مركز البيان للدراسات والتخطيط
Al-Bayan Center for Studies and Planning

Opinion piece

The Need to Propose an Integrated Learning Theory for Knowledge Building in Smart Environments

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Al-Bayan Center pursues its vision by conducting independent analysis, as well as proposing workable solutions for complex issues that concern policy-makers and academics.

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Introduction

In an era marked by the increasing use of generative artificial intelligence (GenAI), future education will be more open, individualized, and integrated with smart technology. However, it will require a humanistic and ethical framework that preserves critical and innovative thinking skills, identity, and human relationships.

Therefore, current traditional learning theories are limited in their ability to explain how learners interact to create and process information in smart learning environments. Although traditional theories, such as behaviorism, cognition, and constructivism, have provided great value to humanity, they are not designed to keep pace with the complexity imposed by AI-powered, self-adapting learning systems, as they originated in a purely human context (1, 7, 2).

With the increase of AI tools at the core of the educational process, such as intelligent tutoring systems, predictive learning analytics, and instant feedback mechanisms, the need has emerged for a new theoretical framework that reframes them and redefines how knowledge is constructed, personalized, and applied in digital social environments (5). Hence, the concept of integrated learning theory.

Cukurova concluded his study by “calling for a broader approach to AI directed toward self-learning that goes beyond considerations related to AI design and development

and includes educating people about AI and creating modern educational systems to remain relevant in a world of ubiquitous AI" (1).

Integrated learning theory assumes that learning is not a linear process of inputs and outputs, but rather a circular and adaptive path that begins with multi-layered AI tools as an interactive partner in knowledge construction and moves through stages starting with attention, cognitive processing, knowledge synthesis, analysis, application, evaluation, feedback, and finally behavior modification.

The newly developed theory is based on the concept of Basic Building Blocks of Cognition (BBBC) as a foundation for knowledge construction in AI-enhanced learning environments. In learning, the concept of "cognitive synthesis" refers to a higher-level cognitive development in which learners engage their prior knowledge, new evidence, and life concepts to create new concepts or values, as opposed to memorization or superficial understanding. Deep learning enhances high-level intellectual synthesis, enabling learners to go beyond memorization or simple understanding.

As some researchers have pointed out, the integrative approach plays a crucial role in encouraging deep learning, critical thinking, and building transferable and applicable awareness. The term "collaborative generative intelligence" defines the learner as not merely a recipient of knowledge,

but rather as a collaborative learning process with GenAI tools to construct knowledge.

An integrated learning theory is formed on this intellectual foundation, arguing that “cognitive synthesis” is not merely a thought process, but rather a recurring learning path shaped through continuous collaboration (GenAI-human interaction). Through a series of steps, the learner engages in an integrated synthetic cycle similar to biological adaptation mechanisms and digital personalization.

Accordingly, this article demonstrates the urgent need to propose a hybrid learning theory as a comprehensive framework for a deeper understanding of how individuals interact with intelligent systems to construct knowledge, providing a theoretical and practical prototype applicable in diverse classrooms (6, 3, 4).

The Current Problem

Despite significant advances in traditional learning theories over the past decades, current theoretical frameworks are still unable to keep pace with the complexities imposed by artificial intelligence systems, digital environments, tailored education, and big data. Traditional theories, such as behaviorism, cognition, and constructivism, offer valuable insights into educational practices, but they do not provide a comprehensive explanation of how knowledge is dynamically constructed and modified in AI-enhanced learning environments.

The increasing reliance on GenAI tools in education, such as adaptive learning systems, intelligent platforms, and learning analytics, may overwhelm existing theories in terms of cognitive or educational justifications. This is because these theories do not adequately consider real-time information processing, the role of mental algorithms in reasoning, cognitive response mechanisms, or the role of non-human agents such as intelligent technology in modeling the experience of knowledge.

Accordingly, this article highlights a theoretical and applied gap in learning research: the lack of an integrated prototype that combines traditional educational philosophies with the capabilities of AI-enhanced learning environments. Therefore, there is an urgent need to propose a unified theoretical framework that not only describes how digital learners interact

with stimuli and construct knowledge but also describes how information is synthesized across interconnected cognitive, social, and technological levels.

Integrated learning theory offers a solution to this current gap. In AI-enhanced environments, this theory reinterprets learning as a cyclical system comprising seven integrated stages to understand the learning process. This novel theory aims to bridge the gap between the evolving nature of education in the age of AI and traditional pedagogical understanding.

A Critical Analysis of Conventional Learning Theories

Weaknesses of Behavioral Theory: First, it focuses on external behavior and neglects internal mental processes such as understanding, learning, or knowledge formation. Second, it makes it difficult to transfer learning to new situations due to the reinforcement of a specific situation. Third, it also ignores individual differences among learners, which in turn overlooks the differences in intrinsic motivation and abilities of different learners. Finally, it weakens teachers' intrinsic motivation due to the reliance on rewards or punishments.

Limitations of Cognitive Theory: This theory places a heavy emphasis on working memory and neglects other factors such as motivation, emotions, and social background. Its practical application is difficult and complex, as it is difficult for teachers to accurately determine the level of cognitive load for each learner. Therefore, it is considered a static theory, as it explains learning from the perspective of cognitive constraints and does not expand the scope of the dynamic interpretation of learners in diverse environments. It also ignores the emotional and motivational aspects, due to its strong focus on managing information in the mind and not attaching much importance to the importance of motivation and emotion.

Weaknesses of Constructivism: It is difficult to implement practically because it requires a long time and additional resources such as teaching aids, classroom activities, and technological tools. Knowledge construction is dependent on the learner, so students with weak abilities may struggle with comprehension. It also focuses on interactive activities, which may reduce their interest in the curriculum or their mastery of all aspects of the educational content. This theory is considered an additional burden on the learner, as the teacher's role is to guide the learner rather than impart knowledge. There is a potential for chaos in the classroom as a result of the introduction of cooperative learning. There is also a lack of clarity due to the learner's reliance on self-exploration, which may lead to misconceptions or inaccurate understanding

unless the teacher corrects them. Finally, social, cultural, and environmental factors play an important role in its success, which may not be present in traditional educational settings with limited resources.

The Relationship of Integrated Learning Theory to Current Traditional Learning Theories

Integrated learning theory represents a comprehensive theoretical framework that enhances and develops traditional educational theories by integrating generative AI tools. This theory provides a more adaptive, personalized, and effective learning experience. The following points illustrate how traditional learning theories are being developed through the GenAI-human interaction:

- **Behaviorism:** AI systems use the principles of immediate reinforcement and motivation (such as punishment and rewards) to promote positive behavior and ensure ongoing engagement with content.
- **Constructivism:** The theory relies on the active construction of knowledge through intelligent digital environments such as simulations and virtual worlds, enabling learners to explore, experiment, and build self-understanding.
- **Cognitive Load Theory:** AI is used to adjust the difficulty of content and deconstruct complex tasks, helping

learners process information without cognitive fatigue, thereby improving comprehension and retention.

- **Connectionism:** Focusing on learning through digital networks and communities, the integrated theory enhances this approach through GenAI tools that support collaborative and interconnected learning in multidisciplinary environments. Through this integration, the integrated theory offers an evolutionary model capable of benefiting from the legacy of traditional learning theories while meeting the requirements of education in the digital age.

The Philosophical and Key Principles of the Integrated Theory

The integrated theory's philosophy is based on a balance between behavior and cognition. This theory presents a hybrid and integrated framework that combines behavior (as evidence) and mental processes (as essence). In this context, we observe apparent behavior (as in behavioral theory) without neglecting abstract mental processes (as in cognitive theory).

Every learning activity must be linked to the learner's circumstances or personal experience. This compensates for the weakness of behavioral and cognitive approaches in connecting learning to real life. This integrated theory

considers the importance and role of social and cultural factors together, incorporating the influence of both society and culture to make learning collaborative and contextual.

This theory manages the cognitive process in a flexible manner (content segmentation, gradation, and the use of multiple media), allowing for creative and innovative learning. It also focuses on integrating artificial intelligence technologies, such as adaptive learning and GenAI, to help provide personalized educational content that reduces cognitive load and supports individual differences among learners.

This theory integrates intelligent adaptive learning and cognitive, social, and contextual principles into an educational framework based on GenAI, enabling a flexible, personalized, and dynamic learning experience.

The theoretical and epistemological foundations of this approach are formed from four main concepts:

1. **Distributed Cognition:** This concept provides a basis for understanding learning as a collaborative process involving the learner, the teacher, the tools, and the technological context. This concept aligns with the essence of constructivist theory, which views learning as a collaborative cognitive interaction between the individual and their surrounding environment, particularly the smart digital environment.

2. **Fragmented Attention:** This theory takes into account the learner's daily interaction with multiple sources simultaneously, which calls for redesigning the learning environment to adapt to their needs, reduce distractions, and enhance concentration. In this context, AI is used to distribute the cognitive load and monitor learner behavior in real time.
3. **Collaborative Learning:** Within the framework of adaptive learning theory, collaborative generative intelligence is an effective tool for enhancing knowledge construction. AI is used as an intelligent knowledge partner, enabling collaboration among learners in shared digital spaces. Knowledge is pooled collectively, enhancing social and cognitive skills.
4. **Just-in-time Learning:** This theory proposes that the most effective learning occurs in the moment and in its real-world context. Therefore, intelligent systems use contextual analysis to deliver appropriate educational content based on the learner's state, whether cognitive or psychological.

These key principles aim to integrate the philosophy of traditional educational theories with intelligent AI tools, particularly generative AI. These principles are as follows:

1. Adaptive learning, which offers different and varied experiences based on the learner's abilities and personal needs.

2. AI-enhanced learning, which invests in AI as a means of ensuring learners' stability in digital environments enhanced by generative AI tools. However, this investment is made through educational strategies that reduce overreliance on it to maintain and improve critical thinking skills.
3. A balance between intrinsic and extrinsic motivation. In other words, learners benefit from reinforcement as a behavioral theory, while cultivating intrinsic motivation and self-curiosity as a cognitive constructivist theory.
4. Multidimensional thinking, which is developed through the cultivation of critical and creative skills and real-world problem-solving, rather than focusing solely on memorization and understanding.
5. The concept of self-monitoring, which is achieved by enhancing learners' awareness of mental processes and how to learn in smart environments, to compensate for the neglect of behavioral theory. In short, these key principles form the basis for building a smart, flexible, and transformative education system that meets the needs and requirements of individuals in the digital age.

Conclusion

This article aims to justify the need to present an integrated learning theory as a hybrid framework that combines GenAI tools and humans in an interactive digital environment. The main objective of this theory is to focus on cognitive cognition supported by intelligent digital technologies such as GenAI tools.

The core of this theory focuses on the shift from abstract cognitive processes to practical cognition enhanced by GenAI. This theory positions AI as an interactive partner that assists the learner in constructing knowledge and provides a new form of support and co-construction of knowledge alongside the learner.

The learning process consists of multiple stages according to the cognitive model, which focuses on the formation and creation of knowledge in a purposeful manner. It becomes clear that the main objective of presenting this integrated theoretical model is to enhance the importance of mental processing through knowledge construction supported by GenAI-human interaction.

This theory will provide a comprehensive explanation of how knowledge is constructed and modified in intelligent environments, unlike traditional learning theories, which do not adequately explain how knowledge is constructed within intelligent adaptive environments and do not precisely

consider how knowledge is processed. It also emphasizes the importance of collaboration and logical, organized interaction between AI technologies, teachers, and learners within the educational environment.

It presents a new philosophical vision that aims to develop the concept of knowledge acquisition by integrating the technical and philosophical foundations of learning, making it an innovative contribution to the field of future educational philosophy.

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