

TRANSFORMATIVE APPROACHES IN PRIMARY MATHEMATICS TEACHING: A PRACTICAL RESEARCH STUDY GROUNDED IN DEEP LEARNING PRINCIPLES

A P C V Gopala Rao¹, D Sankara Rao²

^{1,2}Asst. Professor, Dept. of BS&H, Chalapathi Institute of Technology, Guntur-522016, AP, India.

ABSTRACT

In the dynamic landscape of the knowledge economy, surface-level learning no longer suffices to meet the challenges of the times. The emergence of deep learning, a pedagogical approach emphasizing critical thinking, information integration, communication, collaboration, and constructive reflection skills, addresses this need. This paper explores the fusion of deep learning theories with problem-solving methodologies, aiming to cultivate essential skills in students. The fundamental elements of deep learning theory are integrated into the design system of problem-solving teaching, specifically tailored to the context of elementary school mathematics. The result is a novel problem-solving teaching model grounded in deep learning principles. This model not only enhances students' proficiency in problem-solving but also serves as a platform for the development of core literacy through the acquisition of deep learning skills.

Keywords- Deep Learning, Problem-Solving Teaching, Critical Thinking, Information Integration, Communication, Collaboration, Constructive Reflection, Elementary School Mathematics, Pedagogical Model.

1. INTRODUCTION

The concept of deep learning, originally proposed by American psychologists Ference Marton and Roger Saljo in the mid-1950s, gained systematic attention in 2005 when Professor Li Jiahou's research team introduced it. Deep learning emphasizes the consideration of both explicit subject knowledge and implicit thought and culture when building educational resources. This underscores the cultural characteristics inherent in deep learning, establishing its intrinsic connection to teaching subject culture. Current research in deep learning primarily focuses on teaching (learning) models and strategies, environment design, and resource construction.

However, there is a noticeable gap in research concerning microscopic deep learning strategies and the recreation of classroom context within the realm of deep learning. These aspects are crucial for guiding frontline teachers and facilitating student learning in primary and secondary schools. Deep learning stands as a novel integration and growth point for mathematical culture classroom teaching. This paper aims to explore the structure of elementary school mathematics classroom teaching by delving into microscopic deep learning strategies, resource development, and the recreation of classroom context. The goal is to contribute new perspectives on cultivating moral and core literacy in the field of mathematics.

2. INTRODUCTION TO DEEP NEURAL NETWORKS

2.1. Deep Learning Model- The deep learning model, also referred to as the deep neural network model, stands as a classical nonlinear machine learning model inspired by the neural networks found in the biological brain. This model's design draws inspiration from continuous explorations into the mechanisms of the biological brain, revealing the neuronal cell as its basic unit. In Figure 1, we observe the basic structure of neuronal cells, where each cell differentiates into dendritic and axonal structures upstream and downstream, respectively. The transmission of nerve signals involves the release of chemicals from the upstream neuron cell, captured by the dendritic structure as an input signal. The cell processes this input signal and transmits it to the downstream neuron cell through the axon by releasing it.

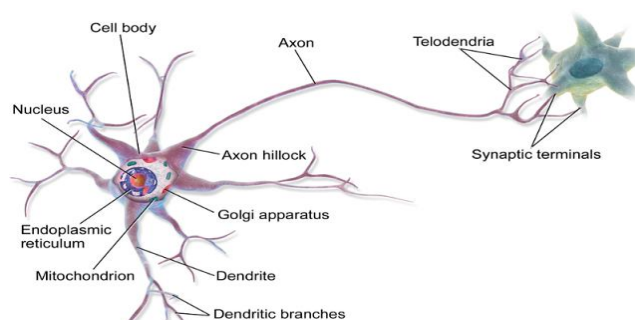


Figure 1: Neuronal cells

Key points of difference

Model Building: Machines lack the ability to independently build models, unlike humans in educational deep learning.

Knowledge Constructs: Each student may have different knowledge constructs when faced with new knowledge.

Implementation Process: While the process is roughly similar, computer science relies on vast data for model building, whereas in pedagogy, teachers focus on activating students' knowledge without excessive practice.

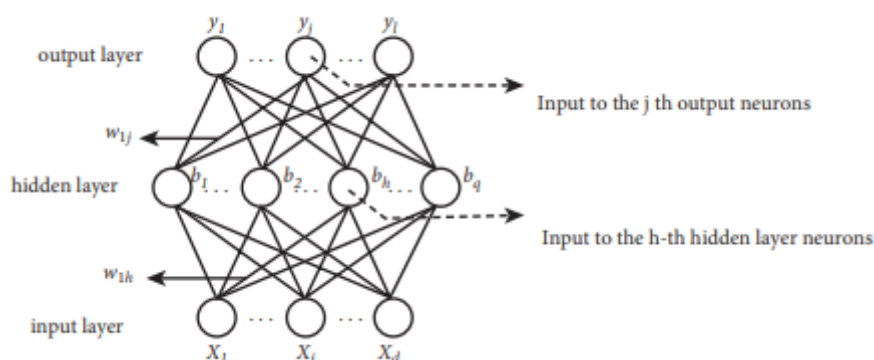


Figure 2: Neuronal Model

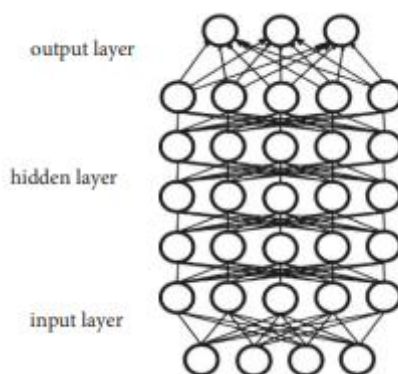


Figure 3: Deep Learning Models with multiple Hidden Layers

3. TEACHING PRACTICES OF ELEMENTARY SCHOOL MATHEMATICS BASED ON DEEP LEARNING

The teaching practice of deep learning in elementary school mathematics is centered around the core subject content. It involves creating contexts conducive to deep learning to foster students' overall development.

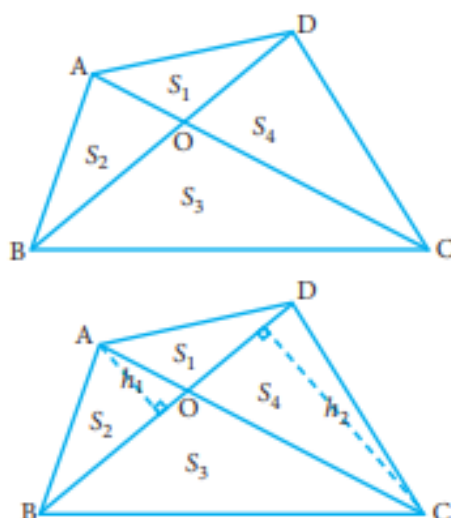


Figure 4: Butterfly theorem for arbitrary parallelograms

3.1 Assigning Learning Tasks:

The purpose of assigning learning tasks is to empower learners to engage in independent learning. These tasks should align with teaching objectives while being appropriately challenging for students. Learning tasks can be mathematical knowledge itself or stem from real-life situations, presenting rich and complex teaching contexts crafted by the teacher.

3.2 Active Inquiry and Activation of Knowledge Elements:

This phase involves actively exploring and activating knowledge elements. Students are encouraged to inquire, question, and delve into the subject matter. The goal is to stimulate curiosity and engagement, fostering a deeper understanding of mathematical concepts.

3.3 Acquiring the Essence of Mathematics:

Deep learning in mathematics involves going beyond surface-level understanding and acquiring the essence of mathematical concepts. Students are encouraged to grasp the fundamental principles and underlying structures, promoting a profound comprehension of the subject.

3.4 Consolidating Connections Between Knowledge Elements:

The consolidation phase focuses on reinforcing the connections between different knowledge elements. Students are guided to see the interrelationships between various mathematical concepts, fostering a holistic view of the subject.

3.5 Summarizing the Learning Process:

The final step involves summarizing the learning process. Students reflect on what they've learned, how they've approached problem-solving, and the connections they've made. This reflective practice enhances metacognition and deepens understanding.

This teaching approach aligns with the principles of deep learning, emphasizing active exploration, contextualized learning, and the development of a comprehensive understanding of mathematical concepts.

Table 1: Deep Learning in the Two Domains

	Deep learning in computers	Deep learning in teaching science
Model	Input layer (initial data)	Challenging learning tasks
	Hidden layer (transmitting between neurons in the brain, processing information, contains multiple layers of neurons)	The existing knowledge in the cognitive structure
	Output layer (output-processed information) Inspection model	The essence of mathematics Persistent evaluation
Goal	Get the machine to be able to learn	Promote students to have the ability of deep learning, independently explore the connection between knowledge, from "learn" to "learn" can "learn"
Method	Use a large amount of training data to determine the model	Under the guidance of teachers, students complete tasks, activate more knowledge elements, and independently explore the relationship between knowledge elements
Keynote	Training process, neuronal activation, and determination of the weights	Students' thinking process, the activation of knowledge element and the relationship between knowledge element

4. TEACHING STRATEGIES FOR ELEMENTARY SCHOOL MATHEMATICS BASED ON DEEP LEARNING

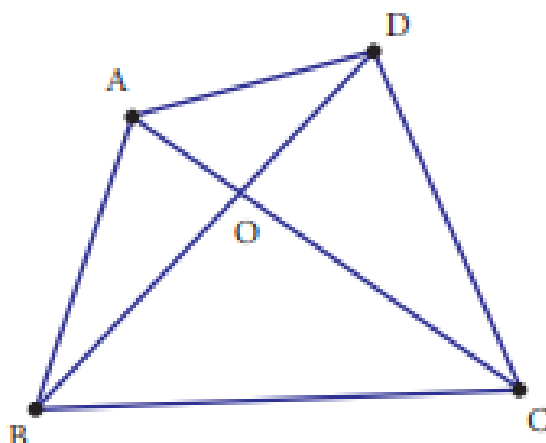


Figure 5: Any quadrangle "butterfly theorem" exercise diagram

4.1 Stimulating Positive Emotional Experiences and Cultivating Interest in Mathematics Learning

Teachers play a crucial role in fostering positive emotional experiences and cultivating students' interest in mathematics learning. Effective and positive communication helps build empathy between teachers and students. By leveraging emotions, teachers can create an environment where students feel motivated and engaged in the learning process.

4.2 Contextualizing Learning Tasks in Real-Life Situations

Contextualizing learning tasks in real-life situations enhances the relevance of mathematical concepts. Teachers design tasks that connect mathematical knowledge to practical, everyday scenarios. This approach not only makes learning more meaningful for students but also encourages them to apply mathematical principles in various contexts.

4.3 Encouraging Collaborative Learning

Deep learning is often a collaborative process. Teachers encourage collaborative learning environments where students can work together, discuss ideas, and solve problems collectively. This promotes not only a deeper understanding of mathematical concepts but also the development of teamwork and communication skills.

5. CONCLUSION

Deep learning, as a prominent area of research and practice in the field of learning science, holds significance in understanding how individuals learn and achieve meaningful learning outcomes. The primary objective of deep learning in the context of mathematics education is to facilitate students in acquiring fundamental mathematical knowledge, exploring connections between various knowledge domains, comprehending the essence of mathematics, and progressing from mere "learning" to true "understanding."

In conclusion, the successful implementation of deep learning principles in mathematics education requires a thoughtful and adaptive approach from teachers. By recognizing the evolving nature of students' learning processes, promoting long-term engagement, and nurturing independent learning habits, educators can contribute to the transformation of students from passive learners to active participants in the realm of mathematics.

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