EME6646 Summer B 2026
A03: Individual Explanation of Human Learning & Memory
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Learning and Memory: Reflections on Neuroscience and Instructional Design

Introduction

One of the biggest shifts in my thinking during this module was realizing that learning and memory are not separate from instruction, but they are the biological processes that instructional design seeks to support. Before studying this unit, I tended to think about effective instruction primarily through the lens of selecting engaging activities, sequencing content, and aligning assessments with learning objectives. While those elements remain essential, the neuroscience of learning and memory helped me recognize that effective instruction is not simply about exposing learners to information. Instead, instructional designers create the conditions that make meaningful learning more likely by helping learners sense, attend to, encode, consolidate, retrieve, and ultimately apply knowledge over time. That subtle change in perspective has fundamentally influenced how I think about both teaching and instructional design.

The assigned resources consistently emphasized that memory is better understood as a dynamic process than as a fixed storage location. Rather than viewing memory as a single structure within the brain, contemporary neuroscience describes learning as the interaction of sensing, encoding, consolidation, retrieval, and ongoing adaptation across multiple neural systems (Byrne, 2020; Squire, 2004). These processes are supported by neuroplasticity, shaped by attention and prior experience, and influenced by emotional and cognitive factors that determine how information is interpreted and remembered. Combined, these ideas reinforced that neuroscience does not replace instructional design theories or cognitive psychology. Instead, it provides a biological explanation for why many evidence-based instructional design principles are effective while also reminding us that understanding the brain alone cannot determine the best instructional strategy. This perspective aligns with Dr. Hirumi's emphasis that learning emerges from the interaction of multiple cognitive, emotional, and experiential processes rather than any single brain structure or function.

This reflection examines the three lessons that most influenced my thinking. First, I discuss how neuroplasticity reframed my understanding of learning as lasting neural change rather than simple information acquisition. Second, I explain how recognizing memory as a reconstructive process changed the way I think about assessment and learner understanding. Finally, I reflect on how studying encoding, consolidation, retrieval, attention, and reflection shifted my perspective from delivering content toward intentionally designing learning experiences that make meaningful learning more likely.

Lesson 1: Learning Changes the Brain

One of the most meaningful lessons I learned from this module was that learning represents lasting changes in the brain rather than simply the acquisition of new information. Although I was familiar with the concept of neuroplasticity, I had never fully connected it to the everyday decisions instructional designers make when creating learning experiences. Before this unit, I tended to think of learning primarily as gaining knowledge or developing new skills. Studying the neuroscience of learning and memory expanded that perspective by demonstrating that meaningful learning reflects ongoing adaptation within the brain as experiences strengthen existing neural connections, establish new pathways, and reorganize neural systems over time. Rather than functioning as a passive storage system, the brain continually changes through attention, practice, feedback, and retrieval, making learning an active biological process rather than a simple transfer of information.

Several of the assigned resources reinforced this understanding from complementary perspectives. The neuroplasticity video demonstrated that the adult brain continues reorganizing itself throughout life in response to meaningful experiences, practice, and recovery following injury. Sebastian Seung (2010) extended this idea by proposing that experiences continually reshape the brain's network of neural connections, suggesting that learning is reflected in the changing architecture of those connections rather than the accumulation of isolated facts. Likewise, Squire (2004) explained that memory depends on multiple interacting systems rather than a single storage location, while Byrne (2020) described learning as a process involving encoding, consolidation, and retrieval across interconnected neural systems. Together, these resources reinforced that learning is not simply acquiring information but continually modifying the biological systems that support future thinking, remembering, and performance.

This realization changed the way I think about effective instruction. Earlier in my teaching career, I often judged successful lessons by how engaged students appeared or how accurately they completed an activity. While those indicators remain important, I now recognize they provide only indirect evidence that meaningful learning has occurred. Learners may enjoy an activity without developing durable knowledge, while appropriately challenging experiences that require sustained attention, retrieval, reflection, and repeated application are more likely to produce lasting changes in understanding. As a result, I increasingly evaluate instruction by asking a different question: *What experiences am I creating that are most likely to help learners build durable knowledge over time?* That question has become central to how I now think about instructional design. Neuroscience has not replaced the instructional design principles I have been studying throughout this graduate program. Instead, it has provided a biological explanation for why those principles are effective and reinforced the importance of intentionally designing learning experiences that make meaningful learning more likely.

Lesson 2: Memory Is Reconstructed, Not Replayed

One of the most surprising lessons I learned during this module was that memory functions less like replaying a video recording and more like reconstructing a story from pieces distributed across multiple neural systems. Before exploring this topic, I rarely questioned the accuracy of my own memories or those of my students. I generally assumed that remembering meant retrieving an intact representation of a previous experience. The neuroscience of learning and memory fundamentally changed that perspective by demonstrating that every act of retrieval involves reconstructing information from interconnected neural systems. This process allows memory to remain flexible and adaptive, but it also makes memory susceptible to distortion, omission, and reconstruction over time. Rather than viewing memory errors as simple failures, I began to recognize them as a natural consequence of how the brain continually interprets, organizes, and reconstructs previous experiences.

Several of the assigned resources reinforced this perspective from different directions. Byrne (2020) illustrates this concept through the Deese-Roediger-McDermott (DRM) word-list demonstration, in which individuals confidently remember words that were never presented because the brain reconstructs meaning from related concepts rather than replaying exact experiences. The World Science Festival discussion similarly emphasized that emotionally significant memories often become stronger while simultaneously changing through repeated retrieval, reminding us that vivid memories are not necessarily more accurate. Joshua Foer (2012) demonstrated that extraordinary memory is often the result of deliberately organizing information into meaningful associations rather than relying on innate ability or simple repetition. Together, these resources reinforced that successful remembering depends less on perfectly preserving information and more on actively reconstructing meaningful relationships among ideas.

This lesson significantly changed the way I interpret student thinking. As a mathematics teacher, I have occasionally viewed incorrect answers as evidence that students either learned the material or they did not. I now recognize that incorrect responses may instead reveal how learners reconstructed knowledge from partially accurate memories, incomplete conceptual understanding, or faulty associations. Rather than viewing misconceptions simply as mistakes to correct, I increasingly see them as valuable evidence of how students are organizing knowledge. That realization has also reshaped how I think about assessment. Formative assessments are not simply opportunities to measure what students remember; they provide insight into how learners are constructing understanding and where important conceptual connections still need strengthening. As I continue transitioning into instructional design, I want to create learning experiences that repeatedly ask learners to explain, retrieve, apply, and refine ideas across multiple contexts. If memory is strengthened through meaningful reconstruction rather than simple repetition, then effective instructional design should continually help learners reorganize, deepen, and extend their understanding instead of merely recalling isolated facts.

Lesson 3: Effective ID Creates the Conditions That Make Meaningful Learning More Likely

The greatest shift in my thinking during this unit was realizing that effective instructional design is not primarily about delivering information but about intentionally creating the conditions that make meaningful learning more likely. Before studying the neuroscience behind learning and memory, I tended to think about instructional design through familiar practices such as sequencing content, selecting instructional strategies, and aligning assessments with learning objectives. While those practices remain essential, this module encouraged me to think one level deeper. Information alone does not become learning. Learners must attend to new information, encode it into meaningful representations, strengthen those representations through practice and reflection, consolidate learning over time, and successfully retrieve and apply knowledge in meaningful contexts. Understanding these biological and cognitive processes fundamentally changed how I define effective instruction.

The Unit 3 resources consistently reinforced that learning emerges through the interaction of multiple processes rather than a single cognitive event. Research on neuroplasticity demonstrated that repeated experiences physically strengthen and reorganize neural connections throughout adulthood (Losin & Losin, n.d.). Squire (2004) explained that memory depends on multiple interacting systems rather than a single storage location, while Byrne (2020) described how declarative and nondeclarative memories rely on different but interconnected neural mechanisms. Other resources further demonstrated that learning is influenced by the interaction of attention, perception, emotional processes, prior experience, metacognition, and cognitive load, all of which affect how effectively information is encoded, consolidated, retrieved, and ultimately transferred to new situations. Viewed together, these resources reinforced an important realization: effective instructional design is not simply about presenting information clearly. It is about intentionally designing learning experiences that support the interconnected processes through which meaningful learning develops.

At the same time, this module reminded me that neuroscience cannot provide a formula for designing effective instruction. Learners enter every learning environment with different experiences, motivations, prior knowledge, cognitive resources, and goals. Even thoughtfully designed instruction cannot guarantee learning because every learner constructs understanding differently. What instructional designers can control is the quality of the experiences they create and the opportunities learners have to attend, organize, practice, reflect, retrieve, receive feedback, and apply new knowledge over time. In practice, I would evaluate whether these design decisions improved learning by examining learners' ability to retrieve, transfer, and apply knowledge in meaningful situations rather than simply recall isolated facts. Recognizing this distinction reinforced that neuroscience should complement, rather than replace, established theories of learning and instructional design.

As I continue transitioning from classroom teaching and curriculum development into instructional design, I believe this lesson will have the greatest influence on my future work. Earlier in my career, I often judged successful instruction by how clearly I explained a concept or how engaged students appeared during a lesson. I now realize those indicators tell only part of the story. The more important question is whether the learning experience has been intentionally designed to help learners build durable knowledge they can retrieve, transfer, and apply long after instruction has ended. The greatest shift in my thinking was moving from designing instruction that communicates information to designing experiences that help learners construct durable knowledge. That realization has fundamentally changed how I think about instructional design, and I expect it will continue to shape every learning experience I design throughout my career.

Conclusion

This module significantly expanded my understanding of how neuroscience can inform instructional design. Rather than viewing learning and memory as isolated neuroscience concepts, I now see them as dynamic biological processes that instructional design seeks to support. Learning is not simply the result of presenting information clearly or engaging learners in interesting activities. Instead, meaningful learning develops as learners attend to new information, connect it to prior knowledge, encode meaningful representations, strengthen those representations through practice and reflection, consolidate learning over time, and successfully retrieve and apply knowledge in new situations. Understanding these interconnected processes has given me a much deeper appreciation for why many evidence-based instructional design principles are effective.

I believe the greatest shift in my thinking is recognizing that instructional design does not directly produce learning. Instead, instructional designers create the conditions that make meaningful learning more likely while learners actively construct knowledge through thoughtfully designed experiences. The role of the instructional designer is to intentionally design learning environments that support attention, organization, practice, feedback, reflection, retrieval, and transfer in ways that increase the likelihood of durable knowledge. At the same time, this module reinforced that neuroscience should complement, rather than replace, established theories of learning and instructional design. Understanding how the brain learns helps explain why many instructional strategies are effective, but successful instructional design still depends on thoughtful analysis of learners, contexts, instructional goals, and meaningful performance outcomes.

Reflecting back across this unit, I realize my thinking has shifted in a subtle but important way. Earlier in my career, I often judged successful instruction by the quality of the lesson I delivered. Today, I am much more likely to judge it by the quality of the learning experiences I design and the opportunities learners have to build, strengthen, retrieve, and apply knowledge over time. That perspective has fundamentally changed how I think about my role as both an educator and a future instructional designer. Rather than focusing primarily on communicating information, I now think more intentionally about creating experiences that help learners construct durable knowledge they can continue using long after instruction has ended. For me, that has become the most valuable lesson of this module. Neuroscience has not changed the goals of instructional design, but it has profoundly deepened my understanding of the learning processes those goals are intended to support.

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Use of Generative Artificial Intelligence

Overview

Generative artificial intelligence (AI) was used throughout this assignment as a collaborative planning, synthesis, evaluation, and revision tool rather than as the author of the final manuscript. I used AI to organize information across numerous course resources, identify recurring neuroscience themes, critique multiple drafts, and support an iterative revision process. However, all professional reflections, instructional design conclusions, interpretations of the neuroscience, and final writing decisions remained my responsibility. Throughout the assignment, I critically evaluated every AI-generated recommendation against the assigned course materials, previous instructor feedback, the assignment rubric, and the course expectations for responsible AI use before deciding whether it strengthened the manuscript.

Critical Use of Generative AI

Rather than asking AI to generate a paper from the assigned readings, I used it to support higher-order thinking throughout the assignment. Before any drafting began, I provided all assigned Unit 3 resources, including textbook chapters, research articles, TED Talks, videos, lecture notes, and supplemental resources, and asked AI to synthesize recurring ideas across those materials. AI then proposed several possible lesson structures based on overlapping themes rather than individual sources. I evaluated each recommendation and selected the three lessons that best reflected my own professional growth as an educator transitioning into instructional design rather than simply emphasizing neuroscience content.

Throughout the drafting process, AI also functioned as a critical reviewer. Multiple review passes evaluated the manuscript for neuroscience accuracy, instructional design implications, organization, depth of reflection, authenticity of voice, APA conventions, and alignment with both Dr. Hirumi's previous feedback and the current grading rubric. Rather than accepting suggestions automatically, I continually compared AI-generated recommendations against the assigned resources and my own understanding of the material before deciding whether revisions genuinely strengthened the paper.

Several recommendations were substantially revised or rejected because they overstated neuroscience findings, implied conclusions that extended beyond the assigned resources, introduced unnecessary technical language, or shifted the manuscript away from reflective instructional design thinking toward neuroscience summary. This continual evaluation required human judgment throughout the writing process and reinforced that AI-supported work still depends on careful analysis, verification, and informed decision-making.

Effective Use of Generative AI

AI supported this assignment through a structured, multi-stage workflow rather than a single prompt. The process included:

1. Synthesizing all assigned Unit 3 readings, videos, and supplemental resources.
2. Identifying recurring neuroscience themes across multiple sources.
3. Ranking several possible lesson topics based on evidence from the course materials.
4. Developing the manuscript one section at a time.
5. Conducting multiple review passes focused on neuroscience mechanisms, instructional design implications, breadth of reflection, authenticity of voice, APA conventions, and rubric alignment.
6. Completing a final comprehensive audit before submission.

This iterative workflow allowed each section to be independently refined while maintaining a cohesive narrative throughout the manuscript. Rather than using AI primarily as a writing tool, I used it as a structured learning and evaluation partner. Most interactions focused on synthesizing information, identifying patterns across sources, evaluating alignment with the assignment rubric, and critiquing successive drafts. Writing represented only one component of a broader reflective learning process.

Ethical Use of Generative AI

Throughout this assignment, I maintained responsibility for all substantive decisions, interpretations, and final wording. AI was not used to replace my own reflection, interpretation of the assigned materials, or professional judgment. Instead, it functioned as a collaborative thinking partner that supported organization, critique, and revision while leaving the intellectual ownership of the manuscript with me.

Every major claim included in the final paper was verified against the assigned course resources before being incorporated into the manuscript. Recommendations that did not accurately represent the neuroscience literature, conflicted with the instructional design principles emphasized throughout the course, or failed to reflect my authentic writing style were revised or discarded. Maintaining transparency about AI use while critically evaluating its output helped ensure that the completed manuscript accurately represented both the assigned resources and my own professional growth.

This assignment reinforced that generative AI is most valuable when it supports thoughtful learning rather than replaces it. Responsible AI use requires continual verification, reflection, revision, and human judgment. Throughout this project, I viewed AI as a collaborative thinking partner that enhanced my learning process while preserving academic integrity, transparency, and personal responsibility for the final submission.

Table 1. Representative AI Workflow Samples

Stage	Representative Prompt	AI Contribution	My Evaluation and Final Decision
Planning & Resource Synthesis	*Review all Unit 3 resources before writing. Identify recurring neuroscience themes, rank possible lesson topics, and explain which themes best support instructional design reflection.*	Synthesized common themes across textbook chapters, research articles, TED Talks, videos, and supplemental resources while proposing several possible organizational structures.	I evaluated each proposed lesson against the assignment objectives and selected the three that best reflected my own professional growth rather than simply emphasizing neuroscience content.
Manuscript Development	*Help me identify the most meaningful lessons I took away from this unit by asking me reflective questions about what challenged my thinking, what changed my perspective, and how the neuroscience connects to instructional design. Once we've identified my key ideas, help me organize for my refelction.*	Produced draft sections emphasizing neuroscience mechanisms, instructional design implications, and professional reflection.	I substantially revised every section to better reflect my classroom experiences, simplify overly academic language, strengthen instructional design implications, and ensure the manuscript reflected my own writing style and professional perspective.

Critical Evaluation & Revision	*Evaluate the completed manuscript using Dr. Hirumi's rubric, previous instructor feedback, and the philosophy of the course. Identify weaknesses before APA formatting and final submission.*	Performed multiple review passes focused on clarity, depth, breadth, neuroscience mechanisms, instructional design implications, authenticity, APA conventions, and rubric alignment.	I accepted recommendations that strengthened reflection, acknowledged the limitations of neuroscience, and improved organization while rejecting suggestions that overstated neuroscience findings, reduced readability, or did not accurately represent my professional thinking.

Reflection on AI Use

This assignment reinforced that AI is most valuable when it supports critical thinking rather than replaces it. Although AI efficiently synthesized large amounts of information, identified patterns across multiple resources, and provided structured feedback during revision, it could not determine what genuinely changed my thinking as an educator or what conclusions best represented my instructional design philosophy. Those decisions required personal reflection, professional judgment, and continual comparison against the assigned course resources.

Perhaps most importantly, this experience demonstrated that effective AI use extends beyond generating text. The greatest value came from using AI as a collaborative learning partner to organize information, challenge assumptions, critique successive drafts, and support an iterative design process. Interestingly, this workflow reflected many of the same instructional design principles discussed throughout this assignment. Like meaningful learning itself, the development of this manuscript depended on iterative feedback, continual refinement, retrieval of prior knowledge, reflection, and repeated evaluation. Ultimately, the quality of the final manuscript depended not on AI's ability to generate content but on my ability to critically evaluate its recommendations and determine which ideas genuinely strengthened my understanding of learning, memory, and instructional design.