PSYCHOLOGICAL AND PEDAGOGICAL FACTORS IN DEVELOPING LOGICAL AND CRITICAL THINKING IN PRIMARY SCHOOL PUPILS: AN INTEGRATIVE CONCEPTUAL REVIEW

Ummatkulova Sayyora
Independent Researcher, Gulistan State University, Uzbekistan

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ABSTRACT

The development of logical and critical thinking in primary education is essential for enabling pupils to analyse information, justify conclusions, evaluate alternatives, and regulate their own reasoning. This article presents an integrative conceptual review of the psychological and pedagogical factors that support these capacities in children aged approximately 7–11 years. Drawing on sociocultural theory, research on executive functions, metacognition, cognitive load, scaffolding, dialogic teaching, cognitive conflict, self-regulated learning, and formative assessment, the review distinguishes logical thinking from critical thinking while treating them as developmentally interconnected. The analysis identifies four key psychological resources: motivation and epistemic curiosity, executive functions and prior knowledge, metacognitive regulation, and emotional readiness for intellectual risk. It also identifies five pedagogical conditions: calibrated scaffolding, dialogic interaction, problem- and inquiry-oriented tasks, an error-tolerant classroom climate, and formative feedback focused on reasoning processes. These factors are integrated into a conceptual model centred on appropriately calibrated challenge, explanation, peer reasoning, cognitive conflict, and gradual transfer of responsibility to the learner. The article concludes that logical and critical thinking should be developed systematically across primary-school subjects, while the proposed framework requires empirical validation in Uzbek educational settings.

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Keywords: *primary school pupils; logical thinking; critical thinking; metacognition; scaffolding; dialogic teaching; formative assessment; zone of proximal development.*

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Introduction

Contemporary schooling no longer faces scarcity of information as its central educational challenge. Children encounter explanations, opinions, visual messages, and competing claims through textbooks, digital media, family communication, and peer interaction. Primary education must therefore help pupils identify relevant information, compare alternatives, justify conclusions, revise an initial position when evidence changes, and apply reasoning in unfamiliar situations. This stage is especially important because it establishes habits of inquiry, classroom participation, self-regulation, and intellectual responsibility that can shape later learning.

Educational reform in Uzbekistan likewise emphasises teaching quality, professional competence, and the preparation of learners who can think independently. Presidential Decree No. PF-6108 of 6 November 2020 places education, upbringing, and science within the country's wider development agenda (President of the Republic of Uzbekistan, 2020). In this policy context, reasoning is not a peripheral skill.

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It contributes to conscious learning, responsible communication, and justified judgement, reducing dependence on authoritative answers alone.

Primary school, understood here as approximately ages 7–11, is a significant period for the development of cognitive and metacognitive resources that support reasoning. Executive functions, including working memory, inhibitory control, and cognitive flexibility, continue to develop during childhood and help pupils hold information in mind, resist impulsive responses, and consider alternatives (Diamond, 2013). Metacognitive knowledge and monitoring also develop across childhood, and young learners benefit when teachers make planning, checking, explaining, and revising strategies explicit (Flavell, 1979; Dignath et al., 2008). The educational question is how instruction can make complex thinking increasingly disciplined, visible, and independent.

This review examines the interaction between psychological resources within the learner and pedagogical conditions created through instruction. An advanced teaching method cannot compensate for disengagement or insufficient prior knowledge. At the same time, curiosity alone does not produce disciplined reasoning if lessons do not require evidence, explanation, comparison, and revision. Three questions guide the review: How should logical and critical thinking be distinguished at primary-school level? Which psychological and pedagogical factors are most defensible as core conditions for their development? Through which classroom mechanisms can these factors be coordinated without creating passive reception or excessive cognitive demand?

Conceptual and Theoretical Foundations

Logical thinking and critical thinking are related but not synonymous. Logical thinking concerns the organisation of relationships among ideas and the use of defensible inferential operations. In primary classrooms, it is visible when pupils classify objects according to relevant attributes, compare cases systematically, identify patterns, distinguish cause from sequence, analyse a whole into components, synthesise information, generalise cautiously from examples, or explain why a conclusion follows from given information. These operations provide an intellectual structure for problem solving.

Critical thinking incorporates these logical operations and adds evaluation and self-regulation. Facione's (1990) Delphi report identified interpretation, analysis, evaluation, inference, explanation, and self-regulation as central critical-thinking skills. More recent work likewise treats critical thinking as purposeful judgement, not mere scepticism (Abrami et al., 2015; Halpern & Dunn, 2023). A pupil who detects a pattern is reasoning logically; a pupil who asks whether the evidence is sufficient, considers another explanation, and revises a conclusion after encountering contradictory evidence is engaging in a more recognisably critical form of thinking. At primary-school level, such thinking can be cultivated through developmentally appropriate acts of justification, comparison, checking, and revision (Kuhn, 1999).

Several psychological resources support this development. Executive functions help pupils maintain and reorganise information, inhibit an immediate but weak response, and shift between perspectives (Diamond, 2013). Relevant prior knowledge is equally important because classroom reasoning is always applied to some subject matter: pupils need enough knowledge of a text, mathematical relationship, or social situation to understand and compare plausible alternatives. Critical-thinking instruction should therefore remain connected to the content through which reasoning is exercised.

Metacognition provides a second foundation. Flavell (1979) distinguished knowledge about cognition from the monitoring and regulation of cognitive activity. In classroom terms, metacognition becomes visible when pupils select a strategy, check whether an answer is reasonable, identify confusion, or explain why they changed their mind. Kuhn and Dean (2004) describe metacognition as an important bridge between cognitive research and educational aims related to critical thinking. Evidence from self-regulated-learning interventions also indicates that primary-school pupils can benefit from explicit instruction in cognitive, metacognitive, and motivational strategies (Dignath et al., 2008).

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The sociocultural perspective places these individual resources within interaction. Vygotsky (2012) argued that higher psychological functions develop through socially mediated activity and language. The zone of proximal development directs attention to tasks that a learner cannot yet complete independently but can accomplish with appropriate support. Scaffolding describes temporary assistance that enables such performance (Wood et al., 1976). Effective scaffolding is contingent on the learner's current understanding and is progressively withdrawn as competence increases (van de Pol et al., 2010). The same principle helps explain why cognitive demand must be calibrated. Difficult tasks do not automatically develop thinking; when too many unfamiliar elements must be processed at once, working-memory resources can be overloaded (Sweller, 1988). Guided inquiry addresses this problem by combining intellectually demanding tasks with prompts, models, representations, and feedback (Hmelo-Silver et al., 2007).

A related mechanism is cognitive conflict: a situation in which evidence challenges an existing conception. Such conflict can prompt reconsideration, but contradiction alone does not guarantee conceptual change. Pupils may ignore the inconsistency, become confused, or memorise a correction without reorganising their understanding (Limon, 2001). Productive cognitive conflict requires explanation, dialogue, activation of prior knowledge, and sufficient support for the learner to construct a more coherent account.

Method

This article uses an integrative conceptual-review design. It does not report original experimental data or claim measured intervention effects. Its purpose is to synthesise established psychological and educational constructs into a coherent framework for primary education. The reference base includes seminal theoretical works, peer-reviewed reviews and meta-analyses, classroom research on reasoning and dialogue, contemporary critical-thinking literature, an official Uzbek policy document, and relevant Uzbek-context publications by Ummatkulova (2025, 2026).

The literature base focused on work addressing logical or critical thinking, metacognition, executive functions, scaffolding, classroom dialogue, cognitive conflict, cognitive load, self-regulated learning, or formative assessment. Primary-school evidence was prioritised where available, while seminal sources were retained for concepts that remain central to current educational research. Review articles and meta-analyses provided the main basis for broad claims about instructional effectiveness.

The analysis used concept clarification and thematic synthesis. Sources were examined in relation to learner resources, pedagogical conditions, mediating classroom processes, and educational outcomes. Four psychological resources were identified: motivation and curiosity, prior knowledge and executive functions, metacognition and self-regulation, and emotional readiness for intellectual risk. Five pedagogical conditions were identified: contingent scaffolding, dialogic interaction, guided problem and inquiry tasks, an error-tolerant classroom climate, and formative assessment and feedback. Transfer across subjects was treated as a cross-curricular instructional principle, not as an additional factor. Because the review is integrative, it does not claim exhaustive database coverage or calculate pooled effect sizes.

Analytical Findings

The synthesis indicates that logical and critical thinking develop through interaction between learner resources and instructional conditions. Psychological resources influence how pupils respond to intellectual demands, while pedagogical conditions shape how those resources are activated, supported, and reorganised. Development is best examined through the pupil's participation in structured reasoning activities involving language, tasks, peers, and feedback.

Within the proposed framework, motivation and epistemic curiosity form the first psychological resource. Their instructional significance lies in sustaining engagement with uncertainty and giving pupils a reason to investigate a problem instead of waiting for an answer. Teachers can support this orientation by asking for predictions before explanations, offering bounded choice among strategies, and inviting pupils to defend or revise a response. This emphasis is consistent with evidence that primary-school self-

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regulated-learning interventions can combine motivational, cognitive, and metacognitive support (Dignath et al., 2008).

The second psychological resource comprises prior knowledge and executive functions. Reasoning requires pupils to coordinate information, inhibit an impulsive response, and shift between alternatives (Diamond, 2013). Because these operations are applied to specific subject content, teachers need to build knowledge and reasoning together. Vocabulary support, visual representations, worked examples where needed, and structured comparisons can reduce avoidable cognitive load while preserving the intellectual core of a task (Sweller, 1988).

Metacognition and self-regulation constitute the third psychological resource. Young pupils benefit from prompts that make monitoring processes explicit: “What made you choose this method?”, “What evidence supports your answer?”, “How can you check this?”, and “What would make you change your mind?” Such questions focus attention on strategy, evidence, monitoring, and revision rather than final correctness alone. This approach is consistent with metacognitive theory and evidence on self-regulated learning in primary education (Flavell, 1979; Dignath et al., 2008).

Emotional readiness for intellectual risk is the fourth psychological resource. Critical thinking involves expressing incomplete ideas, encountering disagreement, and sometimes revising an initial answer. Within this framework, emotional readiness refers to a pupil's willingness to participate under those conditions; it is not presented as a separately measured trait. Classroom feedback can support that readiness when it distinguishes evaluation of an idea from judgement of personal ability and directs attention to the task, strategy, and next step (Black & Wiliam, 1998; Hattie & Timperley, 2007).

Contingent scaffolding is the first pedagogical condition. Teachers need to identify what a pupil can do independently, provide support at the next attainable level, and reduce that support as competence increases. Scaffolding may involve modelling one step, highlighting relevant information, offering a representation, asking a graduated question, or inviting a peer explanation. Its defining feature is responsiveness to the learner's current understanding, not the use of any single technique (Wood et al., 1976; van de Pol et al., 2010).

Dialogic interaction is the second pedagogical condition. Reasoning develops partly through the need to articulate, compare, and defend ideas in language. Mercer et al. (1999) found that explicitly teaching primary pupils how to use talk for reasoning improved collaborative activity and reasoning performance. Howe et al. (2019) likewise identified forms of teacher-pupil dialogue associated with learning outcomes. Productive dialogue is characterised by reasons, clarification, connections between contributions, and respectful challenge; the quantity of pupil talk alone is not sufficient.

Guided problem and inquiry tasks provide the third pedagogical condition. Non-routine problems, cases, discrepant examples, and tasks with more than one plausible strategy create reasons to compare and justify. The relevant issue is the quality of guidance, not a simple choice between direct instruction and discovery. Minimally guided tasks can overload novices, whereas guided inquiry can support meaningful learning when appropriate structure is embedded in the activity (Hmelo-Silver et al., 2007; Sweller, 1988). Cognitive conflict can be incorporated into such tasks, but contradictions should initiate inquiry and explanation rather than function merely as surprise (Limon, 2001).

An error-tolerant classroom climate is the fourth pedagogical condition. Error tolerance does not mean treating all answers as equally valid; it means keeping incorrect responses available for analysis. Teachers can ask pupils to explain how an answer was reached, identify the point at which reasoning changed direction, and use that information to plan the next instructional move. Formative assessment and feedback comprise the fifth condition. Assessment can value explanation, strategy selection, question generation, and justified revision alongside final accuracy, while feedback can clarify the next step in learning (Black & Wiliam, 1998; Hattie & Timperley, 2007). Across all five conditions, transfer should be addressed explicitly by recurring to reasoning moves such as comparing evidence, identifying assumptions,

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considering alternatives, and checking whether a conclusion follows in different subjects (Abrami et al., 2015; Halpern & Dunn, 2023).

Integrative Mechanism

The factors identified above operate as a dynamic system, not an additive checklist. A curious pupil may still struggle if a task depends on unfamiliar vocabulary or exceeds available working-memory resources. A carefully scaffolded task can also produce little independent reasoning when the teacher supplies each inferential step before pupils have an opportunity to think. The central instructional problem is calibration: prior knowledge, task complexity, emotional safety, and the amount of support provided must be considered together. Within the zone of proximal development, support should make the next reasoning move possible while leaving that move to the pupil.

Classroom dialogue, cognitive conflict, and formative feedback are likewise interdependent. A discrepant example can initiate productive thought when pupils are expected to explain the contradiction and possess enough knowledge to examine it. Dialogue makes competing explanations public and comparable; formative feedback directs attention to evidence, strategy, and logical coherence. Metacognitive prompts complete the cycle by asking pupils to identify what changed in their reasoning and why. With repeated use, questions initially supplied by the teacher—for example, “What evidence supports this?”, “Is there another explanation?”, or “How can this be checked?”—can become questions that pupils increasingly ask themselves. Critical thinking can thus move from socially supported reasoning towards greater self-regulation (Kuhn & Dean, 2004; Vygotsky, 2012).

The framework also cautions against treating instructional labels as guarantees of cognitive quality. Group work can proceed without genuine dialogue, inquiry can be poorly guided, and games can be engaging without demanding substantial reasoning. What matters is whether an activity requires pupils to interpret information, generate or compare reasons, use evidence, monitor understanding, and revise conclusions when justified. These criteria allow critical-thinking development to be embedded in ordinary curriculum content instead of confined to occasional enrichment activities.

Table 1

Core Factors Supporting Logical and Critical Thinking in Primary School

Factor	Developmental function	Illustrative teacher actions	Observable indicators
Motivation and curiosity (psychological)	Supports engagement with uncertainty and sustained participation in reasoning	Use meaningful puzzles; invite predictions; allow bounded strategic choice	Persistence; pupil-generated questions; willingness to compare alternatives
Prior knowledge and executive functions (psychological)	Supports holding, inhibiting, comparing, and reorganising information	Activate relevant knowledge; reduce avoidable load; sequence difficulty; use representations	Fewer impulsive responses; flexible strategy use; coordinated reasoning
Metacognition and self-regulation (psychological)	Makes monitoring and strategy control explicit	Ask pupils to explain, check, identify difficulty, and state what would change a conclusion	Self-checking; error detection; strategy monitoring; justified revision
Emotional readiness for intellectual risk (psychological)	Supports participation when ideas are uncertain, challenged, or revised	Allow thinking time; separate critique of ideas from personal judgement; invite revision	Willingness to share tentative ideas; acknowledgement of uncertainty; justified revision
Contingent scaffolding (pedagogical)	Enables performance beyond current independent capability while preserving agency	Model selectively; cue relevant information; ask graduated questions; fade support	Increasing independence; reduced need for prompts; transfer to similar tasks
Dialogic interaction (pedagogical)	Externalises thought and exposes alternative perspectives	Establish norms for reasoned talk; request evidence; connect contributions; encourage respectful challenge	Elaborated explanations; reference to peers' reasons; comparison of viewpoints
Guided problem and inquiry tasks (pedagogical)	Creates a need to compare, justify, and revise while keeping cognitive demand manageable	Use non-routine problems, cases, discrepant examples, and structured prompts	Comparison of strategies; evidence-based explanations; revision after conflict
Error-tolerant classroom climate (pedagogical)	Keeps incorrect responses available for analysis without lowering intellectual standards	Examine how an answer was reached; normalise correction; challenge ideas respectfully	Open participation; explanation of errors; willingness to reconsider a response

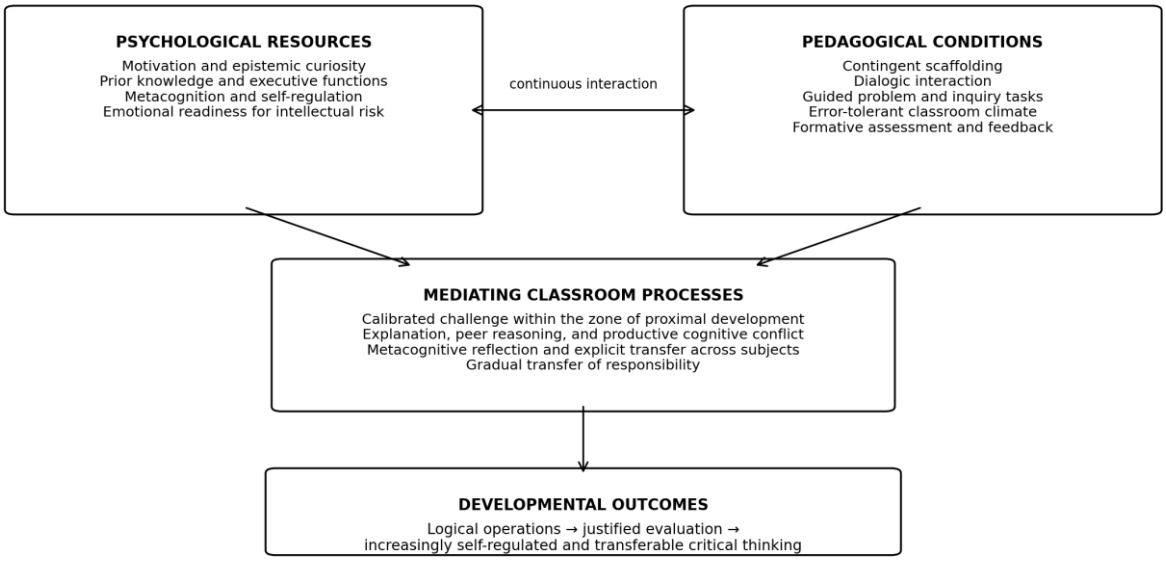
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Factor	Developmental function	Illustrative teacher actions	Observable indicators
Formative assessment and feedback (pedagogical)	Uses evidence about reasoning to guide the next instructional step	Assess explanation as well as accuracy; give task and strategy feedback; prompt self-checking	Use of feedback; clearer strategies; correction with explanation

Note. The framework distinguishes four psychological resources and five pedagogical conditions. It is intended to guide instructional design and future operationalisation; it is not a validated measurement scale.

Figure 1

Integrative Model of Psychological Resources, Pedagogical Conditions, Mediating Processes, and Developmental Outcomes



Discussion and Educational Implications

The framework assigns the primary-school teacher a deliberately balanced role. Direct explanation remains necessary, yet it should be combined with opportunities for pupils to reason for themselves. A worked example may be appropriate at one point; at another, the teacher may withhold an answer and ask pupils to compare strategies, identify evidence, or explain a contradiction. Professional judgement lies in deciding when to explain, question, model, or withdraw support.

In practice, direct teaching and active learning are complementary when the level of guidance is matched to pupils' current understanding. Structure protects limited cognitive resources, while intellectual activity prevents mere imitation. In mathematics, pupils can compare solution paths, identify irrelevant information, explain relationships between operations, and judge whether an answer is reasonable. The question “How else can this problem be solved?” becomes more analytical when followed by “Which method is better here, and why?”, because generating alternatives is then linked to evaluation.

Reading and language lessons offer comparable opportunities. Pupils can distinguish stated information from inference, compare characters' motives, locate textual evidence, and consider whether a narrator's perspective is complete. Tarbiya lessons are particularly suitable for contextualised reasoning because moral and social situations often involve competing values and perspectives. Ummatkulova (2025, 2026) examined logical thinking in Tarbiya and the preparation of future primary teachers for this task. Pupils can be taught to distinguish facts from assumptions, consider consequences, give reasons, and revise a position when stronger evidence emerges.

Assessment should align with these aims. Although well-designed selected-response items can assess more than recall, no single format captures the full process of critical thinking. Constructed responses, oral explanations, strategy annotations, comparison tasks, reflective prompts, and observation of group dialogue can provide evidence about reasoning. Rubrics can distinguish unsupported answers

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from relevant reasons, use of evidence, consideration of alternatives, and justified revision. Such evidence is most valuable when it informs immediate instructional decisions.

Teacher education must go beyond a repertoire of interactive techniques. Teachers need knowledge of children's reasoning, skill in designing tasks of graduated difficulty, competence in dialogic questioning, and the ability to interpret errors diagnostically. They should also examine how classroom discourse shapes participation: rapid correction, frequent evaluation, or answering one's own questions can imply that speed and compliance matter more than reasoning. Repeated routines for justification, comparison, checking, and revision are likely to be more sustainable than occasional elaborate “critical-thinking activities”.

Limitations and Directions for Future Research

The review has limitations arising from its design. It is integrative, not systematic, and does not claim exhaustive coverage of databases, languages, or instructional traditions. The framework should be interpreted as a theoretically grounded synthesis; it does not quantify the relative importance of each factor. In addition, much of the strongest empirical evidence cited here comes from educational systems outside Uzbekistan. Classroom authority, peer interaction, willingness to disagree, and responses to error are culturally and institutionally shaped, so pedagogical practices may require contextual adaptation.

Future research in Uzbek primary schools should operationalise the proposed constructs before testing causal claims. Studies should distinguish outcomes such as logical operations, argument evaluation, metacognitive monitoring, and transfer, avoiding their combination into a single broad thinking score. Mixed-method designs could combine age-appropriate performance measures with classroom observation, pupil explanations, and teacher interviews. Intervention studies should also document instructional fidelity and mediating processes, including the quality of teacher prompts, distribution of participation, use of contingent scaffolding, and gradual transfer of responsibility. Longitudinal research would be particularly valuable because independent critical thinking is unlikely to emerge from a short, isolated intervention.

Conclusion

Logical and critical thinking in primary education are neither spontaneous consequences of maturation nor products of a single instructional technique. They develop through repeated interaction between learner resources and pedagogical conditions. Logical thinking provides operations for analysing, comparing, classifying, relating, and inferring; critical thinking extends these operations through evaluation, justification, consideration of alternatives, and self-regulation. These capacities can be cultivated when teachers make reasoning visible and provide repeated opportunities to explain, compare, check, revise, and transfer strategies.

Four psychological resources emerge from the synthesis: motivation and curiosity, prior knowledge and executive functions, metacognition and self-regulation, and emotional readiness for intellectual risk. Five pedagogical conditions complement them: contingent scaffolding, dialogic interaction, guided problem and inquiry tasks, an error-tolerant classroom climate, and formative assessment and feedback. Their interaction is mediated by calibrated challenge within the zone of proximal development, productive cognitive conflict, verbalised reasoning, explicit attention to transfer, and gradual transfer of responsibility.

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