EME6646 Summer B 2026
A01: How To Explain and Evaluate Brain Basics
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Reflecting on Brain Basics: How Neuroscience Deepened My Understanding of Learning and Instructional Design

Introduction

Entering Unit 1, I was interested in understanding how neuroscience could deepen my existing knowledge of psychology, learning, and instructional design. Although my undergraduate studies in psychology and years of classroom experience had provided a strong foundation in concepts such as cognition, memory, and motivation, I wanted to better understand how the brain's physiological processes influence learning and inform instructional design.

Byrne (2025) explains that neuroscience provides a biological foundation for understanding how the brain supports learning, memory, and cognition. Throughout Unit 1, I came to appreciate that neuroscience does not replace cognitive psychology, learning theory, or instructional design. Instead, it complements these disciplines by providing biological evidence that helps explain why many evidence-based instructional practices are effective (Byrne, 2025). This perspective shifted my thinking from viewing neuroscience as a separate field of study to recognizing it as an important source of evidence that strengthens educational decision-making.

Based on my reflection of Unit 1, this paper focuses on three lessons that most influenced my thinking: (1) neuroscience complements instructional design rather than replacing it, (2) neuroscientific evidence should be interpreted critically before informing educational decisions, and (3) effective instructional design creates the conditions that support meaningful learning. Together, these lessons strengthened my understanding of how neuroscience can inform educational practice while reinforcing the importance of thoughtful, evidence-informed instructional design.

Lesson 1: Neuroscience Complements Instructional Design

Byrne (2025a) explains that neuroscience provides a biological foundation for understanding attention, memory, and learning by examining how neurons communicate and how neural systems support cognitive processes. One of my most impactful takeaways from Unit 1 was recognizing that this biological perspective complements instructional design rather than replacing it. While neuroscience helps explain how learning occurs within the brain, cognitive psychology, learning theory, and instructional design provide the educational frameworks for translating that knowledge into effective teaching and learning practices. Together, these disciplines offer a more complete understanding of how people learn because they examine learning from different, yet complementary, perspectives.

This perspective also strengthened my appreciation for evidence-based instructional practices. Practices such as retrieval practice, timely feedback, and active engagement have been supported through educational research for a long time. Neuroscience does not replace these instructional strategies, instead, it helps explain why they are effective by providing insight into the biological processes that support attention, memory formation, and knowledge construction. Fairclough (2009) cautioned, however, that physiological evidence should inform educational decisions without being interpreted as direct proof of learning or instructional effectiveness. Rather than searching for isolated "brain-based" solutions, instructional designers should integrate neuroscientific evidence with established educational research when making design decisions.

As both an educator and an aspiring instructional designer, this lesson significantly broadened my perspective. I now better appreciate the importance of drawing from multiple sources of evidence when designing instruction rather than relying on any single discipline to explain how learning occurs. Neuroscience provides valuable biological insight, but it becomes most meaningful when combined with cognitive psychology, learning theory, and evidence-based instructional design principles. This integrated perspective will influence how I evaluate research and make instructional decisions throughout my future work as an instructional designer.

Lesson 2: Interpreting Neuroscientific Evidence

Rees (2011) explains that neuroimaging technologies such as EEG, MRI, fMRI, and PET have significantly advanced researchers' ability to study the brain by providing different types of information about brain structure and function. Each technology offers valuable insights into brain function, but each also has important limitations that must be considered when interpreting the results. A primary lesson I learned from Unit 1 was that these technologies provide valuable evidence about brain activity, but they do not directly measure learning itself. Instead, researchers must carefully interpret neuroscientific evidence within the context of well-designed studies while recognizing the strengths and limitations of each method.

This lesson also reinforced the importance of approaching neuroscience from multiple perspectives rather than relying on a single study or technology. Fairclough (2009) explains that physiological measures can provide valuable insights into human cognition, but emphasizes that those findings should be interpreted carefully rather than treated as direct evidence of complex psychological processes. This perspective helped me better appreciate why neuroscientific findings should be considered alongside cognitive psychology, learning theory, and instructional design research rather than being viewed as independent proof of effective educational practice. Together, Rees and Fairclough illustrate that understanding how people learn requires both scientific evidence and thoughtful interpretation.

As I reflected on these ideas, I realized that this lesson extends beyond neuroscience and applies to educational decision-making more broadly. As I continue developing as an instructional designer, I realize it can be tempting to look for definitive answers or "brain-based" solutions that promise to improve learning. Unit 1 reminded me that effective instructional decisions require critically evaluating research, recognizing the limitations of individual studies, and considering evidence from multiple disciplines rather than relying on any single source. Although my undergraduate studies in psychology and years of classroom experience provided a strong foundation, this unit reminded me that understanding how people learn is a lifelong pursuit rather than a destination. This perspective encourages me to approach future design challenges with greater curiosity, humility, and respect for the complexity of human learning.

Lesson 3: Designing Learning Experiences That Support Learning

Byrne (2025b) explains that learning depends on complex interactions among attention, memory, prior knowledge, and neural communication rather than simply being exposed to new information. One of the most meaningful lessons I took from Unit 1 was recognizing that neuroscience provides a biological explanation for many instructional design principles I had previously encountered through educational research and professional practice. Rather than changing my understanding of effective instruction, this lesson deepened it by helping me better understand why learner-centered design, meaningful engagement, formative feedback, and the activation of prior knowledge contribute to learning. Neuroscience strengthened my appreciation that effective instructional design is not simply about presenting accurate content, but about intentionally creating learning experiences that align with how people process, organize, and retain new information.

This perspective influenced how I will think about instructional design moving forward. Throughout both my classroom experience and graduate studies, I have learned to value instructional strategies supported by educational research. Unit 1 added another dimension by providing a neuroscientific perspective that helps explain the biological processes underlying many of those evidence-based practices. Instead of viewing neuroscience and instructional design as separate disciplines, I now see them as complementary perspectives that, together, support more informed instructional decisions. This deeper understanding reinforces the importance of designing learning experiences that are grounded in both educational research and an appreciation for the complexity of how people learn.

One instructional module I would like to redesign is my Algebra I lesson on exponential growth. Rather than beginning with formal procedures and equations, I would first engage students with authentic scenarios that encourage them to recognize patterns, make predictions, and connect new ideas to prior knowledge before introducing formal mathematical models. Students would then revisit those initial observations throughout the lesson as they refine their understanding through guided practice, discussion, and feedback. Although this redesign represents only a small change in sequencing, it reflects one of my greatest takeaways from Unit 1: effective instruction is not simply about delivering information: it is about intentionally designing experiences that help learners construct meaningful understanding.

Table 1. Applying Unit 1 Neuroscience Principles to an Algebra I Exponential Growth Module

Design Element	Current Approach	Revision Informed by Unit 1
Lesson Opening	Introduce exponential growth formulas and procedures through direct instruction.	Begin with an authentic scenario that activates prior knowledge before formal instruction. **Neuroscience:** Attention & prior knowledge. **ID Principle:** Learner-centered engagement.
Prior Knowledge	Brief review of prerequisite mathematical skills.	Explicitly connect prior experiences to new concepts. **Neuroscience:** Strengthens existing knowledge networks. **ID Principle:** Build on prior knowledge.
Student Learning Activities	Guided examples followed by independent practice.	Explore, discuss, justify, then practice. **Neuroscience:** Active processing. **ID Principle:** Conceptual understanding before procedural fluency.
Feedback	Feedback occurs primarily during guided and independent practice.	Embed formative feedback throughout the lesson. **Neuroscience:** Reinforces learning. **ID Principle:** Continuous formative assessment.
Role of the Teacher	Explain concepts and model procedures.	Facilitate inquiry and connect observations to formal concepts. **Neuroscience:** Supports engagement. **ID Principle:** Facilitative instruction.
Overall Design Goal	Develop procedural proficiency with exponential growth.	Build conceptual understanding before procedural fluency. **Neuroscience:** Meaningful learning. **ID Principle:** Evidence-informed design.

Conclusion

Reflecting on Unit 1 broadened my understanding of how neuroscience contributes to learning and instructional design. Byrne (2025) provided the biological foundation for understanding how people learn, while Rees (2011) and Fairclough (2009) reinforced that neuroscientific evidence should be interpreted thoughtfully and integrated with findings from cognitive psychology, learning theory, and instructional design rather than viewed in isolation. Together, these perspectives strengthened my appreciation for evidence-informed educational practice.

The three lessons discussed in this paper influenced not only what I learned about the brain, but also how I think about designing instruction. I now better appreciate that effective instructional design is not about finding isolated "brain-based" strategies. Instead, it requires integrating biological, cognitive, and educational perspectives to create learning experiences that are meaningful, engaging, and supported by evidence.

As I continue developing as both an educator and an instructional designer, I believe these lessons will influence how I evaluate research, design learning experiences, and support student understanding. Perhaps the greatest takeaway from Unit 1 is that neuroscience does not provide simple answers to complex educational questions, but it does provide an important scientific perspective for making more informed instructional decisions.

References

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Fairclough, S. H. (2009). Fundamentals of physiological computing. *Interacting with Computers, 21*(1–2), 133–145. https://doi.org/10.1016/j.intcom.2008.10.011

Rees, G. (2011). The scope and limits of neuroimaging. In *Brain Waves: Module 1: Neuroscience, society and policy* (pp. 13–18). The Royal Society. https://royalsociety.org/-/media/policy/publications/2011/4294974932.pdf

Disclosure of AI Usage to Identify, Explore, Synthesize

AI Tools Used and Purpose

Artificial intelligence (AI) tools were used throughout this assignment to support learning, organization, writing, and revision. The primary AI tool used was ChatGPT (OpenAI), which served as a collaborative thought partner during the development of this paper. NotebookLM (Google) was also used to create an audio overview of Unit 1 materials after I had completed my own review of the readings. The audio summary supported review and reinforcement of concepts but was not used as a substitute for reading the assigned course resources.

AI was intentionally used to support my learning and writing process rather than generate finished work. Throughout the assignment, I directed each stage of the process by determining the topics to explore, identifying the instructional module I planned to redesign, selecting which ideas to develop, and deciding which revisions to accept or reject. AI supported this process by helping locate relevant sections of assigned readings, organize information, compare ideas across sources, review alignment with the assignment rubric, and provide feedback on organization, clarity, and scholarly writing.

Critical and Effective Use of AI

AI was used as a research and writing support tool throughout this assignment, but I remained responsible for directing every stage of the process. I used it to help locate relevant concepts within the assigned readings, identify sections of course resources related to specific ideas, compare information across multiple sources, and organize information for further review. These interactions helped me navigate the Unit 1 materials more efficiently while allowing me to spend more time reading, evaluating, and reflecting on the content myself.

As my understanding of the material developed, I then used AI to evaluate the organization and clarity of my own writing, compare my work against the assignment rubric, identify areas that could be strengthened, and suggest alternative ways to organize ideas. AI suggestions were treated as starting points rather than final answers and were evaluated against the course readings, assignment rubric, instructor guidance, and my own professional experience before being incorporated into the paper. I reviewed every recommendation critically, accepted only those that aligned with the assignment expectations, and frequently rejected or revised suggestions before incorporating them into the paper. I did not accept AI suggestions automatically. Instead, I used several criteria for given recommendations throughout the writing and revision process:

- Strengthened the connection between neuroscience and instructional design?
- Reflected my professional interests and instructional design goals?
- Kept the redesign within the assignment's scope?
- Supported by credible course or scholarly sources?
- Improved the paper while remaining concise?

These questions guided every major revision and ensured that AI functioned as a collaborative design partner rather than an author. All final decisions regarding content, organization, citations, instructional applications, and written reflections remained my own.

Examples of AI-Supported Revision

AI supported several design decisions by helping me explore alternatives rather than generate content. One example involved selecting the three Unit 1 lessons that became the focus of my reflection. Rather than choosing the first concepts that came to mind, I used AI to discuss numerous ideas from the assigned readings, evaluate how they aligned with my professional interests and experience as a mathematics educator, and consider which topics would provide the strongest connection between neuroscience and instructional design. Through this iterative process, I selected the three lessons that I felt most meaningfully reflected both the course content and my own professional growth.

A second example involved refining how I presented the proposed redesign of my exponential growth instructional module. My initial drafts described the redesign only through narrative reflection. During the revision process, I explored multiple ways to communicate the proposed instructional changes before deciding to incorporate a concise comparison table. This format more clearly illustrated how specific neuroscience concepts informed individual instructional design decisions while remaining appropriate for the scope of the assignment. Throughout both examples, AI functioned as a collaborative design partner by helping me evaluate alternatives, while all final decisions regarding the selection, organization, and presentation of ideas remained my own.

Ethical Use, Privacy, and Responsibility

Throughout this assignment, I remained responsible for all learning, writing, and final decision-making. I personally read the assigned course materials, evaluated the accuracy of AI-generated suggestions, verified references and citations, and revised all sections to reflect my own understanding of Unit 1. AI was used to support exploration, organization, and revision, but it did not replace my own analysis, reflection, or academic judgment.

No confidential, proprietary, or personally identifiable information was entered into any AI system during the completion of this assignment. AI was used in a manner consistent with the expectations outlined for this course and with the goal of strengthening my understanding of the course content while maintaining academic integrity and transparency.