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Neuro-Infused Computing: Integrating Neuroscience Concepts into K–12 Computer Science Education

Dr. Bhargav Gangadhara, PhD
Huntington Learning Center, Huntersville, NC 28078, USA
Email: gangadharab@hlcmail.com

Abstract—The convergence of neuroscience and artificial intelligence (AI) is reshaping how we conceptualize cognition, learning, and computation. This paper introduces the Neuro-Infused Computing Framework (NICF)—a cross-disciplinary model piloted at Huntington Learning Center, Huntersville, NC. The program integrates neuroscience principles such as neural firing, learning plasticity, and memory networks into K–12 computer-science instruction. Findings suggest that embedding neuro-computational concepts within existing tutoring ecosystems cultivates deeper, future-ready computational literacy.

Keywords—Neuroscience, K–12 education, Computational thinking, Artificial intelligence, Cognitive literacy, STEM integration, Brain-inspired learning

I. Introduction

Since 1977, Huntington Learning Center has been a leader in individualized tutoring and test preparation, serving students nationwide both in-center and online. According to institutional data, Huntington students on average gain two or more grade levels in reading and math, with SAT score improvements exceeding 229 points and ACT score gains averaging 5.4 points. Each student begins with a Comprehensive Academic Evaluation, leading to a customized learning plan and continuous progress tracking.

II. Theoretical Foundation

Modern AI architectures such as deep neural networks owe their design to biological inspiration. Research by Hassabis et al. and Jha & Akhtar emphasizes how neuroscience informs machine learning through representations of memory, attention, and plasticity. However, K–12 education has not systematically exploited these parallels.

III. Program Context: The Huntington Model as a Platform

Huntington's instructional ecosystem provided an ideal platform for the NICF pilot due to the following factors:

Feature	Huntington Implementation	Neuroscience Analogy
Personalized Evaluation	Diagnostic academic testing	Baseline neural activation
Data-driven Feedback	Continuous progress reports	Synaptic reinforcement
Adaptive Instruction	Individualized learning paths	Neuroplastic adaptation
Network Scalability	300+ U.S. centers	Distributed neural network

Table 1. Comparison between Huntington Learning Model and Neural Mechanisms

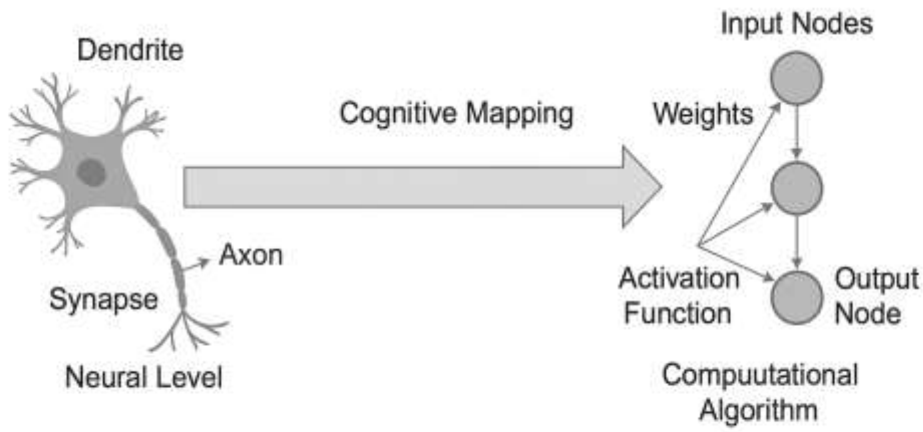

Fig. 1. Neuro-Infused Computing Framework mapping between biological and compuitatonal domains

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IV. Curriculum Framework: Neuro-Infused Computing Model

The NICF curriculum was divided into three modules focusing on neural computation, cognitive circuits, and ethical AI design.

V. Pilot Implementation at Huntington Huntersville

The Huntersville pilot cohort (n = 48, grades 7–10) participated over six weeks within regular tutoring hours. Educators received professional development on brain-based analogies and cognitive scaffolding.

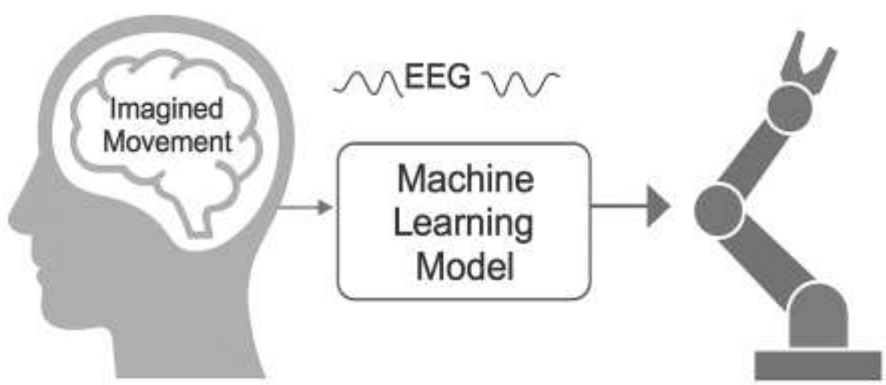

Fig. 2. Neuro-Infused Computing application example: brain-controlled robotic arm

Fig. 2. Comparative improvement across key learning domains.

VI. Discussion

Integrating neuroscience into computer-science instruction provides several pedagogical benefits including cognitive resonance, ethical awareness, scalability, and data alignment.

VII. Conclusion and Future Work

The Neuro-Infused Computing Framework represents a synthesis between biology and computation. By piloting the model within the Huntington Learning Center ecosystem, this study demonstrates that neuroscience-aligned instruction can amplify both academic performance and cognitive engagement beyond conventional tutoring outcomes.

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