuang et al., 2021, 2024). The fact that *Collecting and Analyzing Data* was ranked last, despite its large absolute gap, indicates that teachers perceive students' data-handling skills as less developed, which is dependent on improved problem-definition and reasoning processes.

Insights into the Data and Contextual Factors

The Primacy of Problem Decomposition

The identification of problem decomposition as the foremost need is consistent across a broad realm of literature on analytical thinking in STEM education. Hidayat et al. (2024), in their systematic review, emphasize that ATS in science settings often founders at the stage of defining system boundaries and variables. Our findings suggest that Thai primary students may be presented with problems but lack structured methodologies to break them down, resulting in superficial engagement. This calls for pedagogical shifts toward models that explicitly teach problem deconstruction, such as problem-based learning (PBL) frameworks, in which defining the problem is a distinct, taught phase (Loyens et al., 2023).

The Experienced Teacher Perspective

The comparative analysis showed that although teachers with different teaching experience agreed on the order of priority needs, the more experienced group (>10 years) consistently had larger $PNI_{modified}$ values across the attributes. This suggests that

veteran educators, with a broader frame of reference for students' capabilities over time or a deeper understanding of the skill demands of higher grades and real-world applications, perceive a greater urgency for development. This aligns with findings that teacher expertise influences their perception of student learning challenges and curriculum gaps (Phillips et al., 2016).

Curriculum and Pedagogical Implications

The gaps identified highlight a potential misalignment between curriculum goals and classroom outcomes. The Thai National Education Plan and Basic Education Core Curriculum explicitly aim to develop analytical thinkers. Nonetheless, the continuation of the Developing level in real practice suggests that pedagogical practices may not yet translate this intended policy into achieving competency. Priority indicates that curriculum and teacher manuals should emphasize basic analytical sub-skills, such as problem decomposition, before more complex analytical and synthesis-level reasoning can occur.

Practical Significance and Implications for Teacher Education

The extremely high t-values (all > 60, $p < .01$) and the $PNI_{modified}$ values (all > 0.85) demonstrate that the identified gaps are not only statistically significant but also represent large, educationally meaningful deficits. This practical significance mandates targeted interventions. These might include:

1. **Targeted Teacher Professional Development:** In-service training should be designed around the identified priority sequence. Workshops might first provide tools and activities for teachers to support students in "breaking down" science and computing problems into basic, constituent components (e.g., concept maps; entity-relationship diagrams for simple systems). Subsequent in-service modules would be designed to help students utilize these components to identify the primary issue. Then, students could be supported in applying logical thinking. Finally, teachers could be provided with approaches to support students in applying data collection and analysis techniques.
2. **Integration of Explicit Thinking Routines:** Pedagogical approaches, such as "Thinking Routines" from Project Zero (Ferguson, 2025), or specific inquiry-based learning models, should be integrated into science and technology lesson plans (Kamarudin et al., 2024). Routines such as "See-Think-Wonder," "Claim-Support-Question," or "Parts-Purposes-Complexities" can provide structured scaffolds that directly build the prioritized analytical sub-skills (Kwangmuang et al., 2021, 2024).
3. **Curriculum Resource Development:** Developers of textbooks and other curriculum resources (e.g., IPST) should ensure that units of learning and student learning activities are sequenced to develop analytical thinking progressively. Thus, in the early grades, there should be a heavy emphasis on observation, comparison, and simple categorization (all components of problem decomposition), with a gradual introduction of other reasoning skills and more complex data analysis in the later grades.

4. **Assessment Redesign:** Formative and summative assessments in science and computing need to go beyond factual recall and include items that explicitly measure these analytic sub-skills. This could include, for example, presenting a simple environmental scenario and asking learners to list its key features (problem components) or asking them to highlight the key cause of a problem.

CONCLUSIONS

This study provides a systematic, empirical assessment of the needs for developing ATS among primary school students in Thailand, as perceived by their science and technology teachers. Utilizing the widely accepted PNImodified methodology, the research successfully addressed its two core objectives.

First, it quantified a significant and consistent gap between the current and desired states of students' analytical thinking. Teachers evaluated students' current abilities at the Developing level across all measured skill aspects—identifying problem components, identifying problem issues, using reasoning/logic, and collecting/analyzing data. In stark contrast, the desired level was set at Proficient to Mastery. This substantial disparity highlights an urgent and systemic need to enhance higher-order thinking competencies from the foundational years of education.

Second, the study went beyond identifying a general gap to establishing a clear and actionable hierarchy of developmental priorities. The analysis revealed that the most critical need is in the foundational skill of identifying problem components ($PNI_{modified}$ = 1.09), followed by identifying problem issues, using reasoning/logic, and collecting/analyzing data. This prioritization, consistent across teacher groups with varying experience levels (though the perceived magnitude of need was greater among more experienced teachers), offers invaluable guidance for strategic intervention. Pedagogical efforts and curriculum resources should first strengthen students' ability to deconstruct complex situations before advancing to higher-order analysis and synthesis.

The findings have direct implications for educational practice and policy. They provide a data-driven blueprint for (1) redesigning science and technology curricula to build analytical sub-skills sequentially, (2) designing targeted professional development programs for teachers focused on these priority areas, and (3) allocating educational resources more efficiently to address the most pressing deficits. By grounding its recommendations in the empirical perceptions of practicing teachers, this study contributes a practical framework for aligning Thailand's national educational goals with classroom-level strategies, ultimately aiming to equip students with the critical analytical thinking skills required for the 21st century.

REFERENCES

Al-Ismail, M. S., Naseralallah, L. M., Hussain, T. A., Stewart, D., Alkhiyami, D., Abu Rasheed, H. M., Daud, A., Pallivalapila, A., & Nazar, Z. (2023). Learning needs assessments in continuing professional development: A scoping review. *Medical Teacher, 45*(2), 203–211. https://doi.org/10.1080/0142159X.2022.2126756

Anthonysamy, L., Sugendran, P., Wei, L. O., & Hoon, T. S. (2024). An improved metacognitive competency framework to inculcate analytical thinking among university students. *Education and Information Technologies*, *29*(17), 22475-22497. https://doi.org/10.1007/s10639-024-12678-z

Aroonsiwagool, A., Tuntiwongwanich, S., Pimdee, P., Meedee, C., & Moto, S. (2025). Assessing instructors' perceptions of critical skills in computational thinking and block-based programming: A needs assessment approach. *International Journal of Instruction, 18*(2), 245–260. https://doi.org/10.29333/iji.2025.18214a

Bast, G. (2019). The future of education and labor. In *The Future of Education and Labor* (pp. 9-19). Cham: Springer International Publishing. DOI:10.1007/978-3-030-26068-2_3

Brown, N. J. S., Afflerbach, P. P., & Croninger, R. G. (2014). Assessment of critical-analytic thinking. *Educational Psychology Review, 26*(4), 543–560. https://doi.org/10.1007/s10648-014-9280-4

Chanyawudhiwan, G., Mingsiritham, K., & Brahmawong, W. (2023). An analysis of digital competencies of the digital open universities. *Kasetsart Journal of Social Sciences*, *44*(4), 1101-1108. https://doi.org/10.34044/j.kjss.2023.44.4.14

Chicco, D., Sichenze, A., & Jurman, G. (2025). A simple guide to the use of Student's t-test, Mann-Whitney U test, Chi-squared test, and Kruskal-Wallis test in biostatistics. *BioData Mining*, *18*(1), 56. https://doi.org/10.1186/s13040-025-00465-6

Cohen, L., Manion, L., & Morrison, K. (2017). Inferential statistics: difference tests. In *Research methods in education* (pp. 776-801). Routledge. https://doi.org/10.4324/9781315456539

Dramani, B. A., Arthur, Y. D., Obeng, B. A., & Bannor, A. G. (2025). Investigating the determinants of pre-service teachers' intentions to accept commercial video games for teaching-learning. *International Journal of Instruction, 18*(3), 159–176. https://www.e-iji.net/dosyalar/iji_2025_3_9.pdf

Ferguson, A. G. (2025). Making thinking visible: using thinking routines to promote critical thinking skills in health sciences students. *Medical Reference Services Quarterly*, 1-9. https://doi.org/10.1080/02763869.2025.2588225

Hidayat, R., Nugroho, I., Zainuddin, Z., & Ingai, T. A. (2024). A systematic review of analytical thinking skills in STEM education settings. *Information and Learning Sciences*, *125*(7/8), 565-586. https://doi.org/10.1108/ILS-06-2023-0070

Janpirom, C., Tuntiwongwanich, S., Pimdee, P., Kulworatit, C., & Moto, S. (2025). Lecturers' perspectives on undergraduate students' innovative thinking skills and creative problem-solving skills: A comparative needs analysis. *International Journal of Instruction*, *18*(3), 121-140. https://doi.org/10.29333/iji.2025.1837a

Julkaew, T., & Buaraphan, K. (2025). The Development of STREAM Teaching Unit for Enhancing Students' Creative and Engineering Design Process Skills in the Motion

Topic. *Anatolian Journal of Education*, *10*(1), 117-126. https://doi.org/10.29333/aje.2025.1019a

Kamarudin, M. Z., Mat Noor, M. S. A., & Omar, R. (2024). A scoping review of the effects of a technology-integrated, inquiry-based approach on primary pupils' learning in science. *Research in Science & Technological Education*, *42*(3), 828-847. https://doi.org/10.1080/02635143.2022.2138847

Kotsis, K. T. (2025). Inquiry-based learning in science: Mathematical reasoning's support of critical thinking. *Journal of Research in Mathematics, Science, and Technology Education*, *2*(1), 60-72. https://doi.org/10.70232/jrmste.v2i1.35

Kwangmuang, P., Jarutkamolpong, S., Sangboonraung, W., & Daungtod, S. (2021). The development of learning innovation to enhance higher order thinking skills for students in Thailand junior high schools. *Heliyon*, *7*(6). https://doi.org/10.1016/j.heliyon.2021.e07309

Kwangmuang, P., Jarutkamolpong, S., Duangngern, P., Gessala, N., & Sarakan, P. (2024). Promoting analytical thinking skills development in elementary school students through animated cartoons. Computers in Human Behavior Reports, 15, 100467. https://doi.org/10.1016/j.chbr.2024.100467

Loyens, S. M., Van Meerten, J. E., Schaap, L., & Wijnia, L. (2023). Situating higher-order, critical, and critical-analytic thinking in problem-and project-based learning environments: A systematic review. *Educational Psychology Review*, *35*(2), 39. https://doi.org/10.1007/s10648-023-09757-x

McCoy, A., Lachman, J. M., Ward, C. L., Tapanya, S., Poomchaichote, T., Kelly, J., ... & Gardner, F. (2021). Feasibility pilot of an adapted parenting program embedded within the Thai public health system. *BMC Public Health*, *21*(1), 1009. https://doi.org/10.1186/s12889-021-11081-4

Phillips, W. J., Fletcher, J. M., Marks, A. D. G., & Hine, D. W. (2016). Thinking styles and decision making: A meta-analysis. *Psychological Bulletin, 142*(3), 260–290. https://doi.org/10.1037/bul0000027

Phuangsuwan, P., Limna, P., & Siripipatthanakul, S. (2024). Ethics in the social sciences research. *Advance Knowledge for Executives*, *3*(4), 1-11.

Phurikultong, N., & Kantathanawat, T. (2022). Flipping the undergraduate classroom to develop student analytical thinking skills. *Emerging Science Journal*, *6*(4), 739-757. http://dx.doi.org/10.28991/ESJ-2022-06-04-06

Saraphol, A., & Nuangchalerm, P. (2025). Strengthening Program in Academic Leadership of Primary School Administrators: A Modified Priority Needs Index Study. *Journal of Practical Studies in Education*, *6(*5), 93-100. https://doi.org/10.46809/jpse.v6i5.139

Sugandi, D., & Ruhimat, M. (2021, July). The Urgency of HOTS-Oriented Learning and Assessment Towards Quality of Education in Facing Indonesia Sustainable

Development Goals (SDGs) 2030. In *5th Asian Education Symposium 2020 (AES 2020)* (pp. 237-250). Atlantis Press. https://doi.org/10.2991/assehr.k.210715.052

Techagaisiyavanit, W., Mingmontchaikul, B., & Keitleartthum, S. (2025). Navigating ethical challenges in research ethics approval: A case study of social science research in Thailand. *Research Ethics*, 17470161251336573. https://doi.org/10.1177/17470161251336573

Ussarn, A., Pimdee, P., & Kantathanawat, T. (2022). Needs assessment to promote the digital literacy among students in Thai community colleges. *International Journal of Evaluation and Research in Education, 11*(3), 1278-1284. https://doi.org/10.11591/ijere.v11i3.23218