# Introducing HAIML: A Human-Centered AI Metacognitive Learning Model

## A Framework for Human Agency and Reflective Learning in the Age of Artificial Intelligence

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**Executive Summary**

Artificial intelligence is rapidly changing how students learn, communicate, solve problems, and make decisions. As AI becomes increasingly integrated into education, the question is no longer whether students will use these tools, but how educators can design learning experiences that support meaningful learning while preserving human agency, critical thinking, reflection, and ethical responsibility. Although many current conversations focus on AI literacy, tool proficiency, academic integrity, or responsible use, less attention has been given to how AI influences the learner's thinking and decision-making processes.

The Human-Centered AI Metacognitive Learning Model (HAIML) was developed to address this challenge. HAIML is a practical framework for integrating AI into learning environments while keeping human thinking at the center of the educational experience. Rather than focusing primarily on teaching students how to use AI, HAIML focuses on helping students understand how AI influences their thinking and how to remain reflective, ethical, accountable, and actively engaged decision-makers while using it.

HAIML consists of three interconnected layers: Experiential AI Use, Metacognitive Reflection, and Ethical Decision-Making. Students first engage directly with AI through authentic learning experiences. They then reflect on how AI influenced their thinking, confidence, assumptions, and understanding throughout the learning process. Finally, they evaluate those experiences through ethical and decision-making lenses that emphasize responsibility, transparency, authorship, accountability, and judgment. Together, these layers create a progression from experience, to reflection, to informed decision-making.

The framework is paired with Four AI Use Levels that provide practical guidance for aligning AI use with instructional goals. These levels range from no AI use to AI-integrated creation and evaluation, allowing educators to establish clear expectations while maintaining flexibility across assignments, courses, and disciplines. Across all levels, metacognitive reflection remains central to the learning process.

At its core, HAIML is a human-centered framework grounded in psychological theory and learning science. It recognizes that AI systems may increasingly influence learning, recommendations, and decisions, yet responsibility for those decisions remains human. As AI continues to evolve, HAIML offers a framework for helping students develop the reflection, judgment, agency, and ethical awareness needed to learn effectively in AI-supported environments.

Learning is not defined by what AI can generate. Learning is defined by how individuals think, reflect, make decisions, and exercise judgment while using it. AI may shape decisions, but human judgment remains essential.

## Introduction

The introduction of generative artificial intelligence into education represents one of the most significant shifts in teaching and learning in recent history. Students now have access to tools capable of generating essays, providing feedback, summarizing information, analyzing data, and responding conversationally to complex questions. Unlike previous educational technologies that primarily improved access to information, generative AI participates in cognitive processes that have traditionally been associated with human reasoning. Students are no longer interacting only with information. They are interacting with systems that can generate interpretations, recommendations, explanations, and solutions in ways that often appear authoritative and convincing. As these technologies become increasingly integrated into educational environments, educators face important questions about how learning may be changing.

This distinction matters because learning is fundamentally a cognitive process. Education has always involved helping students develop the ability to analyze information, evaluate evidence, solve problems, communicate effectively, and make informed decisions. While AI can support these processes, it can also create conditions where students begin relying on AI to perform cognitive work that would otherwise contribute to learning and expertise development. The challenge facing educators is not whether AI should be present in educational environments. AI is already here and students are already using it. The challenge is ensuring that students remain active participants in the thinking process while using it.

As a psychologist and educator, I became increasingly interested in how AI influences learning beyond the questions of productivity and efficiency that often dominate public discussions. I was particularly interested in how AI affects metacognition, self-efficacy, decision-making, and human agency. Students may receive a high-quality response from an AI system, but that response alone tells us very little about whether learning occurred. To understand learning in AI-supported environments, we must examine how students engage with AI, how they evaluate its outputs, and how they reflect on its influence on their thinking. These questions became increasingly important as AI tools became more capable and more widely available.

As AI systems improved, students gained access to tools capable of generating outlines, brainstorming ideas, revising writing, summarizing research, and providing feedback with minimal effort. These capabilities offer meaningful benefits and can support learning when used intentionally. At the same time, they create the possibility that students may begin disengaging from some of the very cognitive processes education is intended to develop. The concern is not that AI exists or that students choose to use it. The concern is whether students continue to engage deeply with thinking while using it. If learning is reduced to obtaining answers rather than engaging in the process of understanding, important educational opportunities may be lost.

HAIML was developed in response to this challenge. The framework places human agency at the center of AI-supported learning and positions metacognitive reflection as the bridge between AI use and meaningful learning. It recognizes that students will continue to interact with AI

throughout their educational and professional lives. Rather than attempting to remove AI from learning environments, educators need frameworks that help students understand how AI influences their thinking and how to remain reflective, ethical, and responsible while using it. The purpose of this white paper is to introduce HAIML as one possible approach for preserving the human dimensions of learning in an increasingly AI-mediated world.

**Why HAIML Was Developed**

HAIML emerged from the intersection of psychology, teaching, and the growing presence of artificial intelligence in education. As AI became increasingly integrated into learning environments, I observed a growing tension between the promise of AI and the purpose of education. AI offered powerful opportunities for support, feedback, personalization, and access. At the same time, it raised important questions about learning, authorship, intellectual effort, student engagement, and responsibility. Many conversations focused on whether AI should be allowed in educational settings, but far fewer addressed how AI influences the learner and what responsibilities remain human when working alongside increasingly capable systems.

My background in psychology led me to view these questions through the lenses of cognition, metacognition, self-regulation, decision-making, and human agency. Educational psychology has long recognized that learning involves more than acquiring information. Students must actively engage with ideas, monitor their understanding, evaluate their progress, and make intentional decisions about their learning. As AI systems become increasingly capable of generating ideas, explanations, recommendations, and solutions, understanding how students interact with those outputs becomes an important part of understanding learning itself. This observation revealed what I saw as a gap in many existing approaches to AI integration. While AI literacy, tool proficiency, and ethical use remain important, they do not fully address how AI influences thinking, reflection, confidence, judgment, and decision-making.

HAIML was developed to address this gap. The framework is built on the belief that students need opportunities not only to use AI, but also to examine how AI influences their learning and how they can remain active participants in the process. Through structured experiences, metacognitive reflection, and ethical decision-making, HAIML encourages learners to remain reflective, accountable, and intentional while working with AI. At its core, the framework recognizes that AI may support thinking, but responsibility for learning remains human. HAIML was designed to help ensure that the human dimensions of learning remain visible in an increasingly AI-supported world.

**The Problem HAIML Was Designed to Solve**

Artificial intelligence has introduced new opportunities for teaching and learning, but it has also introduced new challenges that extend beyond questions of access, efficiency, or academic integrity. While educators often focus on whether students are using AI appropriately, a more important question may be whether students remain actively engaged in the cognitive processes

that learning is intended to develop. As AI becomes increasingly capable of generating ideas, explanations, summaries, recommendations, and solutions, it has the potential to influence not only what students learn, but also how they learn. This distinction sits at the center of HAIML and represents the primary problem the framework was designed to address.

One concern involves cognitive offloading, which occurs when individuals rely on external tools to reduce the mental effort required to complete a task. Humans have always used tools to support thinking. We take notes, use calculators, consult reference materials, and rely on technology to extend our capabilities. In many situations, cognitive offloading can be beneficial because it allows individuals to focus attention on higher-order tasks. The challenge with generative AI is that it can now support increasingly complex cognitive activities, including brainstorming, organizing ideas, drafting arguments, evaluating alternatives, and generating recommendations. As these capabilities expand, educators must consider which aspects of thinking should be supported by AI and which remain essential for learning.

The concern is not that students use AI. The concern is that students may gradually disengage from the cognitive activities that contribute to learning, expertise development, and independent judgment. If students consistently rely on AI to generate ideas, construct arguments, evaluate information, or solve problems without actively engaging in those processes themselves, they may miss opportunities to develop the skills education is designed to cultivate. Learning often requires effort, uncertainty, revision, and productive struggle. While AI can provide valuable support, removing all cognitive challenge from the learning process may also remove opportunities for growth. HAIML was developed to help educators strike a balance between support and engagement.

A second challenge involves automation bias, which refers to the tendency to place excessive trust in automated systems and accept their recommendations without sufficient evaluation. Generative AI systems often produce responses that appear fluent, confident, and authoritative. Because those responses are presented in polished language, students may assume that the information is accurate or that the reasoning is sound. In reality, AI systems can produce incomplete, misleading, biased, or entirely incorrect information. Students who develop the habit of accepting AI outputs without verification may become increasingly vulnerable to errors in judgment and reasoning. HAIML addresses this concern by encouraging students to critically evaluate AI-generated information rather than treating it as inherently trustworthy.

Closely related to automation bias is the illusion of understanding. Students may feel that they understand a concept because they have read an AI-generated explanation or received a well-written response. However, exposure to information is not the same as understanding. Meaningful learning requires learners to organize knowledge, connect ideas, apply concepts in new situations, and evaluate their own comprehension. AI can create the appearance of understanding without necessarily supporting the deeper cognitive processes that lead to genuine

learning. For this reason, HAIML emphasizes reflection as a mechanism for helping students distinguish between receiving information and developing understanding.

The emergence of AI also raises important questions about authorship, ownership, and responsibility. Students increasingly work alongside systems capable of generating text, images, code, and creative content. As a result, traditional assumptions about authorship become more complex. If AI suggests an idea, drafts a paragraph, or generates a solution, what role does the student play in the final product? More importantly, how does the student understand their own contribution to the work? HAIML approaches these questions through reflection and transparency rather than through punishment or restriction. The framework encourages students to examine how AI contributed to their work and where responsibility and ownership remain their own.

Perhaps the most significant challenge addressed by HAIML involves human agency. Education should help students develop the ability to make intentional decisions, influence outcomes, and take ownership of their learning. Yet there is a risk that increasingly capable AI systems become influential enough that students begin deferring judgment to technology rather than exercising their own reasoning. The goal of HAIML is not to prevent students from benefiting from AI. The goal is to ensure that students remain active participants in the learning process and maintain ownership of their decisions, judgments, and learning experiences.

Taken together, these challenges reveal a gap in many current approaches to AI integration. Much of the conversation focuses on AI literacy, tool proficiency, or responsible use. While these areas remain important, they do not fully address how AI influences cognition, reflection, judgment, and decision-making. HAIML was developed to address this gap by focusing not only on what students do with AI, but also on how AI shapes their thinking. The framework recognizes that meaningful learning requires more than access to powerful tools. It requires metacognitive awareness, ethical reasoning, human agency, and intentional decision-making. As AI becomes increasingly capable, these human capacities become more important rather than less important.

**Theoretical Foundations of HAIML**

HAIML is grounded in established psychological theory and learning science. While AI introduces new opportunities and challenges for education, the questions at the heart of learning are not new. For decades, researchers have examined how individuals develop confidence in their abilities, regulate their learning, reflect on their thinking, make decisions, and navigate complex environments. As AI becomes increasingly integrated into education, these questions become even more important. HAIML draws from several well-established areas of psychology that help explain how students learn, think, reflect, make decisions, and maintain a sense of agency while interacting with AI-supported technologies. Together, these theoretical foundations provide a human-centered framework for understanding learning in an increasingly AI-mediated world.

One of the primary foundations of HAIML comes from Bandura's work on self-efficacy and human agency (Bandura, 1997, 2001). Self-efficacy refers to an individual's belief in their ability to successfully perform tasks and achieve desired outcomes. Students who possess strong self-efficacy are more likely to persist through challenges, engage in difficult learning activities, and maintain motivation when faced with uncertainty. In AI-supported environments, self-efficacy becomes especially important because students may begin attributing success to the technology rather than to their own effort, abilities, and decision-making processes. HAIML emphasizes that AI should function as a support tool rather than a substitute for confidence in one's own thinking. Bandura's work provides an important foundation for HAIML because the framework assumes that learners must continue to view themselves as capable and responsible participants in the learning process, even as AI systems become increasingly sophisticated.

Closely connected to self-efficacy is Bandura's concept of human agency, which serves as a cornerstone of the HAIML framework. Bandura (2001) argued that individuals are not merely shaped by their environments, but are capable of acting intentionally, regulating their behavior, reflecting on their actions, and influencing outcomes. In describing agency, Bandura (2001) stated, "to be an agent is to intentionally make things happen by one's actions" (p. 2). Importantly, Bandura distinguished human agency from the tools and technologies people use. While computers and other technologies can extend human capabilities and support performance, they do not possess intentionality, forethought, self-reflection, or the capacity to exercise agency. Those qualities remain uniquely human. This distinction becomes increasingly important as AI systems become more integrated into learning environments and more capable of generating information, recommendations, and solutions. Students must continue to see themselves as active participants in the learning process rather than passive recipients of AI-generated outputs. While AI may assist, support, and influence learning, responsibility for learning, decision-making, and judgment ultimately remains with the learner. HAIML therefore places human agency at the center of AI-supported learning and encourages students to remain intentional, reflective, and accountable for the choices they make while interacting with AI systems. Human agency serves as the organizing principle of the framework and anchors all three layers of HAIML.

HAIML is also informed by research on self-regulated learning, particularly the work of Zimmerman (2002, 2008). Self-regulated learners actively plan, monitor, and evaluate their learning processes rather than simply completing assigned tasks. They make intentional decisions about how to approach learning, assess their progress, and adjust strategies when necessary. These skills become increasingly important in AI-supported environments because students must continually decide when to use AI, how much to rely on it, and whether AI-generated outputs are accurate, useful, or appropriate. HAIML extends self-regulated learning into AI-mediated contexts by encouraging students to become more aware of the decisions they make while interacting with AI and the impact those decisions have on their learning. Zimmerman’s work helps explain why learners must remain active participants in their own

development rather than allowing AI systems to assume responsibility for learning processes that ultimately belong to the student.

HAIML is further informed by experiential learning theory, particularly the work of Kolb (1984). Kolb proposed that learning occurs through a continuous cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation. Rather than viewing learning as the passive acquisition of information, experiential learning emphasizes the process of engaging with experiences, reflecting on those experiences, constructing meaning, and applying new understanding to future situations. This perspective aligns closely with the first layer of HAIML, Experiential AI Use. Within the framework, students actively engage with AI tools as part of authentic learning experiences rather than simply receiving information from them. However, meaningful learning does not occur simply because AI was used. Learning occurs when students critically examine those experiences, consider how AI influenced their thinking, and apply those insights to future situations. The structured activities embedded within HAIML reflect the belief that experience alone does not guarantee learning. Instead, learning emerges when individuals actively make sense of experience and use that understanding to guide future action.

A central component of HAIML is metacognition, often described as thinking about thinking (Schraw & Dennison, 1994). Metacognition involves awareness and regulation of one's own cognitive processes, including the ability to monitor understanding, recognize knowledge gaps, evaluate strategies, and reflect on performance. Research consistently demonstrates that students with stronger metacognitive skills become more intentional learners because they are better able to understand how they learn and why certain approaches are effective. Bjork, Dunlosky, and Kornell (2013) further suggest that learners are not always accurate judges of their own understanding and may develop illusions of learning when they mistake familiarity or fluency for genuine comprehension. In AI-supported environments, this concern becomes even more relevant because AI-generated explanations often appear polished, confident, and persuasive.

Within HAIML, metacognitive reflection serves as the bridge between AI use and meaningful learning. Students are not simply asked to use AI. They are asked to examine how AI influenced their thinking, confidence, assumptions, revisions, and decisions throughout the learning process. This reflective process helps learners move beyond task completion and toward a deeper understanding of their own learning experiences. Research on metacognition provides the theoretical foundation for the second layer of HAIML, Metacognitive Reflection, which encourages students to become more aware of both their learning processes and the influence AI may have on those processes.

HAIML also draws from Kahneman's (2011) dual-process theory, which describes two modes of thinking. System 1 thinking is fast, intuitive, and automatic, while System 2 thinking is slower, more deliberate, and analytical. AI-generated outputs often encourage System 1 processing because information is presented fluently, confidently, and with little visible uncertainty.

Students may accept AI-generated responses simply because they appear reasonable or well written. However, meaningful learning and effective decision-making often require the slower and more deliberate thinking associated with System 2 processing. Through reflection, evaluation, and critical inquiry, HAIML encourages students to slow down, question assumptions, examine evidence, and carefully evaluate AI-generated information before accepting it as accurate or useful. Kahneman's work helps explain why learners must move beyond convenience and immediate acceptance when interacting with AI-generated content.

HAIML is further informed by research on human judgment and decision-making, particularly the work of Klein (1998). Klein's research on naturalistic decision-making examined how people make decisions in complex, uncertain, and often high-stakes environments where information is incomplete and time for analysis may be limited. His work reminds us that important decisions are rarely made using information alone. Individuals draw upon experience, context, expertise, pattern recognition, and judgment when evaluating situations and determining appropriate courses of action. This distinction becomes increasingly important as AI systems become more capable of generating recommendations, analyses, and solutions. While AI may provide useful information, it cannot fully account for context, values, goals, or the human considerations that often shape meaningful decisions. HAIML therefore emphasizes that learners must remain active decision-makers who evaluate AI-generated outputs rather than simply accepting them. Students are encouraged to develop the judgment necessary to determine when AI recommendations are useful, when they should be questioned, and when human reasoning should take precedence. Klein's work provides an important foundation for the third layer of HAIML, Ethical Decision-Making, which emphasizes responsibility, authorship, judgment, and human oversight in AI-supported environments.

Finally, HAIML is informed by research on automation bias, which refers to the tendency to place excessive trust in automated systems and defer to their recommendations even when those recommendations may be flawed (Parasuraman & Riley, 1997; Cummings, 2004). This phenomenon has been documented across a variety of professional settings and is becoming increasingly relevant as AI systems become more sophisticated and persuasive. Students may assume that AI-generated information is accurate simply because it was produced by advanced technology. HAIML addresses this concern by encouraging verification, reflection, and critical evaluation. Rather than viewing AI outputs as answers, students are encouraged to view them as inputs that require interpretation, judgment, and thoughtful analysis. The inclusion of automation bias within the framework reinforces the importance of maintaining human oversight and resisting the temptation to outsource thinking to technology.

Together, these theoretical foundations support a central assumption underlying HAIML: technology alone does not produce learning. Learning occurs when students actively engage with experiences, develop confidence in their abilities, regulate and monitor their learning, reflect on their thinking, evaluate information critically, exercise sound judgment, and take responsibility for their decisions. AI may support these activities, but it cannot replace them. For this reason,

HAIML places human agency, metacognitive awareness, ethical reasoning, judgment, and reflection at the center of AI-supported learning. As AI becomes increasingly capable and integrated into everyday life, the uniquely human capacities of reflection, responsibility, intentional decision-making, and agency become more important, not less. In many ways, the theories that inform HAIML all point toward the same conclusion: AI may shape the learning experience, but learners remain responsible for how they think, what they decide, and who they become as a result of those experiences.

**Why Existing Frameworks Are Not Enough**

The rapid adoption of artificial intelligence across education has led to the development of numerous frameworks focused on AI literacy, responsible AI use, digital citizenship, and ethical technology integration. These frameworks have provided valuable guidance for educators and students seeking to understand the capabilities, limitations, and societal implications of AI systems. Collectively, they have helped establish important competencies related to AI awareness, technical understanding, responsible use, and ethical considerations. As institutions continue to develop policies and practices surrounding AI, these frameworks will remain important components of educational planning. However, many of these approaches focus primarily on what learners should know about AI or how learners should use AI. Far fewer address a critical psychological question: How does AI influence the way learners think?

AI literacy frameworks typically emphasize understanding how AI systems function, recognizing limitations, evaluating outputs, and developing technical fluency. Responsible AI frameworks often focus on fairness, transparency, accountability, privacy, and bias. Digital literacy models emphasize information evaluation, media consumption, and responsible participation in digital environments. Each of these perspectives contributes valuable insights and serves an important purpose within contemporary education. However, they often pay less attention to the cognitive and metacognitive processes that occur when learners interact directly with AI systems during the learning process. As a result, important questions related to reflection, judgment, confidence, decision-making, and human agency may receive less attention than they deserve.

Generative AI differs from previous educational technologies because it does more than provide access to information. It actively participates in cognitive activities that have traditionally belonged to the learner. AI can generate ideas, suggest interpretations, organize information, provide recommendations, and propose solutions. As a result, AI influences not only what learners produce, but also how they approach thinking, problem-solving, and decision-making. This shift introduces important questions regarding cognitive offloading, automation bias, self-efficacy, metacognitive awareness, and agency that are not always addressed within existing models. Understanding how AI influences learning processes may ultimately become as important as understanding the technology itself.

HAIML was developed to address this gap. Rather than focusing primarily on AI proficiency or AI ethics, HAIML focuses on the learner's cognitive experience while using AI. The framework

positions metacognitive reflection as the bridge between AI use and meaningful learning and places human agency at the center of AI-supported educational experiences. While AI literacy remains important, understanding how AI influences thinking may prove equally important as intelligent systems become increasingly integrated into educational, professional, and everyday contexts. HAIML therefore extends beyond questions of what learners can do with AI and asks learners to consider how AI influences the way they think, learn, decide, and exercise judgment.

The central purpose of HAIML is not to teach students how to use AI. Rather, it is designed to help students understand how AI influences their thinking, learning, decision-making, and confidence as learners. HAIML encourages students to remain reflective, ethical, accountable, and actively engaged participants in the learning process while working alongside increasingly powerful AI systems. By focusing on the psychological dimensions of human-AI interaction, the framework complements existing approaches to AI literacy and ethics while offering a distinctly human-centered perspective. At its core, HAIML recognizes that learning is not defined by what AI can generate, but by how individuals think, reflect, make decisions, and exercise judgment while using it. In doing so, the framework shifts the focus from technology itself to the development of human agency, metacognitive awareness, and responsible decision-making in AI-supported environments.

**Human Agency as the Foundation of HAIML**

Human agency serves as the foundation of the HAIML framework and represents one of its most important contributions to conversations surrounding AI in education. The central purpose of HAIML is not to teach students how to use AI. Rather, it is designed to help students understand how AI influences their thinking, learning, decision-making, and confidence as learners while ensuring they remain active participants in those processes. As AI systems become increasingly capable of generating information, recommendations, interpretations, and solutions, questions regarding the role of the learner become increasingly important. While AI can provide valuable support, there remains a risk that students shift from active participants in learning to passive recipients of AI-generated outputs. HAIML was developed, in part, to address this concern and to help learners remain intentional, reflective, and responsible participants in their own educational experiences.

Bandura (2001) described agency as the capacity of individuals to influence their thoughts, actions, and environments through intentional decision-making and self-reflection. Within HAIML, agency extends beyond simple choice or autonomy. It involves maintaining ownership of learning, evaluating information critically, making intentional decisions, and accepting responsibility for outcomes. Students who exercise agency do not simply accept AI-generated outputs because they are available or persuasive. Instead, they question assumptions, evaluate evidence, consider alternative perspectives, and determine how information should be used. As AI becomes more integrated into learning and work, these human capacities become more important, not less.

At its core, HAIML assumes that the future of learning depends not on reducing human involvement but on strengthening it. AI systems may become increasingly capable of generating content, recommendations, and analyses, yet responsibility for evaluating those outputs and making decisions based upon them remains fundamentally human. Learning is not defined by what AI can generate. Learning is defined by how individuals think, reflect, make decisions, and exercise judgment while using it. Human agency therefore serves as both a learning outcome and a guiding principle within the framework. AI may shape decisions, but learners must remain reflective, ethical, accountable, and actively engaged decision-makers throughout the process.

## The HAIML Framework: A Human-Centered Approach to Learning with AI

### Introducing the HAIML Framework

The Human-Centered AI Metacognitive Learning Model (HAIML) was developed to provide a practical framework for integrating artificial intelligence into learning environments while preserving human agency, critical thinking, and ethical responsibility. While many current approaches focus on AI skills, tool proficiency, or responsible use, HAIML focuses on the learner. The framework begins with a simple but important question: How can educators design learning experiences that encourage students to engage with AI while remaining active participants in their own thinking, learning, and decision-making processes? HAIML addresses this challenge by providing a structure that encourages intentional engagement, reflection, and judgment rather than passive reliance on AI-generated outputs.

The framework consists of three interconnected layers: Experiential AI Use, Metacognitive Reflection, and Ethical Decision-Making. Students first engage directly with AI tools through authentic learning experiences. They then reflect on how those interactions influenced their thinking, confidence, assumptions, and understanding. Finally, they evaluate those experiences through ethical and decision-making lenses that emphasize responsibility, transparency, authorship, accountability, and judgment. Together, these layers create a progression from experience to reflection to informed decision-making.

A central assumption underlying HAIML is that learning with AI should involve more than completing tasks efficiently. Access to information does not guarantee understanding, and AI-generated outputs do not guarantee learning. Meaningful learning occurs when students actively engage with information, reflect on their experiences, evaluate their thinking, and make intentional decisions about how AI should be used. Reflection serves as the mechanism that transforms AI-supported experiences into learning, while ethical decision-making helps students consider the broader implications of AI use in academic, professional, and societal contexts.

HAIML also serves as the philosophical foundation for the Four AI Use Levels described later in this paper. The AI levels provide guidance regarding appropriate forms of AI use within specific learning activities, while HAIML provides the reflective structure that helps students understand how AI influences their thinking within those boundaries. Together, they create a practical and flexible model for human-centered AI integration that can be applied across disciplines,

educational settings, and professional environments. As AI continues to evolve, HAIML offers a framework for keeping human reflection, agency, and responsibility at the center of learning.

**Figure 1. Human-Centered AI Metacognitive Learning Model (HAIML)**

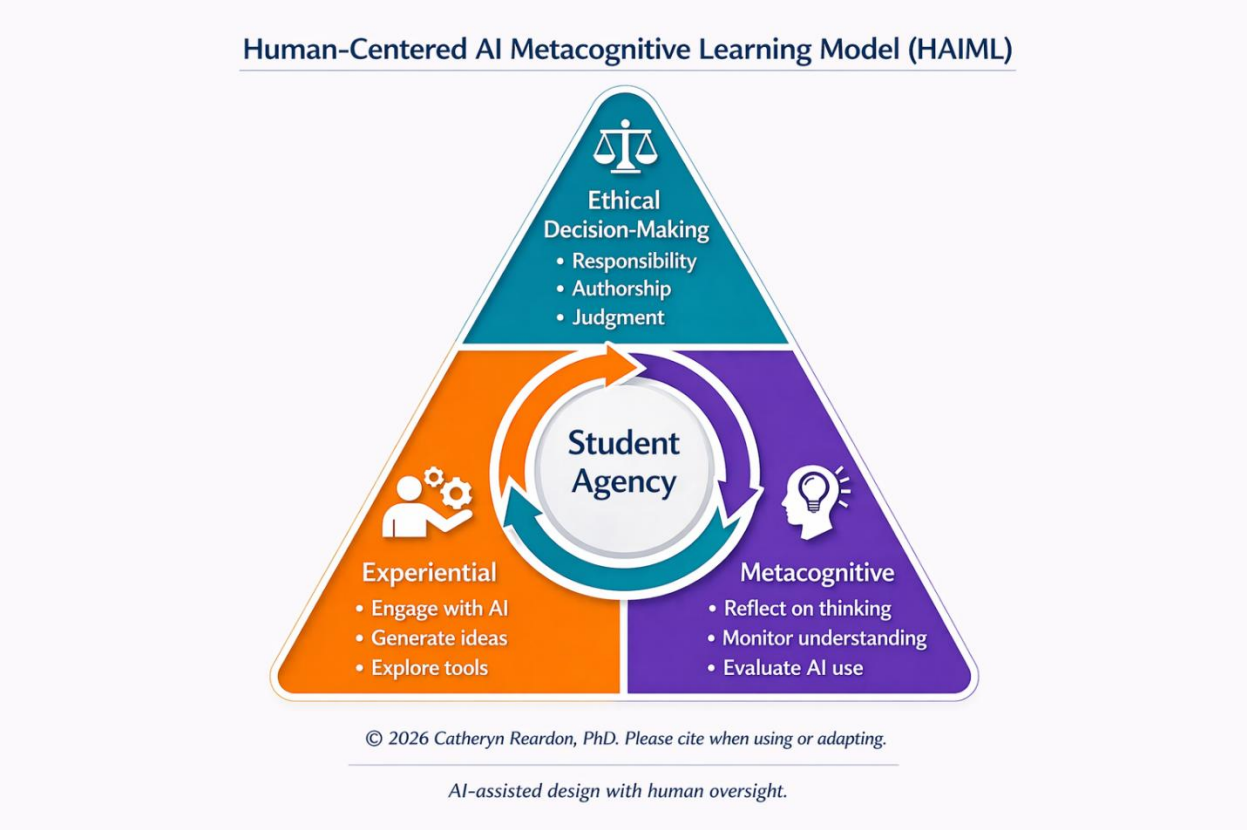


**Figure 1.** *The Human-Centered AI Metacognitive Learning Model (HAIML).* The framework illustrates the relationship between Experiential AI Use, Metacognitive Reflection, and Ethical Decision-Making. Human agency serves as the foundation of the model, while reflection functions as the bridge between AI use and meaningful learning.

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**Layer One: Experiential AI Use**

The first layer of HAIML focuses on experiential AI use. Before students can critically evaluate AI or reflect on how it influences their thinking, they must first engage with it directly. Students learn not only by studying concepts but also through interaction, experimentation, observation, and application. If AI is going to become part of students' educational and professional lives, then students need opportunities to experience AI in authentic learning environments rather than simply learning about it in theory. Direct engagement provides the foundation upon which reflection and judgment can later be built.

Within HAIML, experiential AI use does not mean unrestricted AI use. Instead, it refers to structured opportunities for students to interact with AI in ways that support specific learning objectives. Students might use AI to brainstorm ideas, explore alternative perspectives, receive feedback on writing, analyze information, practice communication skills, or engage in decision-making simulations. The purpose is not to allow AI to complete the work for students. The purpose is to help students understand both the capabilities and limitations of AI while remaining actively involved in the learning process. These experiences create opportunities for students to recognize where AI provides value and where human judgment remains essential.

Experiential AI use also supports the development of confidence and competence. When used appropriately, AI can serve as a form of scaffolding that helps students explore unfamiliar concepts, overcome barriers, and engage more fully in learning activities. However, HAIML emphasizes that AI should support learning rather than replace it. Students should leave these experiences with greater confidence in their own abilities, not greater dependence on technology. Experience therefore serves as the starting point for deeper learning, but it is only the first step within the framework.

**Layer Two: Metacognitive Reflection**

Metacognitive reflection represents the center of the HAIML framework and serves as the primary feature that distinguishes it from many other approaches to AI integration. Students can learn how to use AI tools, understand AI ethics, and develop technical proficiency. However, if they never examine how AI influences their thinking, they may miss one of the most important learning opportunities created by these technologies. For this reason, HAIML positions reflection as the bridge between AI use and meaningful learning. Reflection helps students move beyond simply completing tasks and toward understanding how learning occurred.

Metacognition is often described as thinking about thinking. More specifically, it involves awareness of one's cognitive processes and the ability to monitor, regulate, and evaluate learning. In AI-supported environments, students must monitor not only their own thinking but also the influence of AI on that thinking. They must learn to recognize when AI expanded their thinking, when it challenged assumptions, when it increased confidence, and when it may have reduced deeper engagement. This awareness helps students become more intentional learners and more thoughtful users of AI.

Within HAIML, reflection is not treated as an activity that occurs after learning. Reflection is part of the learning process itself. Students are encouraged to examine how AI influenced their ideas, decisions, revisions, confidence, and understanding throughout an activity. Reflection prompts encourage learners to consider questions such as how AI shaped their thinking, what assumptions they accepted or challenged, what information they verified, and how their work may have differed without AI. These questions help students become more aware of their decision-making processes and more intentional in future interactions with AI.

Reflection also serves as an important safeguard against cognitive dependence and automation bias. As AI systems become increasingly sophisticated, students may begin relying on them in ways that are difficult to recognize. Regular reflection creates opportunities to identify these patterns, evaluate their impact on learning, and make more intentional choices moving forward. Through repeated cycles of experience and reflection, students develop greater awareness of how AI influences learning and strengthen their ability to remain active participants in the process.

**Layer Three: Ethical Decision-Making**

The third layer of HAIML focuses on ethical decision-making. While experiential AI use provides opportunities for engagement and metacognitive reflection encourages awareness, ethical decision-making asks students to consider the broader implications of their choices. Every interaction with AI involves decisions related to responsibility, transparency, authorship, accountability, fairness, and judgment. As AI becomes increasingly integrated into education and professional environments, these decisions become increasingly important.

One of the central assumptions underlying HAIML is that AI systems can generate information, recommendations, and content, but they cannot assume responsibility for decisions. Responsibility remains human. Students must therefore learn to evaluate AI-generated information critically, verify its accuracy, consider potential biases, and determine how that information should be used. Ethical decision-making encourages students to move beyond technical proficiency and consider the broader consequences of their actions and choices.

This layer also reinforces the importance of authorship, transparency, and accountability. Students are encouraged to reflect on how AI contributed to their work and where responsibility remained their own. They are asked to consider not only whether AI was used, but how it was used and what obligations accompanied that use. Through these experiences, students develop habits of reflection, responsibility, and judgment that extend beyond individual assignments and into future educational, professional, and personal contexts.

Together, the three layers of HAIML create a progression from experience, to reflection, to judgment. Students engage with AI, examine how it influences their thinking, and evaluate its use through ethical and decision-making lenses. This progression forms the foundation of human-centered AI-supported learning and helps ensure that reflection, agency, and responsibility remain central to the educational experience.

**HAIML and the Four AI Use Levels**

While HAIML provides the conceptual framework for human-centered AI-supported learning, educators also need practical guidance for determining when and how AI should be used within specific learning activities. For this reason, HAIML is paired with a structured set of Four AI Use Levels that help align AI use with instructional goals. These levels create transparency for students, provide consistency for faculty, and establish clear expectations regarding the role of AI within assignments and learning experiences. Together, the framework and the AI Use Levels

create a balanced approach that encourages meaningful engagement with AI while preserving opportunities for independent thinking and reflection.

The Four AI Use Levels are not intended to rank assignments from better to worse, nor are they designed to suggest that more AI use is always preferable. Instead, each level serves a different educational purpose and supports different learning outcomes. Some assignments require students to work independently in order to demonstrate mastery or develop foundational skills. Other assignments may benefit from AI-assisted brainstorming, collaboration, analysis, or evaluation. The goal is to intentionally align AI use with the learning objectives of a particular activity rather than applying a one-size-fits-all approach across an entire course.

**Level 1: No AI Use**

Level 1 assignments require students to complete work independently without the use of generative AI tools. These assignments are appropriate when the primary goal is to assess individual knowledge, foundational skills, critical thinking, or independent performance. Students are expected to generate ideas, complete analyses, and produce work using their own abilities and resources. While AI is not used during the assignment itself, students may still engage in reflection regarding why independent work was important for that learning experience and what they learned from completing the task without AI support.

**Level 2: AI for Brainstorming and Support**

Level 2 allows students to use AI as a tool for idea generation, brainstorming, clarification, and learning support. Students may ask AI questions, explore concepts, generate examples, or receive guidance during the planning stages of an assignment. However, the final work remains primarily student-generated. This level encourages exploration while preserving opportunities for students to develop and communicate their own ideas. Reflection focuses on how AI contributed to the development of thinking rather than the creation of final products.

**Level 3: AI Collaboration**

Level 3 positions AI as a collaborative partner within the learning process. Students may use AI to generate ideas, receive feedback, revise work, explore alternative perspectives, or support problem-solving activities. The final product reflects an interactive process in which both the student and AI contributed to the development of the work. Students are expected to remain actively involved in evaluating, revising, and making decisions about AI-generated outputs. Reflection emphasizes the collaborative nature of the interaction and encourages students to examine how AI influenced their thinking, choices, and learning.

**Level 4: AI-Integrated Creation and Evaluation**

Level 4 represents the highest level of AI integration within the framework. Students may use AI extensively throughout the creation, analysis, evaluation, and revision processes. Assignments at this level often focus on understanding how to work effectively with AI while maintaining

responsibility for outcomes, decisions, and ethical considerations. Students may be asked to evaluate AI-generated outputs, compare human and AI contributions, identify limitations, or critically assess the quality of AI-supported work. Reflection becomes especially important because students must examine not only what AI produced, but also how its involvement shaped the final outcome.

Across all four levels, metacognitive reflection remains a central component of the learning process. Students are encouraged to examine how AI influenced their thinking, confidence, decisions, and understanding regardless of whether AI was used extensively, minimally, or not at all. This emphasis on reflection distinguishes the HAIML approach from many AI policies that focus exclusively on disclosure or compliance. The goal is not simply to document AI use. The goal is to help students develop greater awareness of how AI influences learning and decision-making.

The Four AI Use Levels provide a practical structure for implementing HAIML across courses, disciplines, and educational contexts. They allow instructors to align AI use with learning outcomes while maintaining transparency and consistency for students. More importantly, they reinforce the central principle underlying the framework: AI use should always support learning, but responsibility for learning remains with the learner.

**Faculty Implementation Considerations**

Implementing HAIML begins with aligning AI use to learning objectives rather than to the capabilities of the technology itself. Faculty should determine when AI supports learning goals, when independent work is more appropriate, and how AI use aligns with the intended outcomes of an assignment. The Four AI Use Levels provide a practical structure for making these decisions while establishing clear expectations for students.

A second principle involves normalizing reflection as part of the learning process. HAIML encourages faculty to create opportunities for students to examine how AI influenced their thinking, decisions, confidence, and learning. Reflection does not need to be extensive, but it should be intentional and connected to the learning objectives of the activity. Through repeated opportunities for reflection, students develop greater metacognitive awareness and become more thoughtful users of AI.

HAIML also emphasizes transparency, human judgment, and meaningful cognitive engagement. Rather than focusing primarily on detection or enforcement, the framework encourages clear communication about expectations and responsible AI use. Assignments should be designed so that analysis, decision-making, evaluation, and reflection remain central to the learning experience. As AI continues to evolve, the role of faculty is not simply to manage technology but to help students develop the agency, judgment, and ethical awareness needed to learn effectively alongside it.

**Applications of HAIML**

Although HAIML was initially developed within higher education, the framework was designed to be flexible and adaptable across a variety of learning environments. The core principles of human agency, metacognitive reflection, ethical decision-making, and intentional AI use are not limited to a single discipline or educational setting. As AI becomes increasingly integrated into workplaces, professional training programs, and everyday decision-making, the need for frameworks that support thoughtful human-AI interaction continues to grow. HAIML provides a structure that can help learners understand not only how to use AI, but also how AI influences their thinking and decision-making processes.

Within higher education, HAIML can be integrated into a wide range of disciplines including psychology, education, business, communication, healthcare, and the social sciences. Instructors can use the framework to guide AI-supported assignments, discussions, projects, simulations, and reflective activities. The framework is particularly useful in courses where critical thinking, problem-solving, ethical reasoning, and decision-making are central learning outcomes. Because HAIML focuses on the learning process rather than a specific technology, it can be adapted as AI tools continue to evolve.

Beyond traditional academic settings, HAIML has applications within workforce development and professional training. Employees increasingly interact with AI systems that provide recommendations, generate reports, support decision-making, and automate complex tasks. Organizations must ensure that individuals understand not only how to use these systems but also how to evaluate their outputs and maintain responsibility for decisions. The reflective and decision-making components of HAIML can help professionals develop the awareness and judgment necessary to work effectively alongside AI while avoiding overreliance on automated systems.

The framework also has potential applications in leadership development, communication training, healthcare education, and other fields where human judgment remains essential. In these environments, AI may provide valuable support, but individuals must continue to evaluate information, consider alternatives, and make decisions that carry real-world consequences. HAIML offers a structured approach for helping learners and professionals maintain agency while benefiting from AI-assisted tools and technologies.

Ultimately, the value of HAIML lies in its focus on the human dimensions of learning and decision-making. While technologies will continue to change, the need for reflection, judgment, accountability, and ethical reasoning will remain. By placing these capacities at the center of AI-supported learning, HAIML provides a framework that is relevant not only for today's educational environments but also for the increasingly AI-mediated environments of the future.

## Conclusion

Artificial intelligence is reshaping education in profound ways. As AI becomes increasingly integrated into learning environments, educators must consider not only how students use these tools, but also how these tools influence thinking, learning, decision-making, and human agency. Questions surrounding AI in education extend beyond efficiency, access, and academic integrity. They also involve understanding how learners remain active participants in cognitive processes that have traditionally formed the foundation of meaningful learning.

The Human-Centered AI Metacognitive Learning Model (HAIML) was developed to address this challenge. Grounded in psychological theory and learning science, the framework provides a practical approach for integrating AI into educational environments while preserving the human capacities that remain essential to learning. Through its three interconnected layers of Experiential AI Use, Metacognitive Reflection, and Ethical Decision-Making, HAIML encourages students to engage with AI while remaining reflective, ethical, accountable, and actively involved in their own learning processes.

As educators prepare students for a future in which AI is increasingly present, the goal should not be to replace human thinking with artificial intelligence. The goal should be to strengthen the human capacities that allow individuals to learn, adapt, evaluate information, and make responsible decisions while using AI. HAIML offers one approach for accomplishing that goal by placing human agency, metacognitive awareness, ethical reasoning, and judgment at the center of AI-supported learning.

Learning is not defined by what AI can generate. Learning is defined by how humans engage with information, reflect on their thinking, make ethical decisions, and exercise agency in the learning process. AI may influence decisions, but humans remain responsible for them.

**References**


Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology, 52*(1), 1–26. https://doi.org/10.1146/annurev.psych.52.1.1

Bjork, R. A., Dunlosky, J., & Kornell, N. (2013). Self-regulated learning: Beliefs, techniques, and illusions. *Annual Review of Psychology, 64*, 417–444.

Cummings, M. L. (2004). Automation bias in intelligent time critical decision support systems. *AIAA First Intelligent Systems Technical Conference*, 1–8.

Kahneman, D. (2011). *Thinking, fast and slow*. Farrar, Straus and Giroux.

Klein, G. A. (1998). *Sources of power: How people make decisions*. MIT Press.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice-Hall.

Parasuraman, R., & Riley, V. (1997). Humans and automation: Use, misuse, disuse, abuse. *Human Factors, 39*(2), 230–253.

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology, 19*(4), 460–475.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice, 41*(2), 64–70.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal, 45*(1), 166–183.