

## Chapter 2

# Neuro-Informed Learning: The Next Frontier

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### ABSTRACT

*As the epicenter for learning activities, the brain is the coordinator of all actions associated with collecting information, organizing it, storing it, and eventually re-organizing it for application in the real world. And yet, to date, little has been known about what happens within the brain during learning activities. We have operated based on a black box set of assumptions that results in researchers testing inputs and outputs but lacking a true understanding of what happens between those two endpoints. However, the fields of neuroscience and cognitive science, along with neuro-technology engineers, have simultaneously been studying the brain and developing apparatus that allow us to understand what is happening in the brain in real-time during learning. The implications of these capabilities and a deeper understanding of learning are boundless. Accordingly, this chapter will delve into four key areas: (1) research and theories, (2) cognitive readiness and comprehension, (3) neuro-technology data, and (4) the necessary evolution of teachers to facilitators.*

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## **INTRODUCTION**

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## **NEURO-COGNITIVE RESEARCH AND THEORIES**

### **What Have We Learned, and How Have We Organized That Information for Application to Learning Structures?**

#### **2000-2010**

Prior to 2010, the majority of neuro-informed learning research was supported by the Office of Naval Research (Walcutt, Horton, Jeyanandarajan, & Yates). The goal was to determine how the brain can intake, process, and apply information effectively and efficiently. Simultaneously, they supported the investigation of real-time cognitive monitoring during learning to determine how the brain operates during decision making under stress, learning complex systems, and applying knowledge in real-world settings. Ultimately, the hope was to define the most optimal pathway for information to enter working memory, travel to long-term memory, and then be retrieved, translated, and applied meaningfully. With greater insight into the brain and its functioning, real-time adjustments to training and education programs could be achieved. The combination of technology and learning science was beginning to make possible optimized learning experiences without over-taxing the human mind (Snyder, 1989; Eisenhardt & Zbaracki, 1992; Zsombok & Klein, 2014; Crichton & Flin, 2017; Flin, Salas, Straub, & Martin, 2017). However, early data, though promising, also included significant “noise.”

For example, in the early 2000s, one of the first large-scale programs in the area, the Augmented Cognition program, combined multiple different neuro and physiological sensors that helped define the art of the possible (Schmorrow & Kruse, 2002). The focus of this project was to improve the reliability of measuring learner state, workload, and cognitive changes during learning. While the significant series of studies moved the research forward, a number of concerns and issues were noted: 1) the technology

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