SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 12 | December 2024 - Peer Reviewed Journal

A MODEL OF COGNITIVE MANIPULATION: A CONSCIOUS EFFORT TO INCREASE THE EFFICACY OF THINKING AND KNOWLEDGE CONSTRUCTION

Kinjal Chakraborty[1], Dr. Abhijit Halder[2]
[1]Student, Department of Education, University of Kalyani, Nadia, W.B, 741235
[2]State Aided College Teacher, Dept. of Education, Plassey College, Plassey, Nadia, WB, 741156

ABSTRACT

This paper presents a useful model of cognitive manipulation, combining the information processing paradigm, radical constructivism and various theories to offer a nuanced perspective on how learners create and restructure knowledge. The age of 21st century facilitates the expansion of knowledge and a deliberate practice of applied epistemology.

The model posits that learners actively engage with cognitive tools to make sense of new information and experiences through continuous reconstruction. The model highlights two types of cognitive manipulation—linear (convexing) and nonlinear (concaving)—and identifies three hierarchical levels of cognitive manipulation: substructuring, conceptualizing, and contemplating. These processes collectively shape how individuals build complex cognitive structures through learning.

KEYWORDS: *Cognitive Manipulation, Substructuring, Conceptualizing, And Contemplating, Applied Epistemology.*

INTRODUCTION

Cognitive manipulation refers to how individuals use cognitive processes to engage with, alter, and construct their knowledge. This process is inherently dynamic, continuously evolving as new information is processed and integrated into existing cognitive structures. This paper proposes a model of cognitive manipulation that blends concepts from two influential learning theories: the information processing paradigm and radical constructivism.

Information processing theory, grounded in cognitive psychology, focuses on how individuals process, store, and retrieve knowledge (Atkinson & Shiffrin, 1968). Radical constructivism, influenced by the works of Piaget and von Glasersfeld, emphasizes the active role of the learner in constructing meaning from their experiences and suggests that knowledge is not passively received but actively created by the learner (Piaget, 1970; von Glasersfeld, 1995). This integrated model offers a comprehensive framework for understanding the continuous restructuring of knowledge and experiences that occurs throughout the learning process.

COGNITIVE MANIPULATION

Linear and Nonlinear Thinking

Linear Manipulation (Convexing)

Linear manipulation, also referred to as convexing, involves a more straightforward approach to thinking. Learners focus on identifying a specific, often predetermined, solution or answer. In convexing, thinking follows a logical sequence where each step naturally leads to the next. It is typically used for tasks that have clearly defined problems and solutions, such as arithmetic calculations or factual recall. Convexing promotes efficiency and accuracy in solving problems where the solution is known or can be determined through a direct application of existing knowledge (Sweller, 2011).

Linear manipulation is fundamental in contexts that require procedural knowledge and the application of structured rules, such as mathematics, technical fields, or problem-solving with well-defined constraints. This form of thinking enables learners to apply their existing knowledge to find solutions in a linear, cause-and-effect manner.

Nonlinear Manipulation (Concaving)

Nonlinear manipulation, or concaving, takes a broader, more exploratory approach to problem-solving. Learners engage with multiple possible solutions, considering various perspectives, alternatives, and scenarios. This form of thinking encourages divergent thinking and creative problem-solving, where the emphasis is on the process of exploration rather than finding a single correct answer. Nonlinear manipulation is central to tasks that require innovation, critical thinking, and the synthesis of diverse ideas, such as designing solutions to complex problems or analyzing abstract concepts (Guilford, 1956).

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 12 | December 2024 - Peer Reviewed Journal

Concaving promotes cognitive flexibility and the ability to integrate new information with existing knowledge in novel ways. This form of thinking aligns with constructivist principles, where learners draw on their prior experiences and perspectives to create new understanding. It emphasizes the multidimensional nature of cognitive processes and encourages learners to explore various pathways to a solution rather than adhering to a fixed sequence.

Theoretical Underpinnings

The model of cognitive manipulation draws on two distinct yet complementary theoretical frameworks: information processing and radical constructivism. Information processing theory portrays the mind as a system that receives inputs, processes them, and produces outputs through various cognitive processes such as attention, encoding, retrieval, and memory (Baddeley, 2000). In contrast, radical constructivism presents knowledge as the outcome of the learner's active engagement with the world, where learning is viewed as an ongoing process of constructing, reorganizing, and refining mental models (von Glasersfeld, 1995).

The stages of substructuring, conceptualizing, and contemplating align well with several psychological theories related to cognitive development, learning, and expertise acquisition. Here are some key psychological theories that correlate with these stages:

1. Piaget's Theory of Cognitive Development

Piaget's stages of cognitive development (1970) provide a framework for understanding how children move from simple to more complex forms of thinking. The substructuring phase aligns with Piaget's sensorimotor and preoperational stages, where children acquire foundational knowledge and basic concepts. As learners progress, they move into the concrete operational and formal operational stages, which correspond to the conceptualizing and contemplating stages. Piaget emphasized how cognitive structures (schemas) evolve through assimilation (fitting new information into existing frameworks) and accommodation (adjusting frameworks to fit new information). These processes are foundational for developing the sophisticated, abstract reasoning seen in the later stages of learning.

2. Vygotsky's Sociocultural Theory

Lev Vygotsky's concept of the Zone of Proximal Development (ZPD) (1978) is crucial to understanding the process of moving through stages of learning. Vygotsky suggested that learners develop cognitive skills through interactions with more knowledgeable individuals (teachers, peers) within the ZPD. The substructuring stage aligns with initial learning within the ZPD, where learners acquire foundational knowledge through scaffolding. As learners gain more independence, they enter the conceptualizing stage, where they organize and relate information on their own. Eventually, through reflection and critical thinking (as seen in contemplating), learners move to more advanced stages of problem-solving, with less need for external scaffolding.

3. Sweller's Cognitive Load Theory

John Sweller's Cognitive Load Theory (1988) is particularly relevant to the substructuring and conceptualizing stages. In the substructuring phase, learners are focused on acquiring foundational knowledge, and cognitive load is relatively low because they are dealing with simpler concepts. As learners progress to conceptualizing, cognitive load increases because they must organize and connect pieces of information, which may lead to a higher demand on working memory. Sweller's theory suggests that instructional strategies should minimize extraneous cognitive load while fostering germane load that supports the development of schemas, which aligns with the transition from substructuring to conceptualizing.

4. Anderson's ACT-R Theory

John Anderson's Adaptive Control of Thought—Rational (ACT-R) theory (2005) explains how knowledge is organized in the brain and processed during learning. The theory posits that new information is first processed in a declarative form (similar to substructuring), and over time, with practice, it becomes proceduralized (similar to conceptualizing). As learners engage in deliberate practice and reflection, their knowledge becomes increasingly automated, allowing for more advanced problem-solving and critical thinking (contemplating). Anderson's theory emphasizes the importance of practice and repetition in developing expertise, which corresponds with the contemplating phase, where learners refine and adjust their cognitive frameworks.

5. Ericsson's Deliberate Practice Theory

K. Anders Ericsson's theory of deliberate practice (2006) emphasizes the role of focused, structured practice in developing expertise. Ericsson argues that experts are made, not born, through years of deliberate practice. This aligns with the contemplating stage, where learners reflect on their learning processes, engage in critical thinking, and refine their skills through ongoing practice. The conceptualizing stage corresponds with the learner's ability to apply previously learned material in more complex ways, which is also a key component of deliberate practice.

6. Metacognition and Self-Regulated Learning (Zimmerman)

Barry Zimmerman's work on self-regulated learning (2002) is particularly relevant to the contemplating phase, where learners become more reflective and intentional about their learning. Metacognitive skills—such as planning, monitoring, and evaluating

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 12 | December 2024 - Peer Reviewed Journal

one's learning—are central to the conceptualizing and contemplating stages. Zimmerman highlighted how self-regulated learners set goals, monitor their progress, and adjust strategies as needed. This kind of metacognitive reflection allows learners to move beyond rote memorization (as seen in substructuring) to a deeper understanding and mastery of material (as seen in conceptualizing and contemplating).

7. Bloom's Taxonomy

Bloom's Taxonomy (1956) provides a hierarchy of cognitive skills, ranging from lower-order skills (such as remembering and understanding) to higher-order skills (such as analyzing, evaluating, and creating). The substructuring phase aligns with the initial stages of Bloom's taxonomy, where learners focus on remembering and understanding basic facts. The conceptualizing stage corresponds to the higher-level skills of analyzing and applying, while the contemplating phase involves evaluating and creating, as learners critically assess their knowledge and construct new insights.

8. Information Processing Theory

The Information Processing Theory (Atkinson & Shiffrin, 1968) explains how information is encoded, stored, and retrieved from memory. The substructuring phase aligns with the initial encoding and storage of information in long-term memory. As learners move to the conceptualizing phase, they begin to organize and make sense of this information, forming more complex mental models. In the contemplating phase, learners engage in deeper processing by retrieving and manipulating information from memory, refining their cognitive structures, and applying them in new contexts.

By integrating these theories, the model suggests that learners are not passive recipients of information but active participants in a continuous process of cognitive manipulation. This manipulation is influenced by how learners approach problems and how they conceptualize and reflect upon the knowledge they acquire.

The stages of substructuring, conceptualizing, and contemplating align with several psychological theories that provide insights into how knowledge is acquired, organized, and applied. The theories of Piaget, Vygotsky, Sweller, Anderson, Ericsson, Zimmerman, Bloom, and information processing all offer complementary perspectives on the cognitive processes that underlie learning at each of these stages. Together, they help explain how learners move from basic knowledge acquisition to advanced critical thinking and problem-solving.

Levels of Cognitive Manipulation

The model proposes a three-level framework for cognitive manipulation: substructuring, conceptualizing, and contemplating. These levels represent stages of cognitive development, each building upon the previous one, resulting in increasingly sophisticated cognitive structures.

Level 1: Substructuring

Substructuring is the foundational stage of knowledge acquisition. It refers to the process of building a basic cognitive framework that supports further learning. At this level, learners engage in the initial construction of mental models and schemas, which are later refined and expanded as they encounter new information. Substructuring involves the assimilation of new knowledge and the accommodation of existing schemas to integrate that knowledge effectively (Piaget, 1970).

In this stage, learners acquire core concepts and skills that form the basis for more advanced learning. Substructuring is critical in subjects that require a strong foundation, such as language learning, mathematics, or science. It sets the stage for deeper understanding by ensuring that learners have the essential building blocks of knowledge.

Substructuring forms the essential base upon which further learning and cognitive development are built. It involves the initial creation of cognitive frameworks that learners use to process and organize information. This stage primarily focuses on the assimilation of new knowledge into existing mental structures (schemas) while also accommodating those structures to integrate new experiences (Piaget, 1970). As such, it plays a foundational role in the construction of knowledge, laying the groundwork for more complex learning. For example, when a student first learns basic mathematical operations or vocabulary in a new language, they are engaging in substructuring. These core concepts and skills serve as the building blocks for more advanced learning and problem-solving.

In this phase, learners focus on acquiring essential facts and concepts without necessarily understanding the relationships between them. In disciplines like mathematics, language learning, or natural sciences, mastering these foundational elements is critical for progressing to more intricate material (Sweller, 1988). Substructuring is pivotal for learners as it ensures that they have a solid knowledge base upon which higher-level cognitive processes can be applied. This stage aligns with Piaget's (1970) concept of schema formation and is essential for the gradual development of more complex intellectual abilities.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 12 | December 2024 - Peer Reviewed Journal

Level 2: Conceptualizing

Conceptualizing represents a deeper understanding of knowledge. It involves the ability to grasp the meaning and relationships between concepts, allowing learners to move beyond rote memorization to a more nuanced comprehension of material. At this level, learners begin to synthesize and organize information in ways that reveal underlying structures and patterns.

Conceptualizing is essential for the development of higher-order cognitive skills, such as critical thinking, analysis, and synthesis. It involves both declarative knowledge (facts and information) and procedural knowledge (how to apply concepts) (Anderson, 2005). This stage also emphasizes the importance of metacognitive strategies, where learners reflect on their thinking processes and adjust their cognitive approaches to improve understanding. Once the basic knowledge has been acquired through substructuring, learners enter the conceptualizing stage, where they begin to build more sophisticated cognitive models. Conceptualizing involves not only understanding isolated facts but also recognizing and organizing relationships between concepts. At this level, learners move beyond simple memorization to comprehend the underlying principles and structures that govern the material (Anderson, 2005). The transition from concrete to abstract thinking marks this stage, as learners start to see how different pieces of information fit together and influence one another.

This stage emphasizes the development of higher-order cognitive abilities such as critical thinking, analysis, and synthesis. It is where declarative knowledge (facts and information) meets procedural knowledge (the ability to apply those facts). For instance, in mathematics, learners may move from understanding basic arithmetic operations to conceptualizing how these operations work together in algebraic equations. In science, students may progress from learning basic concepts about biology to grasping the interconnectedness of biological systems. Metacognitive strategies also emerge at this stage, where learners are able to reflect on their learning processes and adjust their approaches for deeper understanding (Anderson, 2005). This awareness of one's cognitive processes enables learners to assess and refine their understanding of concepts and improve their problem-solving techniques.

Level 3: Contemplating

Contemplating represents the highest level of cognitive manipulation in the proposed model. It involves reflective thinking, metacognition, and the evaluation of one's own cognitive processes. Learners who engage in contemplating examine their thinking strategies, question assumptions, and explore alternative viewpoints. This reflective process leads to deeper insights and a more sophisticated understanding of complex concepts.

Contemplating requires learners to engage in deliberate practice, fostering skills such as problem-solving, creativity, and self-regulation (Zimmerman, 2002). It is a crucial stage for developing expertise, as it allows learners to refine their cognitive processes and develop a deeper, more flexible understanding of the material. The highest level of cognitive manipulation is represented by contemplating, a stage in which learners engage in metacognitive reflection, critical evaluation, and thoughtful analysis of their own cognitive processes. Contemplating requires learners to actively consider the assumptions underlying their thoughts, challenge existing perspectives, and explore alternative ways of thinking about concepts (Zimmerman, 2002). It is in this phase that learners refine their cognitive frameworks and develop the ability to approach problems with greater flexibility, creativity, and depth.

Reflective thinking is at the core of contemplating, and this stage often involves deliberate practice and problem-solving to master complex concepts. Learners at this level are not only absorbing information but critically engaging with it, making adjustments to their learning strategies as needed. They begin to internalize not just the "what" but also the "how" and "why" of the material they are studying, which is crucial for expertise development (Ericsson, 2006). By fostering skills such as self-regulation and the ability to adapt cognitive approaches, contemplating helps learners achieve mastery and creative problem-solving in their fields.

For example, an advanced student of literature might engage in contemplating by critically analyzing the themes, characters, and stylistic elements of a novel, considering multiple interpretations, and refining their personal critical framework. In scientific inquiry, a researcher might engage in contemplating by questioning existing hypotheses, designing new experiments, and rethinking traditional methodologies. In this stage, learners not only understand concepts but also engage with them on a deeper, more personalized level, pushing the boundaries of their knowledge and skills (Zimmerman, 2002).

Implications for Learning

The model of cognitive manipulation has significant implications for educational practice. It suggests that learning is not merely a passive process of receiving information but an active, dynamic process of cognitive restructuring. By highlighting both linear and nonlinear thinking, the model underscores the importance of providing learners with diverse learning experiences that encourage both accuracy and creativity.

Educational environments should incorporate opportunities for both convexing (structured, linear problem-solving) and concaving (open-ended, nonlinear exploration). Tasks that require learners to engage in both types of thinking can foster a more balanced

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 12 | December 2024 - Peer Reviewed Journal

cognitive development, supporting learners in mastering foundational knowledge while also promoting creative problem-solving and critical reflection. Furthermore, encouraging reflection and metacognition at all levels of learning can help learners become more self-aware and effective in their learning processes.

CONCLUSION

This model of cognitive manipulation provides a comprehensive framework for understanding how learners engage with knowledge. By integrating the information processing paradigm and radical constructivism, the model offers insights into the continuous, active process of learning. Through the stages of substructuring, conceptualizing, and contemplating, learners develop increasingly complex cognitive structures that allow them to manipulate knowledge in both linear and nonlinear ways. This model has important implications for educational practices, suggesting the need for a learning environment that fosters both foundational knowledge acquisition and the development of higher-order cognitive skills.

REFERENCES

1. *Anderson, J. R. (2005). Cognitive psychology and its implications (6th ed.). Worth Publishers.*
2. *Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In Spence, K. W., & Spence, J. T. (Eds.), The psychology of learning and motivation (Vol. 2, pp. 89–195). Academic Press.*
3. *Baddeley, A. D. (2000). The episodic buffer: A new component of working memory? Trends in Cognitive Sciences, 4(11), 417–423.*
4. *Guilford, J. P. (1956). The structure of intellect. Psychological Bulletin, 53(4), 267–293.*
5. *Piaget, J. (1970). The science of education and the psychology of the child. Viking Press.*
6. *Sweller, J. (2011). Cognitive load theory. Psychology of Learning and Motivation, 55, 37–76.*
7. *Glasersfeld, E. (1995). Radical constructivism: A way of knowing and learning. The Falmer Press.*
8. *Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. Theory into Practice, 41(2), 64–70.*