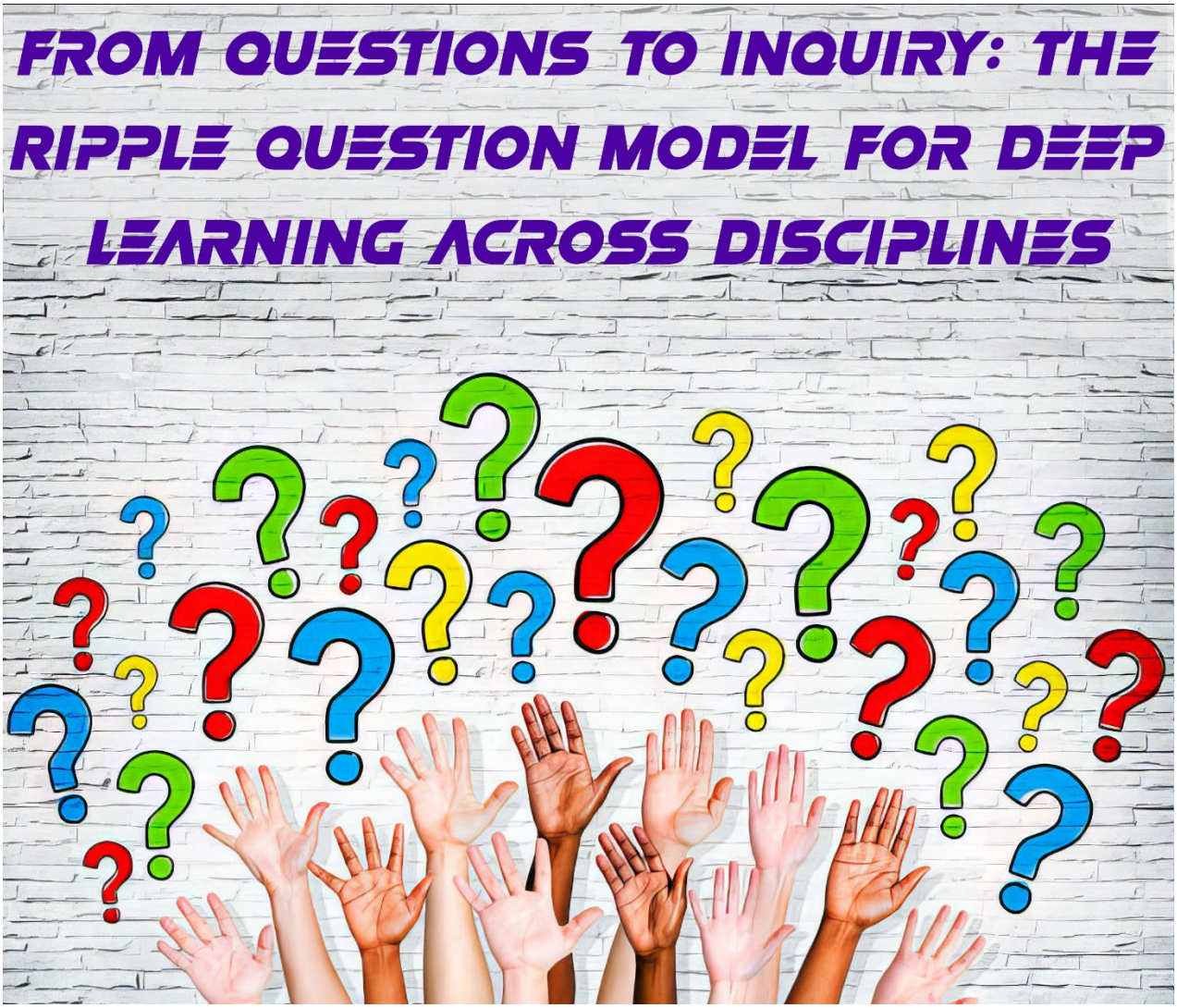


A five-stage framework for noticing, reasoning, justification, transfer, and intellectual extension

SCHOOLS ASK MANY QUESTIONS, YET INQUIRY REMAINS RARE

Classrooms are filled with questions. Teachers ask students to identify, explain, compare, predict, calculate, interpret, and evaluate. Textbooks conclude chapters with questions, examinations measure learning through questions, and digital platforms promise instant responses to almost any question a learner can formulate. Yet the presence of questions does not necessarily indicate the presence of inquiry. A classroom may contain hundreds of questions while offering students very few opportunities to investigate uncertainty, construct explanations, test claims, examine evidence, transfer understanding, or generate questions of their own. The central challenge is not simply whether educators ask questions, but what kinds of intellectual movement those questions create.

Much classroom questioning continues to operate through a familiar instructional pattern. The teacher asks a question, one student supplies an answer, the teacher confirms or corrects it, and the lesson moves forward. This sequence can be efficient, particularly when educators need to check recall, clarify misunderstanding, or maintain lesson momentum. However, when it becomes the dominant pattern of classroom interaction, questioning is reduced to a mechanism for retrieving predetermined answers. Students learn to search for the response the teacher expects rather than to examine what the question might reveal. The appearance of participation can therefore conceal a deeper form of intellectual passivity: learners may be speaking, but not necessarily inquiring.

Even questions labelled “higher order” do not automatically produce deeper learning. Asking students why, how, or what they think may create the possibility of reasoning, but it does not ensure that reasoning will occur. A learner may offer an unsupported opinion, repeat familiar language, or produce a plausible explanation without examining evidence. Similarly, asking students to apply knowledge may result in superficial repetition if they are not required to adapt ideas to a genuinely unfamiliar context. The quality of inquiry depends not only on the wording of an individual question, but on the relationship among questions and the intellectual responsibilities each question places upon the learner.

This distinction becomes increasingly important in an educational environment shaped by generative artificial intelligence. Learners can now obtain summaries, explanations, arguments, examples, and proposed solutions within seconds. Access to answers is expanding rapidly, but the ability to judge those answers is not developing automatically at the same pace. Students still need to notice what is absent, detect inconsistency, question assumptions, evaluate evidence, distinguish confidence from accuracy, and decide whether an explanation is transferable to a particular context. When technology can generate fluent responses almost instantly, education must place greater emphasis on the forms of thinking that precede, interrogate, and extend those responses.

The problem is not that answers have become less important. Accurate knowledge remains essential, and inquiry without sufficient disciplinary understanding can become vague, unfocused, or misleading. The problem is that education has often treated the correct answer as the natural conclusion of learning rather than as a possible beginning. A scientific explanation should lead students to ask where else the principle applies. A historical interpretation should invite examination of evidence, perspective, and omission. A mathematical solution should create space for justification, alternative methods, and generalization. A literary interpretation should open further questions about language, voice, context, identity, and meaning. In each case, knowledge becomes deeper when learners are required to move beyond producing a response toward examining how the response was formed, why it should be trusted, where it can be used, and what further questions it creates.

This is where the distinction between questioning and inquiry becomes critical. Questioning is an instructional act; inquiry is an intellectual process. A question can be isolated, answered, and forgotten. Inquiry develops through a connected sequence of attention, interpretation, evidence, transfer, and further investigation. It asks learners not only to respond but also to observe carefully, reason deliberately, justify responsibly, apply flexibly, and extend independently. Inquiry therefore requires more than a collection of sophisticated question stems. It requires an architecture that helps teachers and students understand how one question can generate another and how thinking can expand from an initial observation into a sustained process of knowledge construction.

Across disciplines, educators already draw upon valuable traditions of reflective inquiry, Socratic dialogue, problem-posing education, constructivism, argumentation, experiential learning, and dialogic teaching. They also use taxonomies to distinguish different cognitive demands and inquiry cycles to structure investigations. These traditions have significantly enriched educational practice. However, teachers still need a model that is memorable enough for everyday classroom use, intellectually rigorous enough to support deep learning, and flexible enough to travel across subjects without ignoring the distinctive ways in which different disciplines construct and justify knowledge.

The Ripple Question Model responds to this need by treating a question not as a single instructional prompt but as the centre of an expanding intellectual process. Like ripples moving outward from a point of disturbance, inquiry begins with something that captures attention: a pattern, contradiction, phenomenon, problem, text, image, claim, experience, or unfamiliar possibility. From that point, learners move through five interconnected forms of thinking: Notice, Reason, Justify, Apply, and Extend. Each ripple increases the learner's intellectual responsibility, while the final ripple generates new questions that can begin the process again.

The model is based on a simple but consequential proposition: the educational value of a question should not be judged only by the answer it produces, but by the thinking it sets in motion. A powerful question does more than reveal what a learner knows. It creates the conditions through which the learner can examine, challenge, transfer, and enlarge that knowledge. In a future-ready classroom, the purpose of questioning is therefore not merely to arrive at an answer. It is to cultivate learners who know how to continue the inquiry after the first answer has been given.

WHAT RESEARCH TELLS US: FROM QUESTIONING TO DISCIPLINED INQUIRY

The educational value of questioning has long been recognized, yet research across philosophy, learning sciences, cognitive psychology, and classroom discourse suggests that questions become transformative only when they are embedded within a purposeful process of inquiry. An isolated question may stimulate recall or momentary participation, but sustained intellectual development requires learners to attend closely, interpret relationships, examine evidence, test explanations, transfer ideas, and generate further lines of investigation. This understanding appears across several educational traditions, although each tradition emphasizes a different dimension of the process. Taken together, they suggest that deep learning does not arise from asking increasingly difficult questions at random; it develops when questions are sequenced in ways that progressively expand the learner's responsibility for constructing, evaluating, and extending knowledge.

John Dewey's theory of reflective inquiry provides one of the most enduring foundations for this understanding. For Dewey, thinking is not simply the accumulation of information or the passive contemplation of ideas. It begins when an individual encounters uncertainty, contradiction, difficulty, or an experience that cannot be explained through existing understanding. The learner must first recognize that something deserves attention, then examine the conditions surrounding it, consider possible explanations, gather relevant evidence, and test whether emerging ideas hold when applied to experience. Inquiry is therefore activated by disturbance: something interrupts the familiar and creates a reason to think. This philosophical position remains highly relevant to contemporary classrooms because it shifts the starting point of learning away from the teacher's explanation and toward the learner's encounter with a problem, pattern, claim, text, phenomenon, or unresolved question. Within this view, noticing is not a preliminary or superficial activity. It is the intellectual act through which the learner identifies what is significant enough to investigate.

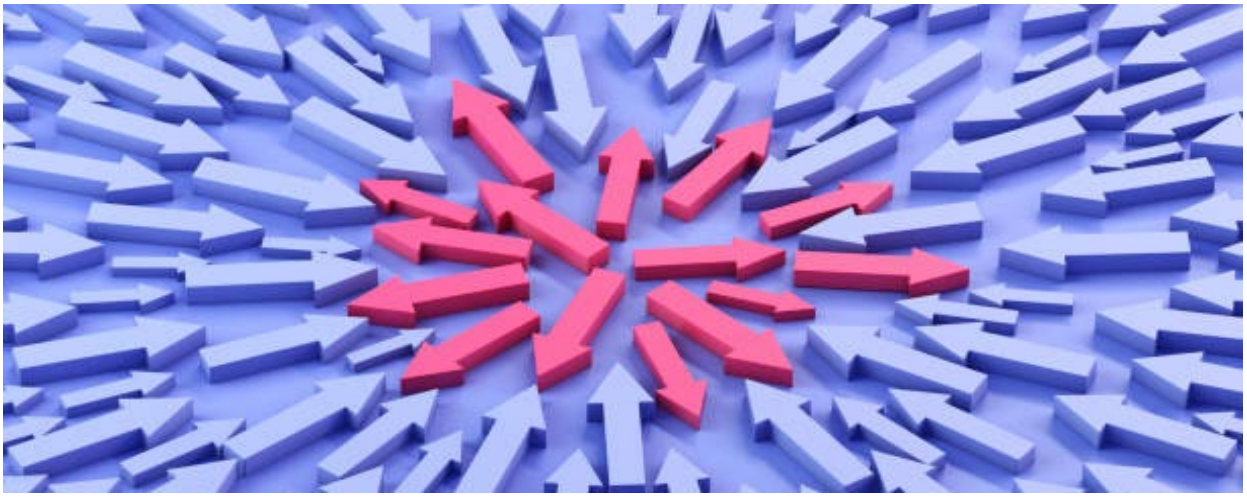
The Socratic tradition similarly positions questioning as a means of examining the quality of thought rather than merely eliciting correct responses. Socratic questioning asks learners to clarify what they mean, identify assumptions, consider alternatives, recognize contradictions, and explain the basis of their claims. Its contribution lies in demonstrating that an answer should not be accepted solely because it is confidently stated or socially familiar. Ideas acquire intellectual credibility when they can withstand examination. However, questioning in this tradition is not simply adversarial. At its strongest, it is a disciplined form of dialogue through which learners become more aware of the limits of their own reasoning. This awareness is essential to inquiry because students must learn that uncertainty is not evidence of failure; it is often the condition from which more rigorous thinking becomes possible.

Paulo Freire extended the educational purpose of questioning by connecting inquiry with agency, dialogue, and the interpretation of lived reality. His critique of the "banking" model of education challenged systems in which knowledge is treated as a finished deposit delivered by an authoritative teacher to passive students. In contrast, problem-posing education invites learners to investigate the social, cultural, political, and material conditions that shape their lives. Questions are not confined to understanding what something is; they also examine why it has become this way, whose interests it serves, whose experiences are missing, and what possibilities for action may exist. This perspective is especially important for future-ready education because it prevents inquiry from becoming an abstract cognitive exercise detached from human consequences. When learners extend an investigation toward new questions, ethical choices, or community action, they begin to use knowledge not only to interpret the world but also to participate responsibly within it.

While Dewey and Freire illuminate the philosophical and democratic purposes of inquiry, sociocultural theory helps explain how learners develop the capacity to participate in it. Vygotsky's work emphasizes that higher forms of thinking emerge through interaction with others and are mediated by language, cultural tools, modelling, and guided participation. A learner may notice a feature of a problem independently but require carefully structured dialogue to explain its significance. Similarly, students may be able to state an opinion but need teacher prompts, peer challenge, exemplars, or disciplinary language to transform that opinion into a defensible claim. The educational implication is that sophisticated inquiry should not be demanded without support. Teachers must scaffold the intellectual moves that expert thinkers often perform implicitly, making reasoning, justification, comparison, and revision visible before gradually transferring responsibility to learners.

Jerome Bruner's work on discovery and the structure of knowledge strengthens this argument by emphasizing that students should encounter the underlying relationships and organizing principles of a discipline rather than merely memorize disconnected conclusions. Yet discovery should not be confused with instructional absence. Learners benefit when educators design experiences that direct attention toward meaningful patterns, provide enough conceptual structure to prevent unproductive confusion, and encourage students to formulate relationships for themselves. Bruner's spiral curriculum also suggests that important ideas should be revisited through increasing levels of complexity. A question explored at one stage of schooling can return later through a different disciplinary lens, a more demanding body of evidence, or a more complex social context. Inquiry therefore does not simply move outward within one lesson; it can develop across years as learners repeatedly encounter, reinterpret, and extend foundational ideas.

Research on classroom dialogue further demonstrates that reasoning deepens when learners are expected to make their thinking public and responsive to others. Dialogic teaching, associated particularly with Robin Alexander, moves classroom interaction beyond the conventional pattern in which teachers initiate questions, students provide brief responses, and teachers evaluate them. In a dialogic classroom, students explain, challenge, connect, revise, and build upon ideas. Classroom talk becomes cumulative rather than fragmented, and questions are used to advance collective understanding rather than merely check individual performance. This matters because many forms of reasoning remain invisible until learners are asked to articulate how they arrived at a conclusion. Dialogue creates opportunities for assumptions to be exposed, evidence to be questioned, and alternative interpretations to be considered. It also teaches students that knowledge is strengthened through accountable exchange rather than weakened by disagreement.



Argumentation research makes the responsibilities of inquiry even more explicit. Stephen Toulmin's model of argument distinguishes among claims, supporting grounds, warrants that connect evidence to conclusions, qualifications, and possible rebuttals. Although this structure need not be reproduced mechanically in every classroom, its central principle is indispensable: a claim is not intellectually sufficient merely because it has been expressed. Learners must be able to demonstrate what supports it and why that support is relevant. Deanna Kuhn's work similarly emphasizes that mature thinking involves coordinating claims with evidence, considering competing explanations, responding to counterarguments, and understanding that knowledge claims can vary in strength. These capacities are particularly important in an information environment in which learners encounter persuasive language, manipulated evidence, misinformation, algorithmically amplified opinions, and artificially generated content. Education must therefore cultivate epistemic responsibility: the ability to ask not only whether an idea sounds convincing, but how it is known, what evidence supports it, what alternatives have been considered, and what would justify revising it.

The meaning of justification, however, changes across disciplines. Mathematical reasoning may depend upon proof, logical consistency, representation, or generalization. Scientific justification may require observation, measurement, experimental evidence, explanatory mechanisms, and recognition of uncertainty. Historical claims are evaluated through sourcing, contextualization, corroboration, and the interpretation of competing accounts. Literary analysis requires close attention to language, form, voice, symbolism, and textual evidence. In the arts, justification may involve intention, technique, aesthetic judgment, cultural context, and the relationship between form and meaning. Cross-disciplinary inquiry therefore cannot rely on one generic definition of "evidence." Students must learn that every field develops particular conventions for deciding what constitutes a credible claim. Effective questioning should help learners enter these disciplinary ways of knowing rather than treating reasoning as a universal skill detached from subject matter.

Contemporary research on guided inquiry reinforces the importance of this structured support. Inquiry-based learning is sometimes presented as a choice between direct instruction and learner independence, but this opposition is misleading. Students require substantive knowledge, clear purposes, accessible resources, feedback, and timely guidance if they are to conduct productive investigations. When inquiry is minimally guided, learners may become overwhelmed by the number of decisions they must make, focus on irrelevant information, or reinforce misconceptions. Strong inquiry teaching therefore combines intellectual agency with carefully designed scaffolding. The teacher does not determine every conclusion, but neither does the teacher withdraw and expect students to reproduce the practices of historians, scientists, mathematicians, or critics without apprenticeship. The instructional challenge is to provide enough structure to support success while preserving enough openness for authentic reasoning and discovery.

Research on deeper learning and transfer adds another essential dimension. Learning is not fully demonstrated when students reproduce knowledge only in the form and context in which it was taught. Deeper understanding becomes visible when learners recognize underlying principles, adapt knowledge to unfamiliar circumstances, make connections across domains, and use what they know to interpret or solve new problems. Transfer is difficult because students often associate knowledge with the specific task, textbook chapter, or assessment format in which it was learned. Questions that ask learners to apply ideas in new contexts can disrupt this dependency, but only when the new context requires genuine adaptation rather than superficial substitution. Application must therefore be followed by reflection: what remained constant, what changed, where did the idea succeed, where did it fail, and what does this reveal about the limits of the original understanding?

The ICAP framework, developed by Michelene Chi and Ruth Wylie, offers a complementary perspective by distinguishing among passive, active, constructive, and interactive forms of engagement. Its central insight is that learning tends to deepen when students generate ideas, explanations, inferences, or connections that go beyond the information directly presented, particularly when they do so in interaction with others. This is significant because visible activity is not synonymous with intellectual construction. Students may highlight text, complete worksheets, manipulate materials, or respond frequently without producing new understanding. Questioning becomes more powerful when it requires learners to construct explanations, defend interpretations, connect concepts, and generate further possibilities. In this sense, deeper inquiry involves not only doing more but also producing thought that was not already contained in the original prompt.

Across these traditions, a shared principle emerges: questioning is most educationally consequential when it moves learners from reception toward intellectual authorship. Dewey contributes reflective inquiry; the Socratic tradition contributes examination of assumptions; Freire contributes problem-posing and agency; Vygotsky explains the social and scaffolded development of thought; Bruner emphasizes structure, discovery, and revisiting ideas; dialogic teaching makes reasoning visible and collective; argumentation theory establishes evidential responsibility; and research on transfer and constructive engagement explains how understanding becomes generative. What remains necessary is a practical architecture that brings these insights together without reducing them to an unwieldy collection of techniques. Educators need a framework that is conceptually grounded, memorable in practice, adaptable across disciplines, and capable of guiding learners from an initial encounter with a question toward reasoning, justification, transfer, and the creation of new inquiry.

THE MISSING ARCHITECTURE: WHY BETTER QUESTIONS ARE NOT ENOUGH

Educators already have access to questioning taxonomies, discussion protocols, inquiry cycles, assessment rubrics, and banks of higher-order question stems. These tools are valuable, but they often remain disconnected. A teacher may know how to ask an analytical question, facilitate discussion, or design an inquiry task without having a clear structure for how one question should lead into the next. As a result, classroom questioning can become episodic: students observe something, offer an explanation, and then move on before examining evidence, testing the idea elsewhere, or generating a further line of inquiry.

This gap is especially visible in the difference between **cognitive difficulty** and **intellectual progression**. A question may appear challenging because it uses verbs such as analyze, evaluate, or create, yet still function as an isolated task. Deep inquiry requires more than increasing difficulty. It requires a coherent movement from attention to explanation, from explanation to justification, from justification to transfer, and from transfer to new possibilities. Without this progression, students may produce sophisticated-sounding responses without developing the habits needed to investigate knowledge independently.

Existing frameworks also tend to emphasize one part of the process more strongly than others. Taxonomies classify levels of thinking; argumentation models focus on claims and evidence; inquiry cycles structure investigations; dialogic approaches organize classroom talk; and experiential models connect knowledge with action. What teachers often lack is a simple cross-disciplinary architecture that brings these dimensions together in a sequence memorable enough for daily use. Such a framework must remain flexible across subjects while still respecting that reasoning, evidence, and application take different forms in mathematics, science, history, literature, the arts, and professional learning.

The missing element is therefore not another list of question stems. It is a model that helps educators design the **relationship among questions**. The Ripple Question Model addresses this need by organizing inquiry around five connected intellectual movements: **Notice, Reason, Justify, Apply, and Extend**. Rather than treating the first correct answer as the end of learning, it asks what that answer should make the learner examine, substantiate, test, or question next.

INTRODUCING THE RIPPLE QUESTION MODEL

The **Ripple Question Model** is a five-stage framework for designing inquiry that expands outward from an initial question, phenomenon, text, problem, experience, or idea. Its five interconnected ripples are **Notice, Reason, Justify, Apply, and Extend**. Each ripple places a different intellectual responsibility on the learner, moving from close attention toward explanation, evidence-based judgment, transfer, and the generation of further inquiry.

The metaphor of a ripple is central to the model. A significant question creates an intellectual disturbance: it interrupts what appears familiar and invites closer examination. The first response may be observational, but that observation should not remain isolated. It should lead learners to ask why something occurs, how it can be explained, what evidence supports the explanation, where the understanding can be used, and what new questions or possibilities emerge. In this way, inquiry widens gradually while remaining connected to its original point of departure.

The model is not intended as a rigid sequence that every learner must follow in exactly the same way. Authentic inquiry is recursive. New evidence may require students to revisit what they first noticed; applying an idea in another context may expose weaknesses in their reasoning; extending an inquiry may generate a new phenomenon that begins the cycle again. The five ripples therefore represent interacting forms of thinking rather than fixed levels that are completed once and left behind.

The framework is also cross-disciplinary but not discipline-neutral. The overall movement from noticing to extension can be used across science, mathematics, literature, history, the arts, language education, sustainability studies, and professional learning. However, the forms of reasoning and evidence must remain appropriate to each discipline. A mathematical claim is justified differently from a historical interpretation, and a scientific explanation requires different forms of evidence from a literary analysis. The model offers a common architecture for inquiry while preserving the distinctive ways in which disciplines construct, test, and communicate knowledge.

Most importantly, the Ripple Question Model is designed to shift students from responding to teacher-generated questions toward becoming authors of inquiry themselves. Teachers may initially model each ripple through carefully sequenced prompts, but over time learners should begin generating their own questions, selecting evidence, challenging interpretations, applying ideas, and determining what deserves further investigation. The ultimate purpose of the model is not simply to improve classroom questioning. It is to develop learners who can continue thinking when the teacher is no longer directing the process.

THE FIVE RIPPLES

Notice: What do we observe, and what deserves closer attention?

Reason: How might this be explained, and why might it be happening?

Justify: What evidence supports this claim, and how strong is the reasoning?

Apply: Where else can this understanding be used, tested, or adapted?

Extend: What new question, possibility, interpretation, or action now emerges?

At the centre of the model is a significant starting point; at its outer edge is not a final answer, but a new beginning. This is what distinguishes the framework from approaches that treat questioning as a route toward closure. In the Ripple Question Model, the strongest answer is often the one that creates the conditions for the next inquiry.

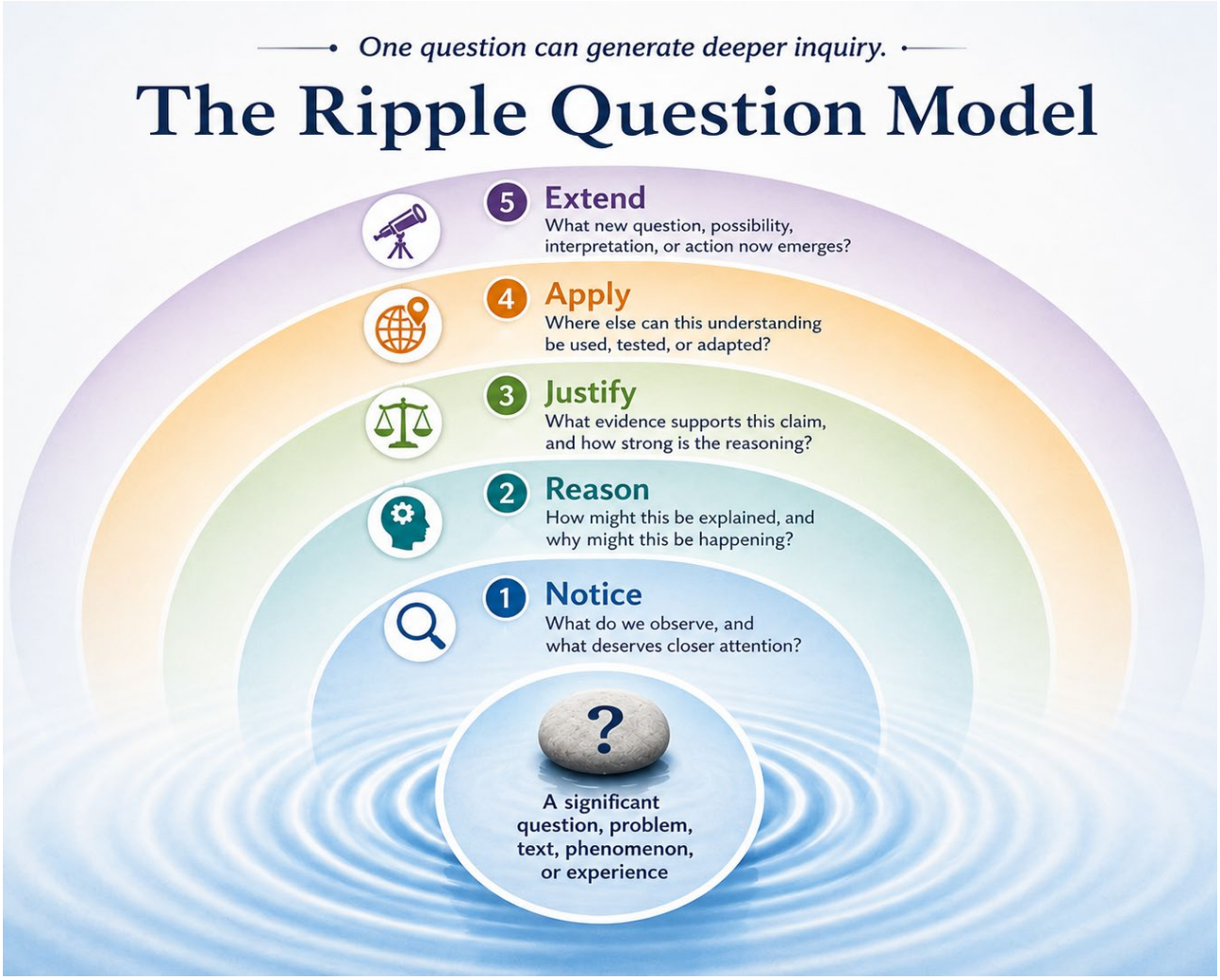


Figure 1. The Ripple Question Model. *An original conceptual framework developed by* ***Javeria Rana****, illustrating how a significant question can generate progressively deeper inquiry through five intellectual moves:* ***Notice, Reason, Justify, Apply, and Extend****.*

THE THEORETICAL ARCHITECTURE OF THE RIPPLE QUESTION MODEL

The five ripples are not arbitrary stages of questioning. Each represents a distinct intellectual movement grounded in established traditions of educational philosophy, cognitive science, argumentation, dialogic pedagogy, and inquiry-based learning. Together, they create a coherent progression from disciplined attention to independent knowledge generation. The model does not reproduce any single existing theory; rather, it brings complementary traditions into a practical architecture that educators can use across disciplines.

Ripple	Core Intellectual Movement	Key Theoretical Connections	Central Learner Question
Notice	Attending closely, identifying patterns, recognizing anomalies, and questioning what appears familiar	Deweyan reflective inquiry, disciplinary noticing, experiential learning	**What do I observe, and what deserves closer attention?**
Reason	Exploring causes, relationships, meanings, mechanisms, and possible explanations	Vygotsky's sociocultural theory, Bruner's guided discovery, constructivism, Socratic inquiry	**How might this be explained, and why might it be happening?**
Justify	Supporting interpretations with evidence, evaluating claims, and considering alternatives or counterarguments	Toulmin's argumentation model, Kuhn's epistemic cognition, dialogic teaching	**What evidence supports this claim, and how strong is the reasoning?**
Apply	Transferring understanding to a new context, problem, discipline, or real-world situation	Deweyan pragmatism, experiential learning, deeper learning, transfer theory	**Where else can this understanding be used, adapted, or tested?**
Extend	Generating new questions, interpretations, designs, investigations, possibilities, or actions	Freirean problem-posing education, Bruner's spiral curriculum, generative learning, creativity	**What new question, possibility, or action emerges from this inquiry?**

Table 1. The Theoretical Architecture of the Ripple Question Model

The map shows that the model is more than a hierarchy of increasingly difficult questions. Each ripple changes the learner's relationship with knowledge. **Notice** requires attentiveness; **Reason** requires interpretation; **Justify** requires epistemic responsibility; **Apply** requires transfer; and **Extend** requires intellectual agency. The progression therefore concerns not only cognitive complexity, but also the increasing degree to which learners become responsible for constructing, testing, and advancing understanding.

The model should also be understood as recursive rather than strictly linear. A learner may attempt to justify a claim and discover that the original observation was incomplete. Applying an idea in a new context may expose a contradiction that requires renewed reasoning. Extending an inquiry may produce another phenomenon, problem, or perspective that must first be noticed. The five ripples therefore operate as an interconnected cycle in which deeper learning repeatedly returns learners to careful observation, stronger evidence, and more refined questions.

HOW THE FIVE RIPPLES WORK

Notice

Directing Attention Before Demanding Interpretation

Inquiry begins with disciplined attention. The **Notice** ripple asks learners to observe closely, identify patterns, detect anomalies, distinguish relevant from irrelevant details, and recognize what deserves further investigation. This stage is often underestimated because observation appears simpler than analysis, yet weak noticing produces weak reasoning. Students cannot explain a pattern they have not seen clearly, evaluate evidence they have overlooked, or question an assumption they have not

recognized. Effective Notice questions may ask learners what they see, hear, measure, detect, compare, or find surprising. The teacher's role is not to supply the significance immediately, but to slow down perception and help students move beyond first impressions. In a history lesson, students might examine whose voices are present or absent from a source; in science, they might identify an unexpected change in a set of observations; in literature, they might notice a shift in tone, imagery, or perspective. Notice establishes the evidential starting point from which the remaining ripples develop.

Reason

Moving From Observation to Explanation

The **Reason** ripple asks learners to interpret what they have noticed by exploring causes, relationships, mechanisms, motives, meanings, and possible explanations. It moves learning beyond description toward the question of how or why something occurs. Reasoning should not be reduced to guessing. Students need opportunities to connect observations with prior knowledge, compare alternative explanations, identify assumptions, and make the intermediate steps in their thinking visible. Teachers can support this process through prompts such as: *What relationship do you see? What might explain this pattern? What assumptions are shaping your interpretation? Could there be another explanation?* In mathematics, reasoning may involve explaining why a method works; in science, it may involve proposing a mechanism; in literature, it may involve interpreting how language constructs meaning; and in social studies, it may involve examining the interaction of historical, economic, or political factors. The quality of the Reason ripple depends upon how well learners connect their explanations to what they initially observed.

Justify

Establishing Epistemic Responsibility

The **Justify** ripple requires learners to support their conclusions with evidence appropriate to the discipline. It is the point at which an interpretation, solution, or explanation must move beyond plausibility and demonstrate why it deserves acceptance. Students are asked to identify the evidence supporting a claim, explain how that evidence connects to the conclusion, evaluate its reliability, and consider competing interpretations or counterarguments. This ripple is particularly important in an environment saturated with confident claims, persuasive media, and AI-generated responses, because fluency can easily be mistaken for accuracy. Justification may involve proof in mathematics, experimental data in science, corroborated sources in history, textual evidence in literature, or ethical principles and consequences in moral reasoning. The purpose is not to train students to defend every initial answer stubbornly, but to develop the intellectual flexibility to strengthen, qualify, or revise a claim when the evidence requires it.

Apply

Testing Understanding Through Transfer

The **Apply** ripple asks learners to use, adapt, or test their understanding in a different context. It reveals whether learning is tied narrowly to the original task or has developed into transferable knowledge. Application should involve more than repeating the same procedure with altered names or numbers. Learners should encounter a new case, context, audience, problem, or discipline that requires them to determine which aspects of their understanding remain relevant and which must be modified. A scientific principle might be used to explain a local environmental issue; a mathematical concept might be applied to financial or architectural decisions; a literary theme might be examined in another text or cultural context; and a historical pattern might be used cautiously to interpret a contemporary development. The Apply ripple also exposes the limits of knowledge. When an idea does not transfer successfully, students gain an opportunity to examine the conditions under which it holds, where it breaks down, and what further understanding is needed.

Extend

Generating the Next Inquiry

The **Extend** ripple transforms learners from respondents into authors of inquiry. After observing, reasoning, justifying, and applying, students are asked what new question, interpretation, possibility, design, investigation, or action should follow. Extension may involve identifying an unresolved problem, proposing an alternative solution, designing a new investigation, connecting the inquiry to another discipline, challenging the assumptions of the original task, or applying learning to a community concern. In sustainability education, for example, students might move from understanding water scarcity to proposing a school-based conservation initiative and investigating how its impact could be measured. In literature, they might rewrite a scene from a marginalized perspective and examine how the shift changes meaning. Extend is not simply a creative activity added at the end of a lesson; it is the point at which knowledge becomes generative. The learner recognizes that an answer can clarify one issue while simultaneously revealing another.

The five ripples are most powerful when they remain connected. Observation without reasoning may remain descriptive; reasoning without justification may become speculation; justification without application may remain confined to the classroom; and application without extension may solve a task without cultivating future inquiry. The model therefore encourages educators to design questions as an intellectual sequence rather than as isolated prompts. Its purpose is not to force every lesson through five mechanical steps, but to ensure that learning has opportunities to move from careful attention toward increasingly independent and consequential thought.

APPLYING THE RIPPLE QUESTION MODEL ACROSS DISCIPLINES

The strength of the Ripple Question Model lies in its ability to provide a shared architecture for inquiry without reducing every discipline to the same form of thinking. The five ripples remain consistent, but the questions, evidence, reasoning processes, and outcomes change according to the knowledge practices of each subject. This distinction is essential. Cross-disciplinary application should not mean using identical question stems everywhere; it should mean helping learners recognize how observation, reasoning, justification, transfer, and extension operate differently across fields.

Science: Investigating a Local Environmental Phenomenon
A science inquiry might begin with photographs, data, or direct observations of declining water levels in a local area. Students first **Notice** patterns in rainfall, consumption, groundwater, or community access. They then **Reason** by proposing possible relationships among climate, population, infrastructure, agricultural practices, and human behaviour. During **Justify**, they evaluate data sources, compare explanations, and determine whether the available evidence supports a causal claim or only an association. They **Apply** their understanding by examining another water-stressed location or evaluating conservation measures within their school. Finally, they **Extend** the inquiry by designing a water audit, proposing an intervention, or asking how the long-term impact of that intervention could be measured.

Mathematics: Moving Beyond the Correct Solution
In mathematics, the model can shift attention from obtaining an answer to understanding the structure of a problem. Students may **Notice** patterns among numerical representations, geometric figures, or alternative solution methods. They **Reason** about why the pattern occurs and whether it can be generalized. During **Justify**, they provide a proof, logical explanation, representation, or counterexample rather than relying on the authority of a formula. They **Apply** the concept to an unfamiliar problem, such as using proportional reasoning to compare prices, interpret scale, or evaluate claims presented through graphs. They then **Extend** their thinking by changing a condition, developing a conjecture, creating another problem with the same underlying structure, or investigating whether the solution remains valid in every case.

Language and Literature: From Interpretation to New Perspective
A literature lesson might begin when students **Notice** recurring imagery, changes in tone, narrative omissions, or differences between what a character says and does. They **Reason** about how these choices shape meaning, identity, conflict, or reader response. During **Justify**, students support interpretations through textual evidence and explain how particular words, structures, or narrative decisions contribute to their conclusions. They **Apply** their understanding by comparing the text with another work, cultural context, contemporary issue, or personal experience without assuming that the situations are identical. They **Extend** the inquiry by questioning whose perspective is missing, rewriting a scene through another voice, or investigating how meaning would change if the text were created for a different audience or historical period.

History and Social Studies: Interpreting Evidence and Perspective
Historical inquiry can begin when learners **Notice** differences among accounts, gaps in a source, emotionally charged language, or the prominence of certain voices over others. They **Reason** about the political, economic, cultural, and social conditions that may have shaped the event or its representation. During **Justify**, students assess authorship, purpose, context, reliability, corroboration, and competing interpretations. They **Apply** historical understanding by examining patterns in another period or analyzing a contemporary issue, while remaining alert to the dangers of simplistic comparison. They **Extend** the inquiry by asking how the narrative might change if marginalized evidence were included, what additional sources are needed, or how public memory continues to shape present-day institutions and identities.

The Arts: Interpreting, Creating, and Revising Meaning
In visual art, music, drama, or design, students may **Notice** choices involving form, composition, rhythm, color, movement, space, or symbolism. They **Reason** about how these choices influence emotional, aesthetic, cultural, or political meaning. During **Defend or Justify**, learners explain their interpretations or creative decisions by referring to technique, context, intention, audience, and the qualities of the work itself. They **Apply** a principle or method to a new medium, theme, or design challenge. They **Extend** the process by producing an original variation, challenging a convention, integrating another disciplinary perspective, or asking how the work might communicate differently to another community.

Sustainability and Global Citizenship: From Understanding to Action
Sustainability education demonstrates the full potential of the model because it requires the integration of knowledge, values, systems thinking, and action. Students may **Notice** a local pattern involving waste, energy use, water access, biodiversity, or inequality. They **Reason** about the interconnected environmental, social, and economic causes of the issue. They **Justify** their interpretation using evidence while considering different stakeholder perspectives. They **Apply** what they have learned by evaluating solutions, adapting an intervention to their context, or anticipating unintended consequences. They **Extend** the inquiry by developing an action project, identifying new partners, measuring impact, or questioning whether the proposed solution addresses the root cause or only its visible symptoms.

Across these examples, the model does not prescribe a single teaching method. The five ripples can be developed through experiments, seminars, problem-solving tasks, fieldwork, debates, close reading, design challenges, collaborative projects, or AI-supported investigations. What remains consistent is the expectation that learners move beyond producing an answer toward observing carefully, reasoning transparently, justifying responsibly, transferring intelligently, and determining what the inquiry should make possible next.

FROM TEACHER-LED QUESTIONING TO STUDENT-GENERATED INQUIRY

The Ripple Question Model should not remain permanently dependent on teacher-generated prompts. Its deeper purpose is to help learners internalize the architecture of inquiry until they can use it independently. At the beginning, teachers may need to model each ripple explicitly by thinking aloud, demonstrating how an observation becomes an explanation, how a claim is tested against evidence, and how an answer can generate a new question. Over time, however, responsibility should shift from the teacher to the learner.

This progression can begin with **teacher modelling**. The teacher introduces a phenomenon, text, problem, or claim and demonstrates how the five ripples guide thinking. Rather than presenting the framework as a list to memorize, the teacher makes the intellectual movement visible: what was noticed, why a particular explanation was considered, what evidence strengthened or weakened it, how the idea could transfer, and what remained unresolved. This helps students see that expert thinking is not instantaneous; it is constructed through deliberate questioning and revision.

The next stage involves **shared question construction**. Teachers and students generate ripple questions together, compare their quality, and discuss which questions are most likely to deepen the inquiry. This collaborative phase is important because students need opportunities to distinguish between a question that merely asks for information and one that creates reasoning, justification, transfer, or extension. They can also learn that not every question belongs neatly to one ripple and that strong inquiry often requires revising a vague question into a more purposeful one.

As learners gain confidence, they can begin to **select and refine their own questions**. A teacher may provide the starting phenomenon while students decide what deserves attention, which explanation should be tested, what evidence is needed, and where the learning might be applied. At this stage, the framework becomes a planning tool for independent or collaborative investigations. Students may use the five ripples to organize a research task, structure a discussion, analyze an AI-generated response, design a project, or prepare a presentation.

The final stage is **learner-authored inquiry**. Students identify the problem, generate the questions, determine the evidence required, select appropriate methods, and decide how the inquiry should be extended. The teacher's role changes from directing the sequence to coaching its quality. Guidance remains important, particularly when students lack disciplinary knowledge or propose questions that are too broad, but the intellectual ownership increasingly belongs to the learner.

This gradual transfer of responsibility distinguishes the Ripple Question Model from approaches in which students simply respond to increasingly difficult teacher questions. The aim is not to produce learners who perform well within a questioning routine, but learners who can initiate and sustain inquiry beyond the classroom. A future-ready learner should be able to encounter an unfamiliar claim, problem, or possibility and independently ask: *What do I notice? How might I explain it? What evidence supports the explanation? Where else could this understanding apply? What should I investigate next?*

ASSESSING LEARNING THROUGH THE FIVE RIPPLES

The Ripple Question Model can also serve as an assessment framework because it makes different dimensions of thinking visible. Traditional assessment often privileges the final answer, but the five ripples allow educators to examine how learners arrived at that answer, how they supported it, whether they could transfer it, and whether they could generate further inquiry. This creates a broader picture of learning that includes observation, reasoning, evidence, application, and intellectual independence.

Assessment at the **Notice** stage can focus on the accuracy, relevance, and depth of students' observations. Teachers can examine whether learners identify significant details, detect patterns or anomalies, and distinguish evidence from assumption. At the **Reason** stage, assessment shifts toward the quality of explanation: whether students make logical connections, consider causes or relationships, acknowledge uncertainty, and compare alternative interpretations. The **Justify** stage provides evidence of epistemic responsibility by showing whether students can support claims with appropriate evidence, explain how that evidence relates to the conclusion, evaluate source quality, and revise their position when necessary.

The **Apply** ripple allows teachers to assess transfer rather than repetition. Learners demonstrate deeper understanding when they can adapt a concept, method, or principle to an unfamiliar context and explain what must change in the new situation. The **Extend** ripple reveals intellectual agency. Students may generate a meaningful research question, propose an alternative solution, design a new investigation, identify an unresolved tension, or connect the inquiry to a wider social or disciplinary concern. The quality of extension should be judged not only by originality, but also by relevance, feasibility, and connection to the preceding inquiry.

A simple assessment rubric could therefore examine five dimensions: **precision of noticing, coherence of reasoning, strength of justification, quality of transfer, and significance of extension**. These dimensions can be used formatively during discussions, projects, written work, experiments, presentations, or interdisciplinary investigations. They can also support self-assessment by asking students to identify which ripple is strongest in their work and which requires further development.

Using the model for assessment does not mean every task must be graded across all five ripples. In some lessons, the emphasis may be on evidence-based justification; in others, it may be on transfer or question generation. The purpose is to ensure that assessment captures the process of inquiry rather than reducing learning to the correctness of a final response. When students understand that reasoning, evidence, transfer, and extension are valued, they are more likely to approach questions as opportunities to construct knowledge rather than simply to perform for evaluation.

THE RIPPLE QUESTION MODEL IN THE AGE OF ARTIFICIAL INTELLIGENCE

Generative artificial intelligence has altered the educational meaning of a question. Learners can now obtain explanations, summaries, examples, arguments, lesson plans, calculations, and proposed solutions within seconds. This accessibility can support learning, but it also creates a new risk: students may confuse receiving a fluent response with developing understanding. An answer generated quickly may appear complete while containing weak evidence, hidden assumptions, oversimplification, bias, or factual error. In this environment, the central educational challenge is no longer simply helping students find information. It is helping them examine how information was produced, whether it deserves trust, and what responsible thinking should follow.

The Ripple Question Model offers a practical structure for turning AI use into inquiry rather than passive consumption. At the **Notice** stage, students examine an AI-generated response for significant claims, omissions, patterns, inconsistencies, or unfamiliar language. During **Reason**, they analyse how the response arrived at its explanation and identify assumptions, causal relationships, or perspectives that may have shaped it. The **Justify** ripple requires students to verify claims through reliable sources, evaluate the quality of evidence, compare alternative explanations, and distinguish plausible language from substantiated knowledge. This stage is especially important because generative systems can communicate uncertainty with the same confidence and fluency as accurate information.

The **Apply** ripple asks learners to adapt the AI-generated information to a specific context rather than accepting a generic answer as universally valid. A proposed teaching strategy, scientific explanation, policy recommendation, or community solution may need substantial modification when applied to a particular age group, culture, language, resource environment, or ethical concern. Students must therefore determine what remains useful, what must change, and what contextual knowledge the system could not adequately provide. Application becomes a test of understanding because learners must make informed judgments rather than simply reproduce generated content.

At the **Extend** stage, students move beyond evaluating the initial response and use it to generate more meaningful inquiry. They may formulate a stronger question, identify an unresolved issue, explore a neglected perspective, redesign a proposed solution, or investigate the social and ethical consequences of using AI in that context. In this way, artificial intelligence becomes a provisional thinking partner rather than an unquestioned authority. The value of the technology lies not in ending the intellectual process, but in providing material that learners can examine, challenge, adapt, and extend.

The model also helps redefine academic integrity in the AI era. Responsible use cannot be reduced to detecting whether a student used a digital tool. It requires examining whether the learner exercised intellectual ownership. A student demonstrates ownership when they can explain what they accepted, what they rejected, how they verified information, why they modified an idea, and what new understanding they produced. The Ripple Question Model makes these decisions visible and therefore provides educators with a more meaningful basis for evaluating AI-supported work.

Future-ready education should not attempt to compete with artificial intelligence by asking students to produce information more quickly. Its distinctive responsibility is to cultivate forms of judgment that automated systems cannot assume on the learner's behalf. Students must learn to notice what a response conceals, reason beyond what it presents, justify what they accept, apply ideas with contextual intelligence, and extend knowledge toward questions that matter. In this sense, the Ripple Question Model is not only a framework for better classroom questioning. It is also a framework for protecting human agency in an educational landscape increasingly shaped by machine-generated answers.

FROM CONCEPTUAL FRAMEWORK TO AN EVIDENCE BASE

The Ripple Question Model is currently best understood as a conceptual and practice-based framework rather than a fully validated theory of learning. Its value lies in offering educators a coherent structure for moving students from observation toward reasoning, justification, transfer, and further inquiry. However, its educational impact should not be assumed solely because the framework is theoretically grounded and practically appealing. Systematic research is needed to examine how the model functions across different subjects, age groups, cultural contexts, languages, and levels of learner readiness.

One important area of investigation concerns implementation. Teachers may interpret the five ripples differently, use them with varying degrees of disciplinary precision, or reduce them to a sequence of generic question stems. Research should therefore explore what kinds of professional learning help educators understand the intellectual purpose of each ripple, design appropriate prompts, and gradually transfer ownership of questioning to students. Studies should also examine whether the model is most effective when used within individual lessons, across extended projects, as a curriculum-planning tool, or as a school-wide approach to inquiry.

A second research priority is learner development. Future studies could investigate whether repeated use of the model improves the quality of student-generated questions, evidence-based reasoning, argumentation, transfer, metacognition, and intellectual independence. Comparative studies could examine differences between teacher-led questioning and learner-authored Ripple inquiries, while longitudinal research could explore whether students internalize the five intellectual movements over time and begin using them beyond formal classroom tasks.

The framework also requires examination in multilingual, low-resource, and culturally diverse classrooms. Inquiry depends heavily on language, confidence, disciplinary vocabulary, access to evidence, and classroom relationships. Students may possess complex reasoning that they cannot yet express fluently in the language of instruction, while limited resources may restrict opportunities for investigation. Research should therefore consider how translanguaging, visual representations, collaborative dialogue, locally available materials, and community knowledge can make the five ripples more inclusive without reducing their intellectual demand.

Further inquiry is also needed into the model's use with generative artificial intelligence. Researchers could examine whether Ripple-structured tasks improve students' ability to identify omissions, verify claims, evaluate evidence, adapt generated content, and maintain intellectual ownership. Such work would help determine whether the framework can support more rigorous forms of AI literacy rather than merely adding another procedural checklist to technology use.

These questions do not diminish the framework's current usefulness; they define the next stage of its development. Educational models become stronger when their assumptions, limits, and outcomes are examined openly. The Ripple Question Model should therefore be treated as an evolving framework—one that invites educators and researchers not only to apply its five ripples, but also to investigate where they succeed, where they require adaptation, and what further questions the model itself must generate.

IMPLICATIONS FOR TEACHERS, LEADERS, CURRICULUM DESIGNERS, AND POLICYMAKERS

The Ripple Question Model has implications beyond individual classroom questioning because the quality of inquiry is shaped by curriculum, assessment, professional learning, school culture, and system-level expectations. Teachers may introduce the five ripples during a lesson, but learners are unlikely to develop sustained habits of inquiry if the wider educational environment continues to reward speed, compliance, and reproduction over reasoning, evidence, transfer, and intellectual independence.

For **teachers**, the model offers a planning lens rather than another collection of question stems. Educators can examine a lesson and ask whether students are merely identifying information or whether they are also explaining relationships, supporting claims, transferring understanding, and generating further questions. Not every lesson must include all five ripples, but a sequence of learning should provide repeated opportunities to experience the complete movement of inquiry. Teachers can also use the framework to differentiate support. Some learners may require visual prompts or vocabulary scaffolds to articulate what they notice, while others may need stronger challenge through counterarguments, unfamiliar applications, or independently designed extensions.

For **school leaders**, the framework provides a way to examine the intellectual culture of classrooms. Lesson observations often focus on visible participation, pace, behaviour, or the number of questions asked. The more consequential question is what those questions enable students to do. Leaders can use the five ripples to guide professional dialogue without turning them into a rigid observation checklist. Collaborative planning, instructional coaching, and professional learning communities can analyse whether classroom tasks invite disciplined noticing, transparent reasoning, evidence-based justification, meaningful transfer, and student-generated inquiry. In this way, instructional leadership shifts from monitoring technique to strengthening the quality of thinking across the school.

For **curriculum designers**, the model can support coherence within and across subjects. Curriculum documents frequently identify critical thinking and inquiry as broad competencies without specifying how they should develop through content. The five ripples can make that progression more visible. Early learners may begin by noticing patterns, explaining simple relationships, and supporting claims with concrete evidence. Older students can work with competing interpretations, disciplinary standards of proof, unfamiliar applications, and independently generated investigations. Curriculum mapping can also identify where inquiry is introduced, revisited, deepened, and assessed, reducing the risk that questioning remains dependent on the preferences of individual teachers.

For **policymakers and assessment authorities**, the model raises a larger question about what educational systems choose to value. When high-stakes examinations reward primarily recall, procedural reproduction, and predetermined responses, schools receive a powerful incentive to restrict inquiry even when curriculum policies promote critical thinking. Assessment reform should therefore include tasks that require learners to interpret evidence, justify conclusions, transfer ideas to unfamiliar contexts, and formulate meaningful questions. This does not require abandoning foundational knowledge; rigorous inquiry depends upon it. It requires ensuring that knowledge is assessed not only as something students possess, but as something they can examine, use, defend, and extend.

The framework may be especially valuable in low-resource settings because it does not depend upon expensive technology, specialized laboratories, or elaborate materials. A local object, community problem, short text, photograph, data set, classroom observation, or everyday phenomenon can become the centre of a Ripple inquiry. What matters is the intellectual design surrounding the resource. However, equitable implementation requires attention to language, confidence, participation, and access to background knowledge. Students should not be judged as weak thinkers simply because they need additional linguistic or social support to express complex reasoning.

Ultimately, the Ripple Question Model invites educational systems to reconsider the purpose of questioning. Questions should not function only as instruments through which teachers control attention or verify coverage. They should become structures through which learners acquire increasing responsibility for knowledge. When this principle is reflected in teaching, leadership, curriculum, and assessment, inquiry becomes more than a classroom strategy. It becomes part of the intellectual culture of the school.

A FUTURE-READY VISION OF INQUIRY

Future-ready education cannot be defined only by access to technology, new curriculum content, or the speed with which learners retrieve information. Its deeper measure is whether students can encounter complexity without becoming intellectually dependent upon the first available answer. They must be able to observe carefully, interpret thoughtfully, evaluate evidence, transfer understanding, and continue questioning when certainty is incomplete. These capacities are not supplementary skills. They are essential conditions for responsible participation in democratic, professional, scientific, cultural, and technological life.

The Ripple Question Model contributes to this vision by repositioning questions as pathways into intellectual agency. The learner is not merely expected to respond accurately but to understand how knowledge is formed, why some claims are more defensible than others, where ideas can be applied, and what further inquiry remains necessary. The model therefore challenges an educational culture in which success is often associated with speed, confidence, and completion. Deep learning may require hesitation, revision, disagreement, and return. A learner who changes an interpretation after examining stronger evidence has not failed; that learner has demonstrated epistemic maturity.

The framework also offers a way to preserve the human purpose of education in an age of artificial intelligence. Machines may increasingly generate explanations, predictions, and solutions, but learners must still decide what deserves attention, whose perspective is missing, what evidence is sufficient, how knowledge should be used, and what consequences may follow. These are not merely computational decisions. They involve judgment, ethics, context, imagination, and responsibility. By structuring inquiry around these intellectual obligations, the Ripple Question Model helps ensure that technology expands human thought rather than replacing it.

A future-ready classroom should therefore be recognized not by how many questions a teacher asks, but by what students learn to do with questions. The strongest evidence of success is not that learners can complete the five ripples when prompted, but that they begin to use them independently: noticing what others overlook, reasoning beyond surface explanations, demanding evidence, adapting knowledge to unfamiliar situations, and generating questions that lead toward new understanding or meaningful action.

The enduring purpose of education is not to prepare students for a world in which every problem has already been defined and every answer is waiting to be retrieved. It is to prepare them to recognize problems that have not yet been named, evaluate answers that may be incomplete, and pursue questions whose significance extends beyond the classroom. The Ripple Question Model begins with one question, but its ultimate aim is the development of learners who know how to keep inquiry alive.

FURTHER READING

The following works provide important philosophical, psychological, and pedagogical foundations for educators who wish to explore the intellectual traditions connected with the Ripple Question Model.

Robin Alexander — *A Dialogic Teaching Companion*
Alexander demonstrates how purposeful classroom dialogue can develop reasoning, shared understanding, and accountable participation. His work helps educators understand how the five ripples can unfold through discussion, collaborative inquiry, questioning, and the cumulative development of ideas.

Jerome S. Bruner — *The Process of Education*
Bruner explores discovery, disciplinary structure, and the spiral curriculum. His work supports the model's emphasis on helping learners recognize underlying relationships, revisit important ideas at increasing levels of complexity, and extend questions across contexts and stages of learning.

John Dewey — *How We Think*
Dewey's account of reflective thought remains foundational for understanding inquiry as a response to uncertainty, difficulty, or contradiction. His work is especially relevant to the movement from **Notice** to **Reason**, because it explains how careful observation develops into the examination and testing of possible explanations.

Paulo Freire — *Pedagogy of the Oppressed*
Freire's problem-posing approach positions learners as active interpreters of their social realities rather than passive recipients of predetermined knowledge. His philosophy is particularly relevant to the **Extend** ripple, where inquiry can generate new perspectives, ethical reflection, community participation, and informed action.

Deanna Kuhn — *Education for Thinking*
Kuhn examines the development of inquiry, argumentation, evidence-based reasoning, and epistemic understanding. Her work provides a strong foundation for the **Justify** ripple and for helping students distinguish between unsupported opinion and claims that can withstand intellectual scrutiny.

These texts represent different traditions, yet they share a common conviction: education should develop learners who can examine knowledge rather than merely receive it. Read together, they provide a deeper foundation for understanding inquiry as reflective, social, evidential, transferable, and generative.

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