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Köhler's Theory and Inquiry Learning: Literature Review of 21st Century Theoretical Implications

Teori Köhler dan Pembelajaran Inkuiri: Kajian Literatur Tentang Implikasi Teoritis Abad 21

Aisha Shafa Kirana[1], Naufal Fais Rahman[2], Suparmi[3]
[1-3]Sebelas Maret University, Indonesia

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Corresponding Author:
Aisha Shafa Kirana
✉aishasha@student.uns.ac.id

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Abstract

Despite global educational mandates to cultivate modern competencies, inquiry learning frequently degrades into superficial guessing due to inadequate cognitive scaffolding during inevitable student impasses. To address this theoretical void, this qualitative study employs a systematic literature review adhering strictly to the PRISMA framework to synthesize Wolfgang Köhler's Gestalt theory of insight with constructivist pedagogical architectures. Analyzing interdisciplinary literature from psychology and education, findings reveal that cognitive roadblocks and epistemic emotions are not instructional failures, but rather necessary incubation mechanisms triggering sudden representational restructuring, known universally as the insight moment. By mapping internal cognitive phases directly onto external pedagogical stages, this research demonstrates how deliberately engineering productive struggle operationalizes the robust development of critical thinking and creativity. Ultimately, this integrated framework provides a rigorous neurocognitive justification for progressive educational policies like Indonesia's Kurikulum Merdeka while simultaneously establishing vital ethical boundaries against premature artificial intelligence integration within modern global learning environments today.

Abstrak

Meskipun terdapat mandat pendidikan global untuk menumbuhkan kompetensi modern, pembelajaran inkuiri sering kali terdegradasi menjadi sekadar tebakan superfisial akibat kurangnya perancah kognitif selama masa kebuntuan siswa. Untuk mengatasi kekosongan teoretis ini, studi kualitatif ini menerapkan sebuah tinjauan literatur sistematis yang mematuhi secara ketat pedoman kerja PRISMA guna menyintesis teori wawasan Gestalt Wolfgang Köhler dengan arsitektur pedagogis konstruktivis. Menganalisis ragam literatur interdisipliner dari ranah psikologi dan pendidikan, temuan mengungkapkan bahwa hambatan kognitif serta emosi epistemik bukanlah suatu kegagalan instruksional, melainkan mekanisme inkubasi esensial pemicu restrukturisasi representasional mendadak, yang dikenal secara universal sebagai momen wawasan. Dengan memetakan fase kognitif internal secara langsung ke dalam tahapan pedagogis eksternal, penelitian ini mendemonstrasikan bagaimana merekayasa pergumulan produktif secara sengaja akan mengoperasionalkan pengembangan pemikiran kritis maupun kreativitas. Kesimpulannya, kerangka kerja terintegrasi ini memberikan pembenaran neurokognitif kuat bagi kebijakan pendidikan progresif seperti Kurikulum Merdeka sembari menetapkan batasan etis esensial demi mencegah integrasi teknologi kecerdasan buatan secara prematur.

A. INTRODUCTION

1. Background

The twenty-first century has catalyzed an unprecedented epistemological paradigm shift in global education, transitioning the fundamental objective of learning from the rote accumulation of static information to the dynamic construction, application, and continuous restructuring of knowledge. This systemic transformation is driven by the escalating complexity of modern global challenges, rapid technological advancements, and the pervasive integration of artificial intelligence into daily life, which collectively demand a workforce and citizenry equipped with highly adaptive, higher-order cognitive competencies.[1] These competencies, universally codified in educational discourse as the 4Cs—Critical Thinking, Creativity, Collaboration, and Communication—are no longer viewed as peripheral or aspirational educational goals, but rather as mandatory survival skills in a rapidly evolving socioeconomic landscape.[2]

However, despite widespread international policy mandates and sweeping curricular reforms aimed at fostering these cognitive skills, a profound and persistent gap remains between pedagogical theory and actual classroom practice. In numerous educational settings, the implementation of progressive learning models frequently devolves into rigid, procedural exercises that fail to trigger genuine cognitive engagement or structural understanding. Students are often guided through the superficial motions of problem-solving without ever experiencing the deep, internal cognitive dissonance required to fundamentally alter their mental frameworks.[3] This phenomenon highlights a critical systemic failure: modern education systems are highly adept at measuring the external outputs of learning through standardized metrics, yet they remain fundamentally underequipped to cultivate, understand, and engineer the internal, structural cognitive mechanisms that drive true intellectual mastery.

To bridge this pedagogical gap, instructional designers and educational policymakers have heavily championed Inquiry-Based Learning (IBL) and related

[1] Trini Balart, Brayan Díaz, and Kristi Shryock, "A Systematic Literature Review on the Pedagogical Implications and Impact of GenAI on Students' Critical Thinking," *Algorithms* 19, no. 3 (February 27, 2026): 179, https://doi.org/10.3390/a19030179.
[2] Branden Thornhill-Miller et al., "Creativity, Critical Thinking, Communication, and Collaboration: Assessment, Certification, and Promotion of 21st Century Skills for the Future of Work and Education," *Journal of Intelligence* 11, no. 3 (March 15, 2023): 54, https://doi.org/10.3390/jintelligence11030054.
[3] Siti Nurhasanah et al., "Bridging the Gap: A Systematic Review of Deep Learning Pedagogy for Indonesia's Curriculum Reform," *Tarbawi: Jurnal Keilmuan Manajemen Pendidikan* 11, no. 02 (August 24, 2025): 277–92, https://doi.org/10.32678/tarbawi.v11i02.11368.

discovery-based methodologies. As a constructivist pedagogical approach rooted in the theories of Piaget and Vygotsky, IBL shifts the locus of control from the teacher to the student, emphasizing problem-based exploration, evidence-driven investigation, collaborative dialogue, and conceptual reflection.[4]

Theoretically, IBL creates the optimal environmental conditions for students to exercise the 4Cs by forcing them to confront real-world ambiguities. Meta-analyses and extensive empirical studies demonstrate that robust IBL interventions yield significant, positive effects on students' higher-order thinking, analytical skills, and overall cognitive development, with substantial effect sizes reported across diverse STEM and humanities disciplines.[5]

The inherent structure of IBL—which moves cyclically through questioning, investigating, analyzing, and communicating—is designed to force learners to confront gaps in their understanding, thereby inducing states of cognitive disequilibrium.[6] However, emerging empirical evidence reveals a troubling blind spot in the contemporary application of IBL: when executed without precise cognitive scaffolding, the inquiry process often degrades into a frustrating sequence of aimless trial-and-error, leading to student disengagement, cognitive overload, and superficial conceptual mastery.[7] While the external stages of IBL are meticulously documented in pedagogical literature, the internal cognitive mechanics—specifically, how a student mentally transitions from a state of confusion to a state of sudden, structural comprehension during an inquiry task—remain largely treated as an unobservable phenomenon in educational research.

To strengthen the depth of this analysis and establish scientific credibility, it is imperative to map the state of the art in recent literature, which reveals a vibrant, albeit fragmented, academic debate across multiple disciplines. A thematic synthesis of primary studies published within the last five years reveals three distinct scholarly clusters that

[4] Sofie M.M. Loyens, Lisette Wijnia, and Remy M.J. P. Rikers, "Student-Centered Instruction: Inquiry-, Problem-, Project-, and Case-Based Learning," in *International Encyclopedia of Education(Fourth Edition)* (Elsevier, 2023), 701–11, https://doi.org/10.1016/B978-0-12-818630-5.14080-1.
[5] Zainal Arifin et al., "The Effect of Inquiry-Based Learning on Students' Critical Thinking Skills in Science Education: A Systematic Review and Meta-Analysis," *Eurasia Journal of Mathematics, Science and Technology Education* 21, no. 3 (March 1, 2025): em2592, https://doi.org/10.29333/ejmste/15988.
[6] Ahmad Qablan et al., "Inquiry-Based Learning: Encouraging Exploration and Curiosity in the Classroom," in *Cutting-Edge Innovations in Teaching, Leadership, Technology, and Assessment*, 2024, 1–12, https://doi.org/10.4018/979-8-3693-0880-6.ch001.
[7] Marit Kastaun et al., "Validation of Cognitive Load During Inquiry-Based Learning With Multimedia Scaffolds Using Subjective Measurement and Eye Movements," *Frontiers in Psychology* 12 (August 31, 2021), https://doi.org/10.3389/fpsyg.2021.703857.

rarely intersect. The first cluster focuses on the procedural efficacy and systemic design of inquiry and problem-based learning. Scholars such as de Jong et al. and Antonio & Prudente have established that while IBL enhances analytical capacity, its success is heavily contingent upon digital and teacher-led scaffolding, without which the learning process becomes shallow and cognitively overwhelming.[8,9] Similarly, recent investigations into secondary and higher education confirm that minimally guided discovery learning often fails to promote critical thinking, as students lack the metacognitive regulation required to systematically restructure their own knowledge.

The second cluster, grounded in cognitive psychology and neuroscience, investigates the phenomenon of insight—specifically Wolfgang Köhler's Gestalt theory of the "Aha!" moment. Researchers such as Osuna-Mascaró & Auersperg, Graf et al., and Robinson et al., have mapped the neurocognitive reality of insight, defining it as a sudden, non-linear representational restructuring of a problem space that occurs after a period of intense cognitive impasse. This cognitive leap involves complex neural networks, including the hippocampus and the right anterior superior temporal gyrus, which process remote semantic associations to bypass logical dead ends.[10,11,12]

The third cluster focuses on the affective dimensions of learning and the integration of emerging technologies. Scholars analyzing epistemic emotions argue that confusion, frustration, and surprise are necessary precursors to radical conceptual change in science and mathematics education, emphasizing that the emotional release associated with sudden comprehension significantly enhances long-term memory retention.[13]

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[8] Ton de Jong et al., "Understanding Teacher Design Practices for Digital Inquiry–Based Science Learning: The Case of Go-Lab," *Educational Technology Research and Development* 69, no. 2 (April 11, 2021): 417–44, https://doi.org/10.1007/s11423-020-09904-z.

[9] Ronilo Palle Antonio and Maricar Sison Prudente, "Effects of Inquiry-Based Approaches on Students' Higher-Order Thinking Skills in Science: A Meta-Analysis," *International Journal of Education in Mathematics, Science and Technology* 12, no. 1 (October 23, 2023): 251–81, https://doi.org/10.46328/ijemst.3216.

[10] Antonio J. Osuna-Mascaró and Alice M. I. Auersperg, "Current Understanding of the 'Insight' Phenomenon Across Disciplines," *Frontiers in Psychology* 12 (December 15, 2021), https://doi.org/10.3389/fpsyg.2021.791398.

[11] Mario Graf et al., "Tracing Cognitive Processes in Insight Problem Solving: Using GAMs and Change Point Analysis to Uncover Restructuring," *Journal of Intelligence* 11, no. 5 (May 3, 2023): 86, https://doi.org/10.3390/jintelligence11050086.

[12] Tracy Robinson, Don Morrow, and Michael R. Miller, "From Aha to Ta-Dah: Insights during Life Coaching and the Link to Behaviour Change," *Coaching: An International Journal of Theory, Research and Practice* 11, no. 1 (January 2, 2018): 3–15, https://doi.org/10.1080/17521882.2017.1381754.

[13] Kati Järvinen et al., "Investigating the Moments of 'Aha' and 'Hmm' through Acoustic Analysis of Voice and Speech in Pre-Service Physics Teacher Education–A Novel Method for Identifying Significant Learning Moments," ed. Gaoxia Zhu, *PLOS ONE* 20, no. 1 (January 24, 2025): e0314344, https://doi.org/10.1371/journal.pone.0314344.

Concurrently, research on Generative Artificial Intelligence (GenAI) warns of "cognitive offloading," where students rely on AI to bypass the productive struggle entirely, thereby eliminating the opportunity for genuine cognitive restructuring.[14]

By bringing these three disparate academic clusters into direct dialogue, a significant research gap becomes glaringly evident. The pedagogical literature rigorously outlines what students should do during IBL, and the neurocognitive literature rigorously explains how the brain achieves sudden insight, yet there is a profound theoretical void connecting the two. Pedagogical frameworks currently lack a unified vocabulary to describe the internal cognitive restructuring that must occur when a student hits an impasse during an inquiry task. Previous studies have either treated trial-and-error as a purely behavioral mechanism devoid of cognitive depth, or they have isolated the study of the "Aha!" moment to highly controlled, abstract psychological laboratory settings, failing to translate these neurocognitive realities into actionable instructional design.[15] Consequently, modern instructional models fail to deliberately engineer the conditions necessary for Gestalt insight, inadvertently treating student confusion as a negative side-effect to be minimized rather than a critical cognitive catalyst to be harnessed.

Based on the identified gaps, distinct from previous studies that predominantly focus on the procedural efficacy of inquiry learning or the neurological mapping of insight in isolated laboratory settings, this research offers a novel theoretical approach by systematically synthesizing Wolfgang Köhler's Gestalt theory of insight directly with the constructivist architecture of Inquiry-Based Learning. This conceptual synthesis provides a theoretical framework that redefines trial-and-error and cognitive impasse not as instructional failures, but as essential epistemological mechanisms that trigger the representational restructuring required for the mastery of 21st-century skills. The novelty of this research lies in its interdisciplinary comparative approach, bridging early 20th-century cognitive psychology with contemporary 21st-century pedagogical challenges, thereby offering a precise cognitive blueprint for instructional designers and educators facing the complexities of modern, technology-rich classrooms.

Ultimately, this article argues that the deliberate pedagogical integration of Gestalt insight mechanisms into Inquiry-Based Learning transforms inevitable student impasses

[14] Balart, Díaz, and Shryock, "A Systematic Literature Review on the Pedagogical Implications and Impact of GenAI on Students' Critical Thinking."
[15] Ivan K. Ash, Benjamin D. Jee, and Jennifer Wiley, "Investigating Insight as Sudden Learning," *The Journal of Problem Solving* 4, no. 2 (May 11, 2012), https://doi.org/10.7771/1932-6246.1123.

into engineered cognitive leaps, thereby operationalizing the abstract goals of the 4Cs into observable, manageable cognitive events. The global academic community must attend to this synthesis because it fundamentally shifts the locus of educational intervention: rather than merely assessing the final outputs of student performance, educators and policymakers can utilize this framework to cultivate the internal mental architectures necessary to solve increasingly complex, ill-structured global problems. As a culmination of this background, this research offers a comprehensive conceptual solution that leverages structured trial-and-error, epistemic emotional regulation, and precise cognitive scaffolding to ensure that moments of failure in the classroom are systematically converted into profound, structural insights, offering direct relevance to global educational reforms and localized policies such as Indonesia's *Kurikulum Merdeka*.

2. Research Questions

The theoretical integration of Gestalt psychology and constructivist pedagogy raises critical questions regarding the internal mechanics of student cognition and the external design of instructional environments. To systematically unpack these complex dynamics, this research is guided by the following problem formulations, which dictate the subsequent analytical discourse:

First, how does the cognitive mechanism of insight—defined as sudden representational restructuring in Wolfgang Köhler's Gestalt theory—theoretically align with the sequential and structural phases of Inquiry-Based Learning?

Second, in what ways do cognitive impasses, epistemic emotions, and structured trial-and-error processes act as necessary, engineered catalysts for triggering the "Aha!" moment during complex problem-solving tasks, rather than acting as indicators of instructional failure?

Third, what are the broader pedagogical implications of synthesizing Gestalt insight with inquiry-based learning for the cultivation of 21st-century competencies (the 4Cs), and how does this integrated framework elevate both localized educational policies (such as Indonesia's Kurikulum Merdeka) and universal educational discourse in the era of artificial intelligence?

3. Research Methods

To rigorously address the problem formulation and dissect the complex intersection of cognitive psychology and educational pedagogy, this study employs a Systematic Literature Review (SLR) integrated with an advanced conceptual synthesis approach.

This methodology is specifically chosen and justified because answering questions of theoretical alignment and internal cognitive mechanisms requires the critical juxtaposition of established psychological paradigms against contemporary empirical data from educational implementations. A purely descriptive or quantitative review would be insufficient; therefore, the SLR is utilized as an analytical tool to trace causal relationships, theoretical overlaps, and instructional gaps across multiple disciplines.

This research utilizes a qualitative, theoretical synthesis approach grounded in systematic review protocols, adhering to the principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework for study selection and evaluation.[16] By adopting a critical multiplism perspective, the study analyzes theoretical texts, meta-analyses, and empirical studies to construct a cohesive conceptual framework. The research design is operationalized through the identification, evaluation, and synthesis of cross-disciplinary literature, moving beyond simple narrative summarization to perform a deep structural mapping of Gestalt cognitive mechanics onto constructivist pedagogical frameworks.

As a theoretical study, the "participants" are the theoretical constructs, empirical findings, and pedagogical models extracted from high-impact academic literature. The primary data sources comprise peer-reviewed journal articles, seminal psychological texts, and meta-analyses published predominantly between 2020 and 2026 to ensure contemporary relevance, alongside foundational historical texts on Gestalt theory (e.g., Köhler's original observations from 1917 and 1925). Data were sourced from major academic digital libraries including Scopus, Web of Science, IEEE Xplore, and ERIC. The empirical studies reviewed encompass a wide demographic of human participants, ranging from early childhood education subjects to secondary students, higher education undergraduates, and pre-service teachers, ensuring that the theoretical synthesis is applicable across the developmental spectrum.

Data collection was executed through targeted, Boolean-based keyword searches. Search strings included combinations such as ("Gestalt theory" OR "insight learning" OR "Aha! moment") AND ("inquiry-based learning" OR "discovery learning" OR "problem-solving") AND ("cognitive restructuring" OR "representational change" OR "21st-century

[16] Xin Zhang et al., "A Systematic Literature Review of Empirical Research on Applying Generative Artificial Intelligence in Education," *Frontiers of Digital Education* 1, no. 3 (September 5, 2024): 223–45, https://doi.org/10.1007/s44366-024-0028-5.

skills" OR "Kurikulum Merdeka"). The initial search yielded a broad corpus, which was subsequently filtered through rigorous inclusion and exclusion criteria based on thematic relevance, peer-review status, and theoretical depth. Selected articles underwent a process of systematic documentation, where key variables—such as the operational definition of insight, the structural components of the pedagogical intervention, the affective states observed, and the reported cognitive outcomes—were extracted and cataloged.

The extracted data were subjected to an interactive thematic analysis and a comparative theoretical mapping process. This analytical mechanism involves three concurrent flows of activity: data reduction, data display, and conclusion drawing/verification. First, literature from cognitive neuroscience regarding insight was conceptually reduced to its core mechanisms (preparation, impasse, incubation, illumination, verification). Second, literature regarding IBL was mapped according to its phased structure (engagement, exploration, explanation, elaboration, evaluation). Third, a critical gap analysis was performed by bringing these two distinct domains into direct academic dialogue. This allowed for the identification of theoretical friction points and synergistic overlaps. Through this dialectical process, the study synthesized a new interpretive framework that operates Gestalt theory as an analytical knife to dissect empirical findings from modern inquiry classrooms, ultimately producing robust conclusions regarding pedagogical implications.

B. DISCUSSION

The integration of Wolfgang Köhler's Gestalt theory of insight with modern Inquiry-Based Learning (IBL) requires a departure from purely descriptive reporting of pedagogical outcomes. To truly understand how 21st-century competencies are forged, it is necessary to dissect the root causes of cognitive development and explore the mechanisms through which instructional environments facilitate deep, structural learning. The following analysis interprets the synthesized data to explain why students encounter cognitive roadblocks during inquiry, how specific pedagogical interventions can successfully engineer the "Aha!" moment, and how these micro-level classroom interactions scale up to influence macro-level educational policies.

1. The Gestalt Mechanism of Insight: A Cognitive Deconstruction

To understand the cognitive underpinnings of problem-solving, one must trace the theoretical origins of Gestalt psychology. In the early 20th century, the dominant paradigm of learning was behaviorism, championed by figures like Edward Thorndike, who posited that learning occurred exclusively through the gradual, associative conditioning of stimuli and responses, or blind trial-and-error.[17] Wolfgang Köhler fundamentally challenged this reductionist view through his seminal experiments with chimpanzees, most notably Sultan, at the Anthropoid Station in Tenerife.[18] By presenting the apes with problems that required novel uses of tools (e.g., stacking boxes or joining sticks to reach suspended food), Köhler observed behaviors that contradicted behaviorist predictions. The subjects did not merely stumble upon solutions through random, gradual iterations. Instead, they often experienced periods of apparent frustration and inactivity, followed by a sudden, fluid execution of a complex solution.

Köhler termed this phenomenon *insight*—a holistic comprehension of the problem space where the structural relationships between isolated elements are suddenly perceived as a unified whole, or a *Gestalt* ("the whole is greater than the sum of its parts").[19] Modern neurocognitive research validates Köhler's initial observations, defining insight as a "representational change" or "cognitive restructuring" that fundamentally alters how the brain processes a specific challenge.[20] Unlike analytical, step-by-step problem solving—which relies heavily on working memory and the prefrontal cortex—insight learning involves complex, non-linear neural networks.[21] Neurological studies using electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) reveal that the "Aha!" moment is characterized by a burst of high-frequency gamma waves in the right anterior superior temporal gyrus, an area

[17] Ash, Jee, and Wiley, "Investigating Insight as Sudden Learning."
[18] Gabriel Ruiz and Natividad Sánchez, "Wolfgang Köhler's the Mentality of Apes and the Animal Psychology of His Time," *The Spanish Journal of Psychology* 17 (October 28, 2014): E69, https://doi.org/10.1017/sjp.2014.70.
[19] Norhafezza and Khairul Azhar, "Conceptual Framework of Gestalt Theory Observation and the Application of HOTS and Advanced Drawing Skills (ADS) in Visual Art Learning," *International Journal of Academic Research in Progressive Education and Development* 13, no. 3 (September 17, 2024): 3724–37, https://doi.org/10.6007/IJARPED/v13-i3/22619.
[20] Mary Vitello and Carola Salvi, "Gestalt's Perspective on Insight: A Recap Based on Recent Behavioral and Neuroscientific Evidence," *Journal of Intelligence* 11, no. 12 (December 9, 2023): 224, https://doi.org/10.3390/jintelligence11120224.
[21] Kadi Tulver et al., "Restructuring Insight: An Integrative Review of Insight in Problem-Solving, Meditation, Psychotherapy, Delusions and Psychedelics," *Consciousness and Cognition* 110 (April 2023): 103494, https://doi.org/10.1016/j.concog.2023.103494.

associated with processing remote semantic associations, accompanied by activity in the hippocampus and amygdala, which consolidate the new representational map into long-term memory.[22]

The cognitive architecture of an insight experience is universally recognized to unfold across four distinct stages:

a. *Preparation:* The conscious gathering of information and the application of existing, standard analytical strategies.
b. *Incubation (The Impasse):* A critical phase where logical attempts fail, leading to a mental block. The conscious mind steps back, allowing subconscious neural networks to search for remote connections.
c. *Illumination:* The sudden "Aha!" moment where representational change occurs, bringing the solution abruptly into conscious awareness.
d. *Verification:* The conscious evaluation and testing of the new insight against the parameters of the problem.

2. The Structural Architecture and Vulnerabilities of Inquiry-Based Learning

Inquiry-Based Learning represents the pedagogical operationalization of constructivist theories proposed by Piaget and Vygotsky, operating on the premise that knowledge cannot be passively transmitted but must be actively constructed by the learner.[23] IBL generally progresses through five interconnected phases: Engagement (activating prior knowledge), Exploration (generating ideas and testing hypotheses), Explanation (articulating findings), Elaboration (applying concepts to new contexts), and Evaluation (reflecting on the process). Depending on the level of teacher intervention, IBL is categorized into structured, guided, and open inquiry.[24]

Despite its theoretical robustness, extensive empirical evidence indicates that IBL frequently fails in practice, particularly during the *Exploration* phase. Studies conducted across diverse demographics—from early childhood science education to secondary biology and university-level physics—reveal that when students are presented with complex, ill-structured problems, they often lack the metacognitive regulation to navigate

[22] Robinson, Morrow, and Miller, "From Aha to Ta-Dah: Insights during Life Coaching and the Link to Behaviour Change."
[23] Trio Erawati Siregar et al., "Implementation of Vygotsky's Constructivism Learning Theory through Project-Based Learning (PjBL) in Elementary Science Education," *Al Qalam: Jurnal Ilmiah Keagamaan Dan Kemasyarakatan* 18, no. 4 (June 21, 2024): 2586, https://doi.org/10.35931/aq.v18i4.3620.
[24] Ayberk Bostan Sarioglan and Ibrahim Gedik, "Investigated Effects of Guided Inquiry-Based Learning Approach on Students' Conceptual Change and Durability," *Cypriot Journal of Educational Sciences* 15, no. 4 (August 31, 2020): 674–85, https://doi.org/10.18844/cjes.v15i4.5050.

the ambiguity.[25] Proponents of direct instruction argue that minimally guided discovery learning overwhelms the learner's working memory, resulting in cognitive overload, frustration, and a failure to construct meaningful conceptual knowledge.[26] In these scenarios, students resort to superficial guessing, and the inquiry process degrades into the very blind trial-and-error that Köhler criticized. The root problem is not the inquiry approach itself, but the pedagogical failure to structurally support the student during the inevitable cognitive impasse.

3. Theoretical Synthesis: Mapping Gestalt Insight onto Inquiry Structures

By operating Gestalt theory as an analytical knife to dissect the empirical failures of IBL, a profound theoretical synthesis emerges. Traditional IBL models view the student's impasse—the moment when their existing schemas fail to explain the data—as a defect to be swiftly corrected by the teacher. However, mapped onto Gestalt theory, this impasse is recognized as the indispensable *Incubation* period. Without the impasse, there is no need for representational change, and therefore, no deep learning occurs. The alignment between the internal cognitive mechanisms of insight and the external pedagogical stages of IBL is detailed in the table below:

Table 1. Cognitive-Pedagogical Framework: Mapping Gestalt Insights to IBL Actions

Gestalt Insight Phase (Cognitive Mechanism)	IBL Stage (Pedagogical Action)	Internal Cognitive State of the Learner	Pedagogical Intervention Required
Preparation (Information gathering, initial logical attempts)	**Engagement & Early Exploration**	Assimilation of data; reliance on existing mental models; standard analytical processing.	Activation of prior knowledge; establishing tool and component skills to automaticity[37].
Impasse & Incubation (Logical dead-end; subconscious processing)	**Exploration (Trial-and-Error)**	Cognitive dissonance; experience of epistemic emotions (confusion, frustration); temporary withdrawal.	Scaffolding for emotional resilience; withholding direct answers; facilitating divergent thinking.
Illumination (The "Aha!" moment; sudden	**Explanation**	Sudden structural understanding; release of	Providing space for articulation; capturing

[25] Raicha Oktafiani et al., "Beyond Discovery Learning: The Impact of the Mordiscvein Model on Students' Critical Thinking Skills in Biology," *Pro-Life* 13, no. 1 (March 18, 2026): 56–70, https://doi.org/10.33541/pro-life.v13i1.7838.
[26] Umiyatul Rahma et al., "The Effect of Discovery Learning Model on Students' Critical Thinking Skills in Biology Learning at SMAN 1 Dampelas," *Jurnal Pendidikan Sains* 14, no. 2 (June 17, 2026): 155–67, https://doi.org/10.17977/2442-3904.1142.

representational change)		positive affect; linking disparate concepts.	the moment of insight for peer sharing.
Verification (Testing the new insight)	**Elaboration & Evaluation**	Application of the new mental model to novel situations; confirmation of validity.	Prompting application in new contexts; encouraging metacognitive reflection on the learning process.

This synthesis reveals the precise mechanism of effective pedagogical scaffolding. Designing for the "Aha!" moment requires what instructional designers term *contingency adduction*—the process where behaviors learned under one set of conditions are recruited by the learner to serve a entirely new function under different conditions. For discovery learning to succeed, teachers must rigorously build fluency in basic "tool skills" (Preparation) before introducing the complex inquiry task. When the foundation is solid, the subsequent task demands connection and recombination rather than improvisation. The student's trial-and-error is then transformed from blind guessing into a systematic elimination of variables, which reliably triggers the cognitive leap.

4. The Role of Epistemic Emotions and Psychological Safety

A critical dimension of this integrated framework is the recognition of affective states in cognitive restructuring. Empirical research utilizing acoustic voice analysis and observational studies in science classrooms has demonstrated that significant learning moments are marked by specific "epistemic emotions"—feelings that relate directly to the process of knowledge construction. When a student encounters evidence that contradicts their existing schema, they experience the "Hmm" moment, characterized by confusion, surprise, or doubt. This confusion is the biochemical driver that compels the brain to abandon analytical rigidity and enter incubation.[27]

If a teacher, uncomfortable with student struggle, intervenes too quickly to provide the correct answer, they short-circuit the entire neural process. By prematurely relieving the cognitive tension, the teacher deprives the student of the dopamine-driven reward of the "Aha!" moment, which typically manifests as a sudden release of tension, widened

[27] Järvinen et al., "Investigating the Moments of 'Aha' and 'Hmm' through Acoustic Analysis of Voice and Speech in Pre-Service Physics Teacher Education–A Novel Method for Identifying Significant Learning Moments."

eyes, and a verbal exclamation of understanding.[28] Conversely, if the student is left entirely unguided without a foundation of psychological safety, the productive confusion degrades into debilitating anxiety, shutting down the right hemisphere's ability to form remote associations. Therefore, within Vygotsky's Zone of Proximal Development (ZPD), the teacher's role is recontextualized not as a dispenser of knowledge, but as an architect of cognitive dissonance and emotional regulation. Teachers must utilize "pedagogical tact" to maintain the tension of the impasse while ensuring the student feels safe enough to risk failure.

5. Operationalizing the 4Cs: Cultivating 21st-Century Competencies

The ultimate objective of synthesizing Gestalt theory with IBL is the robust, observable development of 21st-century competencies (the 4Cs). This framework provides a concrete mechanism for how these abstract skills are actually forged in the brain.

Critical Thinking and Problem Solving: True critical thinking cannot be achieved through algorithmic memorization; it requires the cognitive flexibility to deconstruct a problem and restructure one's understanding based on new evidence. The Gestalt insight mechanism directly trains this capacity. When an "Aha!" moment occurs, it represents a radical conceptual change. Studies demonstrate that insights acquired through sudden restructuring are remembered significantly better and longer than information learned through gradual, analytical deduction—a phenomenon termed the "insight-memory advantage". This ensures that the critical thinking applied to solve the problem becomes deeply embedded and highly transferable.[29]

Creativity: Insight is inherently synonymous with creativity. Both require the brain to forge unprecedented connections across disparate domains of knowledge (divergent thinking). By structuring inquiry lessons that require students to utilize concepts in unconventional ways, educators force the brain out of predictable pathways, cultivating a habit of creative synthesis that resists rote conformity.

Collaboration and Communication: In modern socio-constructivist classrooms, insight is rarely an isolated, solitary event. Collaborative inquiry creates a shared cognitive space where students vocalize their incomplete mental models. The dialogic

[28] Robinson, Morrow, and Miller, "From Aha to Ta-Dah: Insights during Life Coaching and the Link to Behaviour Change."
[29] Maxi Becker and Roberto Cabeza, "The Neural Basis of the Insight Memory Advantage," *Trends in Cognitive Sciences* 29, no. 3 (March 2025): 255–68, https://doi.org/10.1016/j.tics.2025.01.001.

exchange of ideas can act as the external trigger for an internal representational change. When one student articulates a novel perspective, it can immediately shatter the collective impasse of the group, leading to shared "Aha!" moments. This necessitates high-level communication skills to articulate abstract, forming ideas, thereby reinforcing the social dimension of the 4Cs.

6. Elevating the Context: Global Relevance, AI Integration, and Kurikulum Merdeka

While the cognitive mechanisms of insight are biologically universal, their pedagogical application has profound implications for macro-level educational policies and global technological trends. Globally, education systems are attempting to pivot from standardized testing paradigms toward holistic, competency-based frameworks. A prime example of this is Indonesia's *Kurikulum Merdeka* (Emancipated Curriculum), which mandates a shift toward independent, student-centered, and inquiry-driven learning aimed at producing the "Golden Generation" of 2045.[30]

The Kurikulum Merdeka explicitly targets the development of 21st-century skills and critical reasoning, codified in the *Profil Pelajar Pancasila* (Pancasila Student Profile). However, localized studies indicate that the implementation of such curricula frequently struggles due to entrenched traditional teaching mindsets, where educators find it difficult to transition from authoritative knowledge-dispensers to facilitators of inquiry.[31] By introducing the Gestalt-IBL synthesis into this discourse, local policymakers and educators are provided with a concrete, scientifically backed rationale for *why* they must allow students to struggle. Understanding the neuroscience of the "Aha!" moment demystifies the seemingly chaotic appearance of an active inquiry classroom. It provides a universal theoretical bedrock that justifies local policy shifts: enabling student autonomy is not merely a philosophical or political preference, but an absolute cognitive prerequisite for deep structural learning.

Furthermore, this synthesis addresses a critical global challenge: the integration of Generative Artificial Intelligence (GenAI) in education. As AI tools like ChatGPT become ubiquitous, the risk of "cognitive offloading"—where students rely on AI to bypass the

[30] Agariadne Dwinggo Samala et al., "Emerging Technologies for Global Education: A Comprehensive Exploration of Trends, Innovations, Challenges, and Future Horizons," *SN Computer Science* 5, no. 8 (December 15, 2024): 1175, https://doi.org/10.1007/s42979-024-03538-1.
[31] Maesaroh Lubis and Darliana Sormin, "Implementing Pancasila Philosophy in Early Childhood Education: An Indonesian Educational Model Study," *Journal of Smart Pedagogy and Education* 1, no. 4 (March 14, 2026): 1–21, https://doi.org/10.65101/spedu.v1i4.243.

productive struggle entirely—threatens to eliminate the opportunity for insight learning[1]. If GenAI instantly solves the problem at the first sign of difficulty, the incubation phase is destroyed, and representational change cannot occur. Therefore, the integration of Gestalt theory into modern pedagogy provides a vital ethical and structural framework for technology use: AI should be strategically deployed to provide the raw materials for the *Preparation* phase or to offer divergent, open-ended hints during the *Incubation* phase to prevent debilitating anxiety, but it must be rigorously constrained from stealing the student's "Aha!" moment.

In synthesizing Wolfgang Köhler's Gestalt theory of insight learning with the structural architecture of Inquiry-Based Learning, this research establishes that the acquisition of 21st-century competencies is contingent upon the deliberate management of cognitive restructuring. The traditional pedagogical view of learning as a smooth, linear accumulation of facts is fundamentally flawed. Instead, true intellectual mastery is a discontinuous, dynamic process marked by frustration, cognitive impasse, subconscious incubation, and sudden, illuminating representational change. By strategically engineering instructional environments that embrace trial-and-error and epistemic confusion not as behavioral defects but as epistemological necessities, educators can systematically catalyze the "Aha!" moment. This requires a profound shift in the role of the teacher from a transmitter of solutions to an architect of cognitive dissonance, providing the precise scaffolding required to keep students emotionally resilient during periods of productive struggle. Consequently, integrating Gestalt mechanics into constructivist pedagogical frameworks bridges the critical gap between neurocognitive science and classroom practice. This unified approach ensures that education systems—whether implementing progressive national policies like Indonesia's Kurikulum Merdeka or adapting to the disruptive global realities of the AI era—are fundamentally equipped to develop agile minds capable of perceiving, deconstructing, and solving the complex, systemic problems of the modern world.

C. CONCLUSIONS

The theoretical synthesis of Gestalt psychology and Inquiry-Based Learning demonstrates that the cognitive mechanisms of insight directly map onto the pedagogical phases of inquiry, transforming the traditionally unobservable "Aha!" moment into a systematically engineered instructional outcome. Rather than representing instructional

failure, student cognitive impasses and the accompanying epistemic emotions serve as necessary developmental catalysts during the exploration phase, forcing the subconscious incubation required for sudden representational change and structural understanding. Consequently, deliberately scaffolding this productive struggle effectively operationalizes the cultivation of 21st-century competencies, providing a rigorous psychological justification for student-centered policy shifts like Indonesia's *Kurikulum Merdeka*. Furthermore, this integrated framework establishes essential boundaries for integrating Generative Artificial Intelligence in modern classrooms, ensuring that technology supports foundational learning without prematurely short-circuiting the critical cognitive dissonance necessary for genuine intellectual mastery.

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