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Conscious Intelligence in Mathematics: Towards Cognitive Models to Enhance Deep Understanding and Problem-Solving

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Abstract

This research aims to explore the concept of "conscious intelligence" in mathematics education, examine teachers' practices of conscious intelligence in various instructional situations, and develop cognitive models that contribute to enhancing deep understanding and fostering mathematical thinking and problem-solving skills. The descriptive-analytical method was employed to review recent literature and analyze relevant cognitive models. Results indicate that adopting strategies based on metacognitive awareness improves academic performance and enhances mathematical problem-solving skills. The study provides practical recommendations for designing curricula that incorporate conscious intelligence and for creating interactive learning environments that promote critical thinking skills among students.

Keywords

Conscious intelligence, Mathematics, Deep understanding, Problem-solving, Cognitive models, Active learning, Critical thinking, Self-monitoring.

Introduction

The field of mathematics education has witnessed remarkable developments over the past decades. The focus has shifted from merely mastering computational skills to also developing critical thinking and mathematical problem-solving abilities. With the emergence of trends such as artificial intelligence, data-driven education, and the increasing use of robotics concepts, interest in enhancing students' conscious cognitive processes has grown. "Conscious intelligence" emerges as a modern trend that enhances students' ability to regulate their cognitive processes, achieve deep understanding, and solve problems. This study raises key questions: How can conscious intelligence contribute to enhancing deep understanding and problem-solving in mathematics? What are the most effective cognitive models in this context?

Research Problem

Despite the availability of various teaching strategies in mathematics, a gap persists between superficial understanding of concepts and achieving deep, connected understanding. The research problem lies in determining how conscious intelligence can be employed as a tool to sustainably enhance deep understanding and solve complex mathematical problems.

Research Objectives

- Clarify the concept of conscious intelligence and its role in mathematics education.

- Analyze effective cognitive models that enhance deep understanding.

- Propose a cognitive model that supports problem-solving and critical thinking skills.

- Develop criteria to assess conscious intelligence practices within classrooms.

Significance of the Research

The significance of this study lies in presenting a modern theoretical and practical framework that contributes to the development of mathematics teaching strategies to meet the demands of the 21st century. It also helps build independent learners capable of applying higher-order thinking skills across various fields and provides an applied framework for conscious intelligence skills in mathematics, problem-solving, and deep understanding.

Research Methodology

The research adopted a descriptive-analytical approach, analyzing theoretical and practical studies related to conscious intelligence and cognitive models in mathematics. Comparisons were made between different models, identifying the most effective strategies.

Research Terminology

- Conscious Intelligence: An individual's ability to deliberately regulate cognitive processes to achieve specific cognitive goals (Flavell, 1979; Efklides, 2020).

- Cognitive Models: Theoretical frameworks describing how individuals process information and understand concepts (Anderson, 2020).

- Deep Understanding: The ability to logically connect mathematical concepts, allowing for their application in novel situations (Hattie & Donoghue, 2016).

- Problem-Solving: A cognitive process that requires applying acquired knowledge innovatively to face new situations (Schoenfeld, 2022).

Theoretical Framework

1. Concept of Conscious Intelligence: Flavell (1979) defines conscious intelligence as involving self-knowledge, awareness of cognitive processes, and the ability to regulate performance. Efklides (2020) further highlighted emotional regulation and conscious attention to learning situations as crucial components that directly impact academic performance.

2. Cognitive Models in Mathematics: Modern models such as Anderson (2020) and Schoenfeld (2022) stress the importance of developing skills in planning, self-monitoring, and performance evaluation during mathematics learning. Winne & Hadwin (2018) emphasized continuous self-monitoring as vital for improving learning outcomes.

3. Deep Understanding and Problem-Solving: Hattie & Donoghue (2016) argue that deep understanding requires linking new information to existing cognitive structures, enabling innovative problem-solving. Adaptive strategies based on conscious intelligence are foundational to this process. Schoenfeld (2022) supported this by highlighting the role of flexible mental habits in fostering critical thinking.

4. Relationship Between Emotional and Conscious Intelligence: Durlak et al. (2022) indicated that emotional intelligence serves as a supportive component of conscious intelligence, with emotional control aiding cognitive regulation during problem-solving situations.

Previous Studies

- Swanson (2021) found that training students in conscious thinking significantly improved their performance and problem-solving skills across various topics.

- Veenman et al. (2022) emphasized that enhancing self-monitoring and organizational strategies positively impacted students' ability to solve complex mathematical problems.

- Dehaene (2020) showed that integrating conceptual knowledge with metacognitive awareness leads to more interconnected cognitive networks, contributing to deeper understanding and problem-solving.

- Efklides (2020) demonstrated that strengthening self-efficacy through self-feedback enhances performance in complex thinking tasks.

- Durlak et al. (2022) revealed that social-emotional learning (SEL) programs enhance students' conscious intelligence, positively impacting academic achievement.

Proposed Model for Conscious Intelligence in Mathematics

This study proposes a cognitive model for activating conscious intelligence in mathematics education, consisting of four main phases:

1. Motivation and Preparation: Activating prior knowledge and stimulating self-motivation through self-questioning techniques.

2. Planning Phase: Defining the goal of solving the mathematical problem, choosing the appropriate strategy based on the problem's nature, and anticipating potential challenges.

3. Execution Phase: Applying the selected strategy while maintaining self-awareness of the steps taken and recording mistakes and reflections.

4. Review and Evaluation Phase: Reviewing the solution, evaluating its effectiveness, analyzing errors, and reinforcing learning by reconstructing knowledge based on experience.

The model design emphasizes principles of self-monitoring, cognitive flexibility, and self-regulation, thereby fostering higher-order thinking skills among students.

Findings

- Conscious intelligence is a pivotal factor in enhancing deep understanding in mathematics.

- Cognitive models based on self-monitoring significantly improve problem-solving skills.

- There is a positive relationship between training in conscious strategies and increased self-motivation for learning.

- Emotional intelligence directly influences the development of conscious intelligence, thereby improving academic performance.

Recommendations

- Integrate conscious intelligence strategies into mathematics curricula from early educational stages.

- Train teachers to develop students' metacognitive awareness skills.

- Develop educational programs based on adaptive cognitive models to support self-directed learning.

- Strengthen the connection between emotional and conscious intelligence through specialized educational programs.

- Conduct more experimental studies to validate the effectiveness of the proposed models in diverse educational environments.

Conclusion

This study concludes that adopting a conscious intelligence approach in mathematics education represents a promising step toward achieving deeper and more effective

learning. It calls for adopting pedagogical strategies based on metacognitive self-awareness and monitoring cognitive processes during learning. Moreover, developing flexible, integrated educational models that combine cognitive and emotional aspects will contribute to preparing students capable of critical and creative thinking in facing future challenges.

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