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Theory to Practice: A Framework for Generative AI

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Abstract: Recent advancements in generative artificial intelligence (AI) have disrupted assessment practices within the higher education sector. The efficacy of existing assessment approaches is under reexamination with the introduction of generative AI's ability to generate human-like text. Simultaneously, there are calls to integrate generative AI into assessment design to enhance learning and prepare students for a new era of technology in their careers. This paper proposes a framework to integrate generative AI into formative and summative assessments across Bloom's levels and Knowledge Dimensions. Its purpose is to illustrate the versatility and intricacy of generative AI's potential applications grounded in existing learning theory while retaining a focus on authentic assessment. The goal is to support higher education professionals stimulate assessment design concepts featuring generative AI positioned within varying learning complexities.

Keywords: *Assessment Design, AI in Assessment, AI in Curriculum, Learning Theory, Bloom's Taxonomy, Formative and Summative Assessment, Higher Education*

Introduction

The genesis of generative artificial intelligence's (AI) ability to create original outputs resembling human-like dialogue is challenging the status quo of higher education's assessment landscape. The ability of AI-assisted tools to effortlessly create a diverse set of texts and images within parameters set by users is disrupting long-established assessment traditions in higher education. Standard assessment deliverables such as discussions, essays, and research papers commonly used to evaluate student learning outcome achievement are now able to be outsourced to these tools. With no surefire method to distinguish human from AI generated text, this raises questions about the academic integrity of existing assessment processes. This also comes at a time when progressive educators are pushing to move from traditional assessment mechanisms to authentic assessments that are career-relevant. To further complicate matters, employers anticipate the development of skills related to generative AI usage will be pivotal in many industries, suggesting they will need to be incorporated into assessments. While higher education institutions have quickly begun to accept this new reality and support the use of generative AI in assessments, the sector is still in the early phases of examining how to effectively build it into curricula. Faculty, instructional designers, and academic leaders could benefit from

examples of how to integrate generative AI into assessment design in a variety of learning contexts, specifically with a connection to existing theoretical models. This paper aims to expand upon prior work of Anderson et al. (2001) and Page (2024) examining how the nuances of varying Bloom's levels, Knowledge Dimensions, and goals of assessment translate to authentic, differentiated formative and summative assessments featuring the use of generative AI; the hope is it will showcase the diversity of its potential applications and open the mind of educators to new possibilities in assessment design.

Generative AI

The World Economic Forum (2023) discusses the increased appetite of businesses to harness the efficiencies of AI for task augmentation and, if possible, automation. Further, it is generally accepted that AI will establish itself as a technology of high utility in the coming years (Frey & Osbourne, 2023; Ooi et al., 2023). With the rise of generative AI and its increasing demand as an industry skill, it would be prudent for educators to incorporate the use of these tools in their curricula so students can develop their related facilities. Reactions have ranged from embracing the technology to eschewing it. Attempted antidotes of those in the latter camp have included banning generative AI tools or implementing anti-plagiarism software designed to distinguish between the writings of humans and AI (Grassini, 2023; Supriyanto, 2023). However, AI detection tools exhibit inconsistencies in accurately identifying human and AI generated text, limiting their utility in holding students accountable to following academic integrity guidelines (Elkhatat et al., 2023). The prevailing sentiment among the majority of 116 high research activity higher education institutions in the United States reported encouraging its use in a recent survey of their externally-facing documents (McDonald, 2024). Likewise, researchers encourage the adoption of robust assessment mechanisms that simultaneously capitalize on the utility of AI while preserving academic integrity (Ardito, 2023; Walczak & Cellary, 2023). This can be accomplished through a combination of assessments including but not limited to tackling intellectually rigorous problem-solving requiring creative solutions supplemented by support from generative AI, developing communication skills by having generative AI participate in an individual or multi-way dialogue while appropriately directing the conversation and critiquing for accuracy of information provided, or for educators who wish to supplement with an ironclad process eliminating any potential evaluation impurities, the administration of examinations impregnable to the use of generative AI.

Theoretical Underpinnings

Bloom's Taxonomy (1956) has secured a strong foothold as an influential framework underpinning the tenets of cognitive learning theory. More recently, the model in Appendix A was expanded to incorporate the concept of Knowledge Dimensions: a new spectrum that exists within each Bloom's Level ranging from concretized concepts of the Factual Dimension to the abstract of the Metacognitive Dimension (Anderson et al., 2001; Iowa State University, 2012). The Theory to Practice Assessment Framework expands upon Anderson et al.'s (2001) Knowledge Dimensions by associating Goals of Assessment and proposing common Assessment Measure pairings with respective Bloom's Levels and Knowledge Dimensions (Page, 2024). Although the original model alludes to the types of tasks to be completed at each Bloom's Level and Knowledge Dimension, much was left to the imagination of the reader to properly translate these manifestations to practice. The Theory to Practice Assessment

Framework's objective is to promote consistency of goal and measure interpretation and alleviate the intellectual burden of establishing these connections previously required of educators and course designers prior to putting Anderson et al.'s (2001) model to use in guiding assessment development (Page, 2024). Further, when designing learning outcomes, it provides program leaders with a visual representation of how language will translate to subsequent learning goals and assessment mechanisms.

Formative, Summative, and Authentic Assessment

A variety of assessment mechanisms and styles shape the trajectory of the learning process. Formative assessment is a feedback mechanism embedded throughout curricula to inform students and faculty of their understanding. The purpose is not to formally evaluate student learning, but to uncover strengths and weaknesses of student understanding so adjustments may be made as the course progresses (Belini, 2015). Conversely, summative assessment aims to make a final determination of student learning achievement after the learning process has concluded, typically through a high-stakes assessment. Ideal learning experiences attempt to scaffold formative and summative assessments; a common pitfall of curricula is the development of disparately related formative assessments that are suitable as individual learning activities, but when viewed in the whole tend to lack a sense of cohesion and inadequately prepare students for the subsequent summative assessment. Conversely, it is preferable to design courses intentionally with a sense of continuity allowing assessment deliverables build upon each other through an integrative process resulting in a cumulative representation of learning upon reaching its crescendo: the summative assessment. Kealey (2010) advocates for this complementary approach to promote a constructive process resulting in ongoing feedback and improvement over time. Recent assessment research has focused on practices that are learner-centered, leading to more meaningful student learning experiences (Pereira, 2016). This is commonly described as authentic assessment, the concept that learning experiences are emblematic of the real-world tasks students will encounter in their careers and citizenship. This is in accordance with Banta and Paloma (2015) and Wiggins and McTighe (2005) who contend authentic assessment immerses students in real-world, contextually rich environments. The approach has beneficial effects on student motivation, independence, and learning (Villarroel et al., 2018).

Generative AI in Assessment

Approaches to assessment will necessarily be informed by the prevalence of generative AI. While research has found that generative AI tools are principally capable of sufficiently addressing assessments at lower Bloom's levels, the proficiency of their capabilities are diminished as the Bloom's level and authenticity of the assessment increases (Thanh et al., 2023). One should not conclude, however, that learning outcomes and assessments at lower Bloom's levels should never be utilized. Instead, a reinvention of how to approach these learning outcomes through the meaningful integration of generative AI can sidestep the vulnerabilities of these assignments while promoting ethical and realistic usage. For instance, a key criticism is students can prompt generative AI to easily find the answers for assignments at lower Bloom's levels. A possible solution is to alter their nature by having

students complete the assessment, ask generative AI to critique their work, and conclude by having the student reflect upon the feedback from generative AI. Further, it is hazardous to place blind trust into the output of generative AI; critical analysis of content developed by AI and an exploration of ethical use have been identified as key skills students will need to be successful (Walczak & Cellary, 2023). Churches (2008) created a digital taxonomy for Bloom's to represent a variety of new technology-related learning outcomes and tasks that learners may utilize in their learning processes. More recently, Bloom's Taxonomy was updated to outline the capabilities of AI tools and unique human skills that reside at each learning level (Oregon State University, 2023). What is missing is a practical framework to depict the potential uses of generative AI in formative and summative assessments at and within different Bloom's levels. How can educators seamlessly embed generative AI into curricula, and how might the usage of generative AI vary depending on the context of the assessment in question? The uses of the AI tools will be unique for formative and summative assessments and need to be considered across different Bloom's levels and Knowledge Dimensions. Program leaders, faculty, and instructional designers may find it difficult to conjure a mental list of its various incarnations without a referential framework.

Assessment Framework for Generative AI

The proposed Assessment Framework for Generative AI is presented in Appendix B and an abridged representation of the model is provided in Figure 1. The two leftmost columns are built upon the work of Anderson et al. (2001), which represent the Bloom's Level and Knowledge Dimension. The third column's Goals of Assessment are reflective of the Theory to Practice Assessment Framework (Page, 2024). The Formative Assessment with the Inclusion of AI column suggests formative learning activities featuring the use of generative AI appropriately matched to the corresponding Bloom's level, Knowledge Dimension, and Goal of Assessment. The final Summative Assessment Measure column expands upon the prior formative assessment activity; scaffolding formative to summative learning experiences is beneficial to students as it fosters continuity of and enhances the learning process (Doo et al., 2020).

The proposed Assessment Framework for Generative AI was created in a number of phases. First, the authors met to mutually agree upon an outline for the framework. Second, the authors diverged to independently intuit and insert formative and summative assessment measure examples into the framework. Third, once placed the framework, the authors reconvened to collectively review and vet for appropriate, inventive, authentic, and career-relevant use of generative AI, correct and clearly differentiated Bloom's leveling, and meaningful formative to summative assessment scaffolding. Lastly, a variety of interested stakeholders internal to the University of Phoenix provided feedback including three associate deans from different colleges, an instructional designer, an institutional assessment professional, and a faculty training and development professional. Their feedback primarily informed what aspects of the model needed clarification through supplemental text in this paper.

Figure 1

Abridged Representation of the Assessment Framework for Generative AI

Bloom's Level	Knowledge Dimension	Goal of Assessment	Formative Assessment with the Inclusion of AI	Summative Measure Example (with AI)
Remember [Recall Information]	**Procedural** [Recall]	Remember	Generate a list of vocabulary terms and definitions on a topic and ask AI to turn them into flashcards for studying	Test - learner is provided the definitions and must fill in the term
Understand [Demonstrate Understanding of Facts]	**Metacognitive** [Predict]	Infer Personal Reaction to Information/Situation	Ask AI to describe the way in which a particular organizational role might respond to a new HR policy	Draft a memo to those with this role explaning the policy and how it applies to them/why it matters
Apply [Use Information or Solve Problems in New Situation]	**Factual** [Respond]	Answer Procedural Questions	Ask AI to detail the stages of grief (Elizabeth Kubler Ross)	Respond to a scenario where an individual is grieving - what stage are they in and what do you do
Analyze [Break Information into Parts]	**Conceptual** [Differentiate]	Compare and Contrast, Separate, Classify (What are the different parts of), Characterize, Distinguish, Examine	Ask AI to outline similarities and differences between federalists and anti-federalists	Video presentation – why I am a federalist and then flip to why I am an anti-federalist
Evaluate [Make Judgements and Defend Opinions]	**Procedural** [Judge]	Assess, Synthesize, Interpret, Conclude, Predict, Justify, Critique	Ask AI to identify strengths and weaknesses of a speech/presentation. Ask AI to evaluate 6th grade student essays and assign writing skill levels	Write an argumentative essay and have AI provide a critique. Revise based on AI feedback
Create [Develop New Idea or Solution]	**Metacognitive** [Create]	Personal Transformation, Mapping Self-Improvement	Ask AI to provide 5 sources on becoming a better teacher, nurse, counselor, etc. Reflection flip - reflect upon a recent difficulty or failure. Ask AI to offer solutions	Use AI research to build a career improvement plan Rank solutions and discuss why one makes the most sense or offer an additional solution

Note. Full version in Appendix B

What is remarkable about the Formative Assessment with the Inclusion of AI column is its display of AI's versatility in facilitating a wide array and complexity of learning activities as evidenced by the diversity of assessment activities within and between each Bloom's level. Moreover, in many cases it attempts to do so by situating the assessment in an authentic context, for example, the task to research potential solutions for addressing falls in hospitals in the Analyze, Procedural row. In others, it balances the specificity of authentically situated examples with broad tasks generalizable to a variety of career-relevant situations. The combination displays the breadth of its capabilities in augmenting formative assessments while showcasing practical vocational or discipline-specific applications. The final Summative Assessment Measure column follows a similar approach.

Incorporation of generative AI is encouraged in formative assessment for many reasons. First, it provides opportunities to practice using AI tools as they will undoubtedly become ubiquitous in industry (World Economic Forum, 2023). It is the responsibility of higher education institutions to prepare students for success in their lives and careers; the exclusion of generative AI would be akin to the negligence of banning calculators or computers. Educators should welcome new technology rather than renounce it to prepare students for the modern as opposed to the historical workplace. Second, it inculcates a proactive attitude that AI tools should be embraced rather than eschewed through positive signaling to students. Third, integration opens the door to discussing ethical usage and an exploration of its limitations, biases, and the necessity of a human element in its utilization. Baking in exposure to generative AI offers an opportunity for faculty to set boundaries and for students to learn its flaws. Lastly, these efforts could decrease the chances students will abuse AI tools through unethical academic conduct, particularly in the subsequent summative assessment having previously used it in the formative; student awareness of faculty conversance with generative AI may lead them to reconsider before using it in an academically dishonest manner.

When reviewing the summative measure examples in the framework, an astute observer would notice while generative AI was used in the preceding formative assessment, it could potentially, but not always, be used again in the subsequent summative assessment. For instance, AI cannot be used for the framework's summative assessment measure at Bloom's create level asking the student to reflect on the personal reasons why they chose a particular project topic as this is unable to be intuited through large language modeling. Conversely, it could be used to produce a first draft of the lesson plan summative measure example at Bloom's understand level and then undergo further fine-tuning by the student. The framework does not intend to suggest generative AI should be avoided in the latter example, but instead attempts to convey faculty and course designers should use discretion whenever generative AI can potentially be incorporated into an assessment. Sound curriculum design is the goal; it is not necessary to shoehorn a new technological tool into every assessment simply because the possibility exists. Further, it is likely preferable for summative assessments to primarily, if not entirely, represent original work of the student rather than the output of generative AI to uphold institutional integrity. If a vast majority of assessments completed by students are predominately facilitated by generative AI, internal and external stakeholders may question the aptitudes of program graduates. Program leaders, faculty, and course designers need to make deliberate decisions about the incorporation of generative AI in assessments, as well as when they may choose to disallow it. Bearing the goal in mind of centering assessment in an authentic, career-relevant context, considering how AI may be used in the workplace helps guide this decision. In assessments where the use of generative AI is not natively built-in to the instructions, plausible, yet not prohibited, faculty and course designers need to set clear boundaries on usage and source attribution. Additionally, students must be equipped to make informed decisions regarding the use of AI and whether it is useful or a hinderance when completing assessments.

Conclusion

Given that researchers and higher education institutions are urging the utilization of Generative AI and assessment mechanisms that simultaneously feature these new tools and protect academic integrity, there is a strong desire for potential assessment solutions (Ardito, 2023; McDonald, 2024; Walczak &

Cellary, 2023). The proposed Assessment Framework for Generative AI attempts to meet these needs through the lens of existing learning theory by exemplifying practical applications in authentically situated, complementary formative and summative assessments at a wide variety of learning level complexities. This framework should help educators navigate the waters of assessment design in the age of generative AI and likewise steer future research strengthening the interrelationships between AI, assessment theory, and practice.

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Appendix A

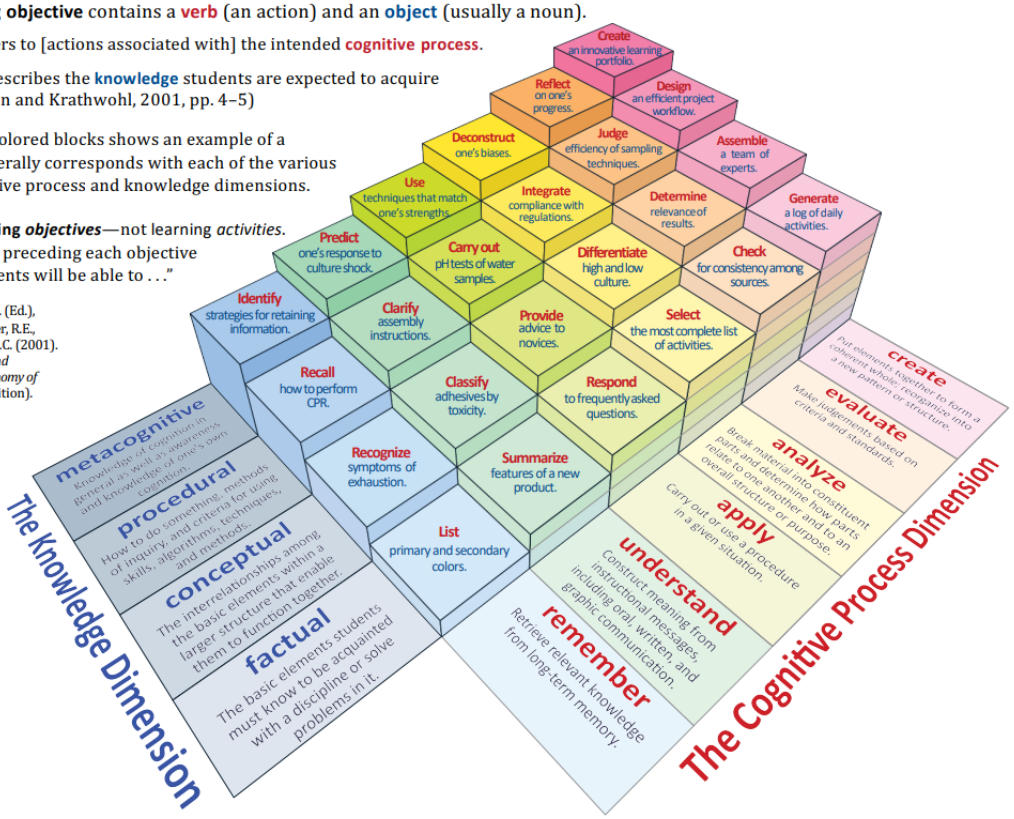
A statement of a **learning objective** contains a **verb** (an action) and an **object** (usually a noun).

- The **verb** generally refers to [actions associated with] the intended **cognitive process**.
- The **object** generally describes the **knowledge** students are expected to acquire or construct. (Anderson and Krathwohl, 2001, pp. 4–5)

In this model, each of the colored blocks shows an example of a learning objective that generally corresponds with each of the various combinations of the cognitive process and knowledge dimensions.

Remember: these are **learning *objectives***—not learning *activities*. It may be useful to think of preceding each objective with something like: "Students will be able to . . ."

*Anderson, L.W. (Ed.), Krathwohl, D.R. (Ed.), Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., & Wittrock, M.C. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of Educational Objectives* (Complete edition). New York: Longman.



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Appendix B

Theory to Practice – Assessment Framework for Generative AI

This Theory to Practice Framework for Generative AI was developed to connect existing models of learning objectives featuring Bloom's Taxonomy and Knowledge Dimensions to recent advancements in generative AI (Anderson et al., 2001; Iowa State University, 2012; Page, 2024). The framework illustrates how AI can be used and scaffolded between formative and summative assessments at each learning level and Knowledge Dimension. It should serve as a source of inspiration for faculty and instructional designers to incorporate Generative AI into curricula across a variety of learning levels.

Bloom's Level	**Knowledge Dimension**	**Goal of Assessment**	**Formative Assessment with the Inclusion of AI**	**Summative Measure Example (with AI)**
These columns reflect Bloom's Taxonomy as presented by Anderson et al. (2001) to include Knowledge Dimensions for each Bloom's learning level. Knowledge Dimensions attempt to represent the type of knowledge learners will gain within each learning level moving from concrete to more abstract concepts.		This column was adapted from Page (2024) expanding on the Knowledge Dimension framework of Anderson et al. (2001). The goals of assessment are designed to clarify and expand upon learning goals that are implied but not overtly stated within the knowledge dimensions of each Bloom's level for ease of interpretation.	The formative assessment suggestions propose learning activities appropriately matched to each Bloom's level and Knowledge Dimension that incorporate the use of generative AI.	When possible, the summative assessment measure examples list opportunities to expand upon the corresponding formative assessment with the inclusion of AI examples to promote scaffolding between formatives and summatives harnessing generative AI.
Remember [Recall Information]	**Factual** [List]	Itemize	Ask AI to create a list of items you would need as a first responder	Add additional items based on the area of the country you are in
	Conceptual [Recognize]	Notice	Matching activity where AI creates a list of specific thinking behaviors and the categories that go with those behaviors: students have to match them	Learner is provided with examples of these thinking behaviors in situations and must identify which is which
	Procedural [Recall]	Remember	Generate a list of vocabulary terms and definitions on a topic and ask AI to turn them into flashcards for studying	Test - learner is provided the definitions and must fill in the term
	Metacognitive [Identify]	Find Techniques to Improve Retention of Information	Ask AI for tips on how to remember (insert topic)	Choose a tip and reflect on how it did or did not work
Understand [Demonstrate Understanding of Facts]	**Factual** [Summarize]	Outline Key Concepts	Ask AI to summarize an article	Extemporaneous presentation - three key concepts in article
	Conceptual [Classify]	Arrange by Association, Identify	Ask AI to scan a list/data set and identify all items related to a particular topic or theme	Classify a set of something (e.g., differentiation strategies for students, order of care for nursing), then ask AI to check your classification and provide feedback
	Procedural [Clarify]	Explain Concept, Discuss	Ask AI to explain a topic you do not understand Ask AI to provide immediate feedback to student (this latter suggestion about providing feedback can apply to other levels and dimensions as well)	Use the information to create a lesson plan for a particular population of students explaining the topic
	Metacognitive [Predict]	Infer Personal Reaction to Information/Situation	Ask AI to describe the way in which a particular organizational role might respond to a new HR policy	Draft a memo to those with this role explaning the policy and how it applies to them/why it matters
Apply [Use Information or Solve Problems in New Situation]	**Factual** [Respond]	Answer Procedural Questions	Ask AI to detail the stages of grief (Elizabeth Kubler Ross)	Respond to a scenario where an individual is grieving - what stage are they in and what do you do
	Conceptual [Provide]	Teach, Train, Recommend, Relate, Advise, Choose the Best Explanation/Way to Handle a Situation	Ask AI for guidance on best practice in social work to counsel an elderly person who is believed to be a "hoarder"	Oral presentation to social workers in the community on signs and solutions for dealing with individuals who are part of this population. Design an accompanying handout (with AI?)
	Procedural [Carry Out]	Follow a Process, Use Program, Solve a Problem, Perform	Use AI to create an annotated bibliography for a particular topic	Identify incorrect citations and summarizations and correct as necessary – AI is notorious for hallucinations
	Metacognitive [Use]	Employ Process Best Suited to Needs/Abilities	Ask AI to design an ESL lesson for refugees	Make suggestions for how to design the lesson even more effectively
Analyze [Break Information into Parts]	**Factual** [Select]	Choose Most Complete List, Identify Problems	Ask AI to compile a list of problems in the field - a "top ten list" Ask two different AI programs to summarize an article	Learner analyzes the problem from varying perspectives (e.g. nurse, patient, family member) Learner chooses summary that is best and reflects on evaluation mechanism they used and why
	Conceptual [Differentiate]	Compare and Contrast, Separate, Classify (What are the different parts of), Characterize, Distinguish, Examine	Ask AI to outline similarities and differences between federalists and anti-federalists	Video presentation – why I am a federalist and then flip to why I am an anti-federalist
	Procedural [Integrate]	Dissection of Theory in Practice, Critical Analysis	Provide a problem - ask AI to come up with three solutions related to addressing falls in hospitals	Learner analyzes pros and cons of solutions to address falls and ranks them from best to worst
	Metacognitive [Deconstruct]	Identify Biases and Limitations of Perspective	Ask AI to outline the reasons that lead an individual to be anti-police	Essay, discussion, presentation to police department detailing solutions for increasing support to police departments in your community
Evaluate [Make Judgements and Defend Opinions]	**Factual** [Check]	Was Procedure Followed? Are Sources Consistent? Rate	Ask AI to identify a current event where existing procedures were not followed	Ask AI to offer three reasons the procedure was not followed – rank the influence of each and explain justification
	Conceptual [Determine]	Identify Best Solution or Process, Discern, Prioritize	Ask AI to create a list of prior solutions to similar problems and their outcomes	Apply most appropriate solution to an existing case study and explain why it was chosen
	Procedural [Judge]	Assess, Synthesize, Interpret, Conclude, Predict, Justify, Critique	Ask AI to identify strengths and weaknesses of a speech/presentation. Ask AI to evaluate 6th grade student essays and assign writing skill levels	Write an argumentative essay and have AI provide a critique. Revise based on AI feedback
	Metacognitive [Reflect]	Appraisal of Assessment Process	Ask AI to generate 10 self-improvement options around (insert topic), choose two to try and report on their usefullness	Reflective essay or journal, self-assessing existing processes/work (e.g., how a lesson went that you taught)
Create [Develop New Idea or Solution]	**Factual** [Generate]	Develop a List	Ask AI to create a list of ideas for a project topic	Reflect upon the suggestions and choose one
	Conceptual [Assemble]	Intentional Arrangement with Interrelationships Leading to Overall Product	Ask AI to detail synergies between two items - e.g. green and nuclear energy Ask AI to create a presentation on (insert topic)	Ask AI to create a pamphlet on the synergies between green and nuclear energy and revise as necessary
	Procedural [Design]	Invention, Propose a Plan or Solution	Ask AI to summarize research on what makes art "art" and run a proposed solution through AI to check for errors/holes	Write a letter to the editor at the WSJ that seeks to convince readers we do or do not need a definition of art
	Metacognitive [Create]	Personal Transformation, Mapping Self-Improvement	Ask AI to provide 5 sources on becoming a better teacher, nurse, counselor, etc. Reflection flip - reflect upon a recent difficulty or failure. Ask AI to offer solutions	Use AI research to build a career improvement plan Rank solutions and discuss why one makes the most sense or offer an additional solution

The framework includes a mixture of general and specific examples to contextualize how it is applied both in a broad sense as well more nuanced applications.

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