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THE IMPACT OF QUESTIONING ON CLASSROOM DYNAMICS: A CRITICAL ANALYSIS

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Abstract: This article critically examines the impact of questioning on classroom dynamics, restructuring and deepening the understanding of its role as a fundamental catalyst for learning environments intended to be dynamic, collaborative, and particularly student-centered. Through a comprehensive review of the literature, the article discusses how intentional and strategic questioning can foster critical thinking, intellectual curiosity, student autonomy, and metacognitive skills. In this regard, active learning methodologies are addressed, with emphasis on Problem-Based Learning (PBL), the Socratic method, and Inquiry-Based Learning (IBL), highlighting the transformative potential of the teacher's role as a facilitator. Additionally, contemporary challenges are explored alongside emerging opportunities, particularly the impact of Artificial Intelligence (AI) on the promotion and development of questioning and critical thinking. The conclusion is that questioning, beyond a mere pedagogical technique, constitutes an indispensable competence for the holistic development of autonomous, critical citizens prepared for the challenges of a constantly transforming world, thus requiring a continuous recalibration of pedagogical priorities and teacher training.
Keywords: Strategic questioning; Critical thinking; Active learning methodologies

INTRODUCTION

Questioning, in the context of pedagogical practice, has emerged as a central pillar in building educational environments that transcend the mere transmission of content (Dias, 2018). Its relevance lies essentially in its capacity to transform the classroom into a vibrant space of interaction, collaboration, and active knowledge construction, where the student assumes a leading role in their own learning process (Dias, 2018). This shift from a model of passive transmission to one of active knowledge construction is not merely a pedagogical choice, but an intrinsic requirement of an education committed to fostering the critical, autonomous, and reflective development that contemporary times demand. In this context, where information is readily accessible (Chin & Kayalvizhi, 2005), the ability to formulate meaningful questions and critically evaluate information becomes more crucial than ever (Moore, 2023; Montenegro Rueda et al., 2024; Papageorgiou, 2023). The current proliferation of content, including that generated by Artificial Intelligence (AI), requires students—as well as individuals in general—to discern, question, and verify the validity of information, thereby elevating questioning from a simple teaching-learning technique to an essential competency for navigating and making sense of the modern world (Montenegro Rueda et al., 2024; Zhai et al., 2024). Thus, questioning is not limited to facilitating the learning of content; rather, it empowers individuals to learn how to learn and, beyond the classroom context, to navigate complex informational landscapes, thereby becoming a fundamental survival skill in the 21st century.

This article seeks to deepen understanding of the impact of questioning on classroom dynamics, exploring its multiple dimensions and pedagogical implications. Starting from the premise that school should act as a catalyst for divergent thinking and inquiry, we analyze how systematic and intentional questioning can enhance the development of essential skills such as hypothesis formulation, argumentation, and the revision of ideas, culminating in more meaningful and enduring learning (Dias, 2018). The article is structured into six main sections. Following this introduction, Section 2 provides a critical review of the literature as well as the theoretical framework of questioning as a catalyst for deep learning and critical thinking, including the active learning methodologies that support it.

Section 3, in turn, focuses on the role of the teacher as a facilitator of inquiry and student autonomy, detailing effective pedagogical strategies, whereas Section 4 explores the development of metacognition and self-regulation through questioning. Section 5 discusses the challenges and future perspectives in promoting questioning in the classroom, including an in-depth analysis of the impact of Artificial Intelligence, and finally, Section 6 presents the conclusions and implications of questioning for educational practice.

CRITICAL REVIEW OF THE LITERATURE AND THEORETICAL FRAMEWORK

QUESTIONING AS A CATALYST FOR DEEP LEARNING AND CRITICAL THINKING

Theoretical Foundations of Cognitive Dissonance and Constructivism

According to Dias (2018), questioning transcends its merely inquisitive function to establish itself as a driving force of meaningful learning. Its effectiveness lies in the ability to unsettle prior knowledge, generate cognitive dissonance and, consequently, propel the search for new understandings. As Oliveira (2008) underlines, by encouraging deep questioning about the world, schools enable students to transcend the obvious and assign intrinsic meaning to knowledge through the problematization of reality. This perspective aligns with constructivist theories of learning, which argue that knowledge is not passively received but actively constructed by the learner through interaction with the environment and reflection on experiences, as posited by authors such as Piaget (1970) and Vygotsky (1978). The act of formulating questions—something inherent to human nature and present from the earliest stages of cognitive development—finds in formal education (particularly in school) a fertile ground for its full flowering (Pinto et al., 2015). Freire and Faundez (1988), in turn, argue that the very origin of knowledge lies in the act of asking questions, thereby emphasizing the dialogic nature of knowledge construction.

Impact on Engagement, Understanding, and Skill Development

Numerous studies in cognitive psychology and education have consistently demonstrated that systematic questioning enhances student engagement with curricular content (Schein & Coelho, 2006; Dias, 2018). According to these authors, when challenged to question, students are compelled to process information more deeply, establish connections between different concepts, and identify gaps in their own understanding. Such active engagement bolsters the development of metacognitive skills, such as the ability to monitor and regulate one's own learning (Dias, 2018). The formulation of hypotheses, the construction of solid arguments, and the critical revision of ideas thus become inherent practices in a learning process driven by questioning, which helps lead to the acquisition of more robust and enduring knowledge (Ennis, 1987). In this context, doubt ceases to "sound" like hesitation and becomes an invitation to investigation and discovery, transforming the classroom into a laboratory of ideas where curiosity is the main driving force (Dias, 2018).

Recent research confirms that questions generated by students themselves have a significant impact on their engagement and motivation. Students prefer to investigate questions they pose, and report feelings of joy, excitement, and pride in doing so, describing the experience as exciting, fun, and interesting (Chin & Kayalvizhi, 2005). This emotional connection to learning establishes a solid foundation for sustained academic engagement. Furthermore, questioning contributes to dee-

per understanding, better memory retention, and more effective problem solving (Chin & Kayalvizhi, 2005).

If we focus on the quality of a teacher's questioning patterns, it is intrinsically linked to their own assessment literacy. Questioning is recognized as a powerful assessment tool—certainly the most traditional—allowing teachers to gather accurate information about students and make more informed pedagogical decisions (Leung, 2014; Stiggins, 1991; Taylor, 2009). This interconnection suggests that professional development for teachers should extend beyond mere questioning techniques, integrating training on how to use questioning as a diagnostic and formative assessment tool to guide instruction. This competence should be considered from the outset in initial teacher education as well as in ongoing professional development. The ability to formulate effective questions reflects a teacher's competency in understanding students' learning processes and adapting their practice accordingly.

Additionally, the strategic design of questioning, grounded in Cognitive Load Theory (CLT), can significantly optimize learning. CLT posits that human working memory has a limited capacity (Sweller, 1988; NSW DoE, 2018; Paas, Renkl & Sweller, 2003). Well-planned questioning can thus reduce extraneous cognitive load—the unnecessary mental effort that does not directly contribute to learning—by promoting generative learning strategies such as reflection and elaboration. By activating students' prior knowledge and encouraging them to express ideas in their own words, effective questioning directs working memory resources toward constructing new knowledge schemas, thereby optimizing deep understanding. Conversely, superficial or poorly formulated questions, or asking multiple questions at once, can increase cognitive overload and thus cause frustration and hinder information retention. In this way, applying CLT to question design provides a neurocognitive basis for the effectiveness of questioning strategies in the classroom.

ACTIVE LEARNING METHODOLOGIES: PBL, SOCRATIC METHOD, AND INQUIRY-BASED LEARNING (IBL)

Materialization of Inquiry in Student-Centered Approaches

The emphasis on questioning in pedagogical practice finds its most expressive manifestation in the adoption of active learning methodologies. In fact, these approaches—in contrast to traditional models centered on passive information transmission—tend to place the student at the center of the educational process, encouraging active participation in knowledge construction, giving full meaning to Bruner's (1996) statement that "The teacher's role is not to dispense information, but to stimulate the learner's own inquiry" (p. 84).

Problem-Based Learning (PBL) thus becomes a paradigmatic example of this philosophy. As Pinto et al. (2015) describe, PBL starts from real-world problems, preferably proposed by the students themselves, which serve as catalysts for curiosity and questioning. This process stimulates the autonomous search for solutions, facilitating not only the construction of new knowledge but also the development of higher-order cognitive and social skills (Pinto et al., 2015). In fact, recent meta-analyses confirm that PBL is significantly more effective than conventional teaching methods when the focus is on improving critical thinking skills—particularly in medical education—through contextual learning, facilitation, and peer collaboration (Khosravizadeh et al., 2022; Dharma, Tasrikah & Churiyah, 2020).

Beyond PBL, the Socratic method stands out for its depth and effectiveness in promoting critical thinking and complex reasoning (Dias, 2018; Paul & Elder, 2007). Inspired by the ancient philosophical practice of Socrates, this method involves a dialogue led by the teacher with the goal of guiding students to explore different perspectives, deepen their reasoning, and ultimately discover knowledge for themselves (Dias, 2018). Vieira and Vieira (2005) explain that the teacher acts as a facilitator, intervening strategically at moments of cognitive frustration or premature satisfaction with answers. This method has proven to be a powerful tool for critical thinking and problem solving in modern contexts, including education, law, and medicine (Paul & Elder, 2007).

Other active methodologies, such as Project-Based Learning (PBL, in Portuguese ABP), the flipped classroom, and gamification, also benefit greatly from questioning (Dias, 2018). In all of these approaches, the teacher assumes the role of facilitator, guiding students in formulating pertinent questions, researching information, and critically analyzing data.

Inquiry-Based Learning (IBL) and 21st Century Skills

Inquiry-Based Learning (IBL) is a student-centered approach designed to enhance critical thinking, creativity, and problem-solving skills by harnessing students' natural curiosity (Marks, 2025). IBL deepens understanding and fosters curiosity and active participation, shifting the focus from passive information reception to active exploration and investigation of topics. Research consistently demonstrates the effectiveness of IBL in improving academic outcomes and enhancing critical thinking skills (Škoda et al., 2015; Pei, 2025; Cahyono & Rusiadi, 2025), thus contributing to the promotion of the "4 Cs" of 21st-century skills: critical thinking, communication, collaboration, and creativity (Thornhill-Miller et al., 2023).

We should not, however, consider the effectiveness of active methodologies like PBL, the Socratic Method, and IBL in a merely additive sense. In fact, these approaches often share underlying mechanisms that amplify their impact on 21st-century skills. By fostering metacognition, self-regulation, and the collaborative construction of knowledge, they create a synergistic learning environment. Take PBL as an example: it promotes critical thinking through contextual learning and by encouraging peer collaboration, aligning with social constructivist perspectives (Vygotsky, 1978). Similarly, student questioning, intrinsic to IBL, proves to be a key factor in metacognitive development (Chin & Kayalvizhi, 2005). This interweaving of fundamental pedagogical principles results in a more holistic development of complex skills, where the whole becomes greater than the mere sum of the parts.

The effective implementation of Inquiry--Based Learning requires teachers to develop and apply differentiated support, taking into account students' varying levels of competence. Questioning can be structured, guided, or open, and progression through these levels is crucial to avoid cognitive overload in younger students while maximizing engagement and autonomy in more advanced learners. In terms of support, this involves breaking down complex problems into manageable steps and providing questioning prompts to help students plan and monitor their approaches (University of Wisconsin–Madison, 2024). This adaptive approach ensures that, while IBL is not a one-size-fits-all solution, it allows a flexible pedagogical strategy that optimizes cognitive engagement for all students, adjusting the level of support as competence develops.

Skill Developed	Impact and Rationale	References
Critical Thinking	Enhances problem analysis, evaluation of evidence, and development of innovative solutions. IBL encourages students to question assumptions and test hypotheses instead of memorizing facts.	(Marks, 2025)
Creativity	Fosters originality, flexibility, and fluency in thought by encouraging hypothesis formulation and exploration of possibilities.	(Marks, 2025)
Problem Solving	Develops the ability to approach and solve complex problems through hands-on experiences and active investigation.	(Marks, 2025)
Communication	Improves the ability to express ideas, debate topics, and present findings, especially through group discussions and presentations.	(Thornhill--Miller et al., 2023; Marks, 2025)
Collaboration	Promotes teamwork, sharing of ideas, and collective knowledge building, which are essential in cooperative learning environments.	(Thornhill--Miller et al., 2023; Marks, 2025)
Deep Conceptual Understanding	Leads students beyond surface comprehension to achieve a deeper mastery of core concepts.	(Marks, 2025)
Engagement and Motivation	Increases student interest and curiosity, transforming them from passive recipients into active, enthusiastic participants in their learning journey.	(Chin & Kayalvizhi, 2005)
Metacognition	Develops awareness and understanding of one's own thought and learning processes through self-reflection and self-questioning.	(Chin & Kayalvizhi, 2005)
Transferable Skills	Includes time management and self-assessment skills, applicable across disciplines and beyond the classroom.	

Table 2. Impact of Inquiry-Based Learning (IBL) on the Development of 21st-Century Skills

THE TEACHER AS A FACILITATOR OF QUESTIONING AND STUDENT AUTONOMY

THE TRANSFORMATION OF THE PEDAGOGICAL ROLE

In an educational approach that values questioning and active methodologies, the role of the teacher undergoes a profound transformation. The teacher ceases to be the sole holder and transmitter of knowledge and becomes a facilitator, guide, and mediator of learning (Dias, 2018) – a paradigm shift crucial for creating educational environments where curiosity and inquiry are encouraged.

The teacher's facilitating role aligns with constructivist and socio-constructivist theories, which emphasize the active construction of knowledge by students through their experiences and interactions (Cahyono & Rusiadi, 2025; Gautam & Agarwal, 2023). From this perspective, the teacher acts as an architect of the learning environment, designing situations that allow students to participate actively, explore, and solve problems, connecting new information to their real lives. This role encompasses creating a conducive learning environment that supports social interactions, provides emotional support, and effectively manages tasks. By fostering collaboration and discussion, offering constructive feedback, and understanding students' needs and motivations, the teacher cultivates student autonomy and intrinsic motivation, empowering them to construct their own knowledge and become self-directed learners. The effectiveness of questioning in this context, therefore, depends not only on technique but fundamentally on the learning ecosystem the teacher is able to establish.

PEDAGOGICAL STRATEGIES FOR EFFECTIVE QUESTIONING

Types of Questions and Planning

Assuming that questioning is not just a routine instructional gesture but rather a deliberate strategy of cognitive mediation, the quality of questions posed by the teacher is one of the most decisive elements for the success of a student-centered pedagogical approach. In planning their practice, it is essential for teachers to intentionally consider different

types of questions to use, in order to stimulate various skills such as reasoning, curiosity, and active student engagement in the knowledge--construction process.

Open-ended questions that stimulate logical and critical reasoning, self-reflection, and active learning are preferable to closed questions that only require a memorized answer (Ghafar & Hazaymeh, 2024; NSW DoE, 2025). The "art" of questioning involves, beforehand, the ability to diagnose students' needs, identify their prior conceptions, and challenge them to go beyond what they already know (Dias, 2018).

In this sense, it is important for teachers to design higher-order cognitive questions (e.g., analysis, evaluation, creation, according to Bloom's Taxonomy) and sequence them logically, progressing from the specific to the general or from lower to higher levels of complexity (Crowe, Dirks & Wenderoth, 2008). Prior planning of key questions—known as "scripting"—helps ensure that the questions are aligned with learning objectives and address important material (NSW DoE, 2025).

On the other hand, certain questioning techniques can create significant obstacles in the classroom. Superficial questions that lack cognitive demand, or posing too few questions, do not promote an environment of continuous inquiry. Additionally, using inappropriate language (either too advanced or too simplistic) or poorly phrased questions with double negatives or ambiguities can end up confusing students. Moreover, categorizing answers strictly as "correct or incorrect," asking multiple questions in one breath, directing questions only to certain students, expecting students to "read the teacher's mind," failing to provide wait time, or asking leading questions are ineffective practices that undermine student confidence, equitable participation, and deep thinking—practices that teachers should take special care to avoid.

"Wait Time" and Responses

Increasing "wait time" after asking a question is a crucial pedagogical strategy. A pause of 3 to 10 seconds (or more for higher-order questions) significantly improves the quantity and quality of students' responses, encouraging elaboration and promoting equitable participation (NSW DoE, 2025). Research shows that teachers tend to give less wait time to students perceived as having learning difficulties. By extending this wait time, educators signal that all contributions are valued, reducing anxiety and encouraging a wider range of students to participate. This democratizes classroom discourse and fosters interaction among students themselves.

Effective teacher responses involve redirecting, probing, and reinforcing, with a focus on the clarity, accuracy, and plausibility of students' answers, rather than offering vague or critical feedback. Socratic probing questions are particularly effective in deepening student reasoning, including queries for clarification, underlying assumptions, reasons and evidence, alternative viewpoints, and implications.

Category	Best Practices (Examples and Rationale)	Pitfalls to Avoid (Examples and Rationale)
Planning and Types of Questions	Conceive Higher-Order Cognitive Questions: Use Bloom's Taxonomy (analysis, evaluation, creation) and tools like the Weiderhold Matrix or "Thinker's Keys" to stimulate complex reasoning (NSW DoE, 2025).Sequence Logically: Organize questions from specific to general or from lower to higher levels of complexity to guide thinking (NSW DoE, 2025).Pose Open-Ended Questions: Encourage self-reflection and active learning by asking questions that demand more than a memorized response (Dias, 2018; Ghafar & Hazaymeh, 2024; NSW DoE, 2025).	Superficial Questions: Low cognitive-demand questions that do not promote deep thinking. Few Questions: Failing to establish a culture of continuous questioning. Inappropriate Language: Using vocabulary that is either too advanced or too simplistic, rendering questions ineffective or confusing. Poorly Phrased Questions: Confusing wording, double negatives, or imprecise phrasing that hinders understanding.

Category	Best Practices (Examples and Rationale)	Pitfalls to Avoid (Examples and Rationale)
Managing Responses and Participation	Increase Wait Time: Pause for 3–10+ seconds after posing a question and after a student's response to improve the quality and quantity of answers and promote equitable participation (NSW DoE, 2025). Involve All Students: Use techniques like "cold call," "no opt-out," and "think-pair-share" to ensure inclusive participation (NSW DoE, 2025).Assist Toward Correctness: Guide students to arrive at correct answers themselves, instead of simply providing the solution (Ghafar & Hazaymeh, 2024).	Not Allowing Wait Time: Expecting immediate answers, which prevents reflection and the formulation of thoughtful responses. Calling on Only Certain Students: Creating an uneven playing field and discouraging others from participating. "Guess What I'm Thinking" Questions: Going around the class until someone guesses the answer the teacher has in mind.
Quality of Feedback	Redirect, Probe, and Reinforce: Focus feedback on the clarity, accuracy, and plausibility of responses. Use probing Socratic questions (e.g., for clarification, assumptions, evidence, perspectives, implications) (NSW DoE, 2025).Embrace All Responses as Steps: Create a culture of open acceptance where errors are seen as learning opportunities (NSW DoE, 2025).	Making Questions "Right or Wrong": Creating an environment of fear of being wrong, which undermines student confidence. Multiple Questions at Once: Overloading and confusing students who are unsure which question to answer. Leading Questions: Questions that contain their own answer, seeking only affirmation or agreement.

Table 1. Questioning Strategies for Teachers: Best Practices and Pitfalls to Avoid

CONTINUOUS TEACHER TRAINING FOCUSED ON QUESTIONING

Adopting a truly inquiry-oriented stance by teachers naturally requires continuity, intentionality, and above all a systematic practice. In other words, for questioning to become part of a teacher's professional identity, it is not enough to use it sporadically or occasionally. It must be genuinely incorporated into the daily life of the classroom—planning activities that provoke students' curiosity, encouraging them to raise their own questions and explore knowledge independently and meaningfully. Above all, it is about cultivating an environment where asking questions is as valued as answering them.

Meyrink (2020) refers to **Inquiry-Based Professional Development** (IBPD) for teachers, which has proven effective when it prioritizes teachers' voice and choice, adopting a cyclical approach of learning and experimentation. According to the author, this model—allowing teachers to investigate questions that interest them, experiment with new strategies in their classrooms, and reflect on their effectiveness—has led to greater engagement and practical application in the classroom.

THE DEVELOPMENT OF METACOGNITION AND SELF-REGULATION THROUGH QUESTIONING

Questioning also plays a crucial role in the development of metacognition, that is, the awareness and understanding of one's own thinking and learning processes. Ossa, Rivas, and Saiz (2023) empirically demonstrated that metacognitive strategies—such as structured questioning and guided reflection—are associated with higher levels of critical thinking in university learning.

Metacognition is not only an outcome of questioning, but a fundamental skill that, when explicitly taught through questioning, significantly enhances critical thinking and self-regulated learning, creating a positive feedback loop (Chin & Kayalvizhi, 2005; Ossa, Rivas & Saiz, 2023). According to the Teaching Excellence in Adult Literacy (TEAL, 2010), students with developed metacognition can plan, monitor, and evaluate their own learning, thus becoming more autonomous.

Drawing on Schunk (2008), metacognition encompasses three types of knowledge:

- **Declarative Knowledge:** Knowledge about oneself as a learner and about the factors that can influence performance (the "what" of knowledge).

- **Procedural Knowledge:** Knowledge about how to do things, demonstrated through heuristics and strategies.
- **Conditional Knowledge:** Understanding when and why to employ specific forms of declarative and procedural knowledge.

The development of conditional metacognitive knowledge, in particular, is fundamental for the effective use of learning strategies. Knowing when and why to use a specific strategy allows students to apply declarative and procedural knowledge adaptively, avoiding rote learning and promoting flexible problem solving (Ossa, Rivas & Saiz, 2023). Consider, for example, a student who knows how to summarize a text (procedural knowledge) and knows what a summary is (declarative knowledge); only with conditional knowledge will they understand when summarizing is the most appropriate strategy for a specific learning goal (Schunk, 2008). This type of knowledge enables students to save time and mental effort, and it is crucial for success in complex tasks. Metacognitive questioning, which leads students to reflect on their own thought process (e.g., "What do I already know about this?", "What strategy should I use?", "Is this working?"), is a powerful tool for developing all three types of metacognitive knowledge, especially conditional knowledge.

CHALLENGES AND FUTURE PERSPECTIVES IN PROMOTING QUESTIONING IN THE CLASSROOM

Despite the undeniable benefits of questioning and inquiry-based methodologies, their implementation faces several challenges. Common obstacles include teachers' lack of knowledge about inquiry methodologies and their benefits—perhaps the most significant—and resistance to change, as well as the still persistent concern (or even obsession) with covering the entire curriculum content, and uncertainty about where to begin. Viegas (2022) reminds us that teacher workload and lack of time to plan and implement these strategies can also be significant barriers. Moreover, as noted by Montenegro Rueda et al. (2024) in the context of distance learning (though not exclusively), additional challenges arise in cultivating critical thinking. These notably include systemic limitations, a pedagogical culture that prioritizes memorization over inquiry, superficial engagement with academic material, students' difficulty in applying theoretical knowledge in practice, a lack of consistent reflection, and reliance on ready-made solutions.

The Impact of Artificial Intelligence (AI)

As we witness the emergence and rapid development of Artificial Intelligence (AI), we are introduced to unprecedented opportunities as well as significant challenges for questioning and critical thinking in education. Sayad (2023) considers:

> *The future intrigues schools more than the present, but when it comes to critical thinking and artificial intelligence, it is a pressing issue. If the so-called 'singularity'—defined […] when technological advances are as rapid as they are irreversible—causes fear, we must realize that these are impacts caused by AI in the present, and they must be addressed urgently, especially regarding critical thinking.* (p. 133)

Building on this reflection, it becomes evident that schools cannot postpone discussing the role of AI in teaching and learning processes. Developing critical thinking—far from being an intellectual luxury—proves to be an urgent necessity in an era when algorithms make decisions, filter information, and shape perceptions. It is crucial to consider that, more than teaching how to use digital tools, we must prepare students to question them: to understand how they work, what logic they operate on, and what consequences they pro-

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duce. In this scenario, questioning ceases to be just a pedagogical strategy and becomes an essential competency for intellectual autonomy and active citizenship in the age of AI.

Opportunities

From the perspective of opportunities, AI can optimize efficiency and expand access to information, facilitating literature review and personalized learning (Montenegro Rueda et al., 2024). According to these authors, AI tools such as adaptive learning algorithms and data analytics platforms can offer personalized guidance and feedback to students, simplifying administrative and instructional processes for educators. AI can be used to analyze large datasets and explore multiple perspectives, and when students are taught to critically interrogate its outputs (comparing them with peer-reviewed sources, identifying assumptions), it can function as a productive scaffolding tool rather than a cognitive shortcut (Montenegro Rueda et al., 2024). Platforms such as Brisk Teaching (https://www.briskteaching.com/pt-br), QuestionWell (https://questionwell.org/), Khanmigo (https://www.khanmigo.ai/pt), Revisely AI Quiz Generator (https://www.revisely.com/), OpExams (https://opexams.com/pt/), Google Gemini (https://gemini.google.com/), ChatGPT (https://chatgpt.com/), Elicit (https://elicit.com/), and Perplexity (https://www.perplexity.ai/) all already offer support for generating questions, providing feedback, and facilitating inquiry.

Challenges and Risks

However, not everything is a marvel in this fascinating world of AI. Despite the opportunities, uncritical use of AI can pose a considerable threat to the development of independent critical thinking and questioning. This is the case when excessive reliance on AI tools leads to cognitive offloading, where students prefer to delegate mental effort to the machine, reducing the need for analysis and synthesis and potentially resulting in a "growing ignorance" if they become dependent on ready answers (Montenegro Rueda et al., 2024; Zhai et al., 2024). In a recent article, Szmyd and Mitera (2024), based on extensive research, caution that:

> *Overdependence on AI may lead to passive attitudes among students, who might expect ready-made solutions from the system rather than engaging in independent thought. [...] 83% of respondents believe that excessive reliance on artificial intelligence can significantly weaken the ability to think independently.*(p. 1026)

This can diminish attention and concentration, undermine independent problem-solving and creativity, and lead to uncritical acceptance of information (Montenegro Rueda et al., 2024).

In light of these considerations, effectively integrating AI in education—especially to foster questioning and critical thinking—decidedly requires a focused professional development for teachers in this domain. Teachers need to understand the capabilities (and limitations!) of AI in order to design pedagogical approaches that use it as a support tool, not as a mere cognitive shortcut. This implies developing "AI literacy" in teachers, enabling them to teach students to critically interrogate AI outputs and to evaluate the reliability of algorithms, preventing students from naively assuming the "perfection" of AI-generated answers.

The Question Formulation Technique (QFT) thus emerges as a crucial pedagogical strategy to counter the challenges posed by AI. The QFT offers a structured, teacher-facilitated approach to explicitly teach students how to generate, refine, and prioritize their own questions (Cancellieri, 2024). By placing the responsibility for inquiry on the student, QFT directly addresses the risk of cognitive offloading and fosters independent inquiry skills essential in an AI-saturated world. This

technique empowers students to develop divergent thinking, convergent thinking, and metacognition, making them more capable of navigating and contributing to knowledge construction in the digital age.

AI Tool	Features for Questioning and Inquiry	Potential Pedagogical Impact
Brisk Teaching	Offers prompts, support, and questions to keep students engaged; creates quizzes, lesson plans, personalized feedback; adjusts reading levels.	Optimizes teacher workflow, enables differentiation and quality feedback, and keeps students engaged through adaptive support.
QuestionWell	Design studio for teachers to create and export materials (questions, readings, vocabulary, interactive videos) aligned with curriculum standards.	Reduces teacher workload in material creation, ensures curricular alignment, and supports the implementation of inquiry frameworks.
Khanmigo	AI support for teachers (simplifies tasks, differentiation, lesson plans, quiz questions), students (challenges critical thinking, guides answers via Socratic questioning), and parents.	Acts as a personal AI tutor, guiding students to discover answers on their own without directly providing them, and automates administrative tasks for teachers.
Revisely AI Quiz Generator	Creates quizzes from notes, books, PDFs, PowerPoints; edits questions and evaluates responses.	Speeds up the creation of assessment and practice materials, allowing teachers and students to generate questions from existing content.
OpExams	Generates multiple types of questions (multiple choice, true/false, short answer, open-ended) from text, topics, links, YouTube videos, media, and PDFs.	Offers flexibility in question creation for different assessment formats and content types, promoting a diversity of inquiry.
Google Gemini	Conversational AI chatbot that facilitates research and content generation; helps generate research questions, outline theses, and summarize essays.	Supports students in the initial phase of inquiry, assisting in formulating research questions and structuring ideas for academic work.
ChatGPT	Tool for brainstorming, clarifying concepts, study planning, generating practice questions, and assisting in research.	Facilitates initial exploration of topics and question formulation, but requires supervision to avoid reliance on ready-made answers.
Elicit	Research article assistant specialized in academic research, including the formulation of research questions.	Advanced tool for students and researchers needing specialized support in creating complex research questions.
Perplexity	AI-powered search engine with the ability to handle complex queries.	Helps students refine their research questions to obtain more precise and relevant results.

Table 3. Artificial Intelligence (AI) Tools to Support Questioning and Inquiry in Education

CONCLUSION

Questioning, far from being a mere pedagogical technique, proves to be a fundamental competency and an essential pillar in building truly transformative learning environments. A critical analysis of its multiple dimensions and the exploration of its pedagogical implications demonstrate that, when applied intentionally and strategically, questioning acts as a powerful catalyst for critical thinking, intellectual curiosity, and student autonomy. Its integration into active methodologies, such as Problem-Based Learning, the Socratic method, or Inquiry-Based Learning, not only promotes the active construction of knowledge but also prepares students to face the complex challenges of the 21st century with creativity and an investigative spirit.

The long-called-for transformation of the teacher's role—from content transmitter to facilitator and mediator of the questioning process—is imperative for realizing an education that values doubt, inquiry, and the collective construction of knowledge. This change thus requires continuous reflection on pedagogical practices and a commitment to ongoing improvement at both individual and institutional levels. By encouraging students to formulate their own questions, explore different perspectives, and critically analyze information, teachers empower them to develop an investigative stance that transcends the four walls of the classroom, preparing them to be

active, critical, and engaged citizens in society.

Finally, the emergence of Artificial Intelligence presents a dual scenario: on one hand, it offers powerful tools to personalize learning and optimize administrative tasks; on the other, as we have seen, it can carry a significant risk of cognitive offloading and uncritical acceptance of information, which can compromise the development of critical thinking and inquiry. To mitigate these risks and maximize AI's opportunities, it is crucial to invest in teacher training in AI literacy, assuaging teachers' fears and resistance while empowering them to integrate these technologies as support tools that promote higher-order thinking, rather than as mere cognitive shortcuts, as is still relatively common in our classrooms. Implementing strategies such as the Question Formulation Technique (QFT) is vital to explicitly teach students to generate and refine their own questions, cultivating the inquiry skills essential in the digital age.

In summary, questioning is the driving force that propels meaningful and long-lasting learning. By recognizing and valuing its potential, educational institutions can cultivate a culture of curiosity and innovation, where the pursuit of knowledge is a continuous and collaborative process. The practice of questioning, therefore, is not just a didactic tool but an educational philosophy aimed at forming individuals capable of questioning, reflecting, and building their own path in the world, contributing to a more informed, critical, and engaged society.

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