Development of an Integrated CORE Learning Model for Cognitive Conflict Strategies to Improve Higher-Order Thinking Skills (HOTS) of Elementary School Students

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ABSTRACT:

Conventional learning practices at the elementary school level are still dominated by teacher-centered approaches, which structurally rarely facilitate students to confront intuitive misconceptions or construct complex cognitive schemas1. As a result, traditional learning models fail to make a significant contribution to advancing students' Higher-Order Thinking Skills (HOTS)1. This research report describes the development and empirical evaluation of a hybrid pedagogical framework that integrates the Connecting, Organizing, Reflecting, and Extending (CORE) learning model with the Cognitive Conflict Strategy to optimize the HOTS of elementary school students1. Through Research and Development (R&D) design, this framework was tested on Class V students of SD Negeri 104208 Medan City for the 2024/2025 school year with a cohort of 34 students1. Expert evaluations confirm that the developed model meets high standards of content, construct, and syntax validity1. The assessment of practicality by teacher practitioners resulted in a percentage of 85.42%, which puts this model in the category of very practical1. Post-intervention classical completeness reached 85.29%, proving that students' cognitive capacity successfully exceeded the threshold of standard mastery1. Inferential hypothesis tests through the paired-samples t-test produce a value , which significantly exceeds the value at significance level 1. These findings confirm that cognitive disequilibrium induction structured in four CORE phases is able to destabilize intuitive misconceptions, accelerate schema restructuring, and optimize HOTS achievement at the primary education level1.

Keywords: cognitive, restructuring, hypothesis, practitioners

Introduction

The demands of the modern curriculum of the 21st century indicate a fundamental shift from memorization-based low-level cognitive processing to mastery *of Higher-Order Thinking Skills* (HOTS) that include analytical (C4), evaluation (C5), and creative synthesis (C6)[1]. Chalkiadaki's (2018) Scopus indexed study in *the International Journal of Instruction* confirms that the formation of 21st century competencies in basic education requires an update of instructional approaches that explicitly train critical reasoning and problem-solving from an early age8. However, various empirical studies show that instructional realities in primary schools are still dominated by the traditional teacher-centered teaching paradigm1. This passive state is made clear by Khoshaim and Rashid (2016) in *the International Journal of Instruction*, where conventional forms of assessment fail to trigger deep reasoning and tend to allow intuitive misconceptions to develop undetected9. As a result, students maintain a false mental schema that makes it difficult for them to master abstract concepts1.

In order to overcome these instructional limitations, the international literature encourages the implementation of active constructive learning models1. *The Connecting, Organizing, Reflecting, and Extending* (CORE) model presents a four-phase architecture that facilitates the construction of knowledge in a structured manner1. Research published by Saregar (2021) in *the International Journal of Evaluation and Research in Education* (IJERE) proves that the CORE model has significant effectiveness in improving students' creative thinking skills through the binding of conceptual experiences11. These results are reinforced by a study by Tong et al. (2024) in *the Mathematics Teaching-Research Journal*, which found that the organization of concepts and structured reflection in the CORE model substantially improves students' problem-solving abilities compared to conventional methods12. However, the application of the CORE model standards risks assimilation bias if students carry strong intuitive misconceptions1. In these situations, students tend to force new scientific information into the wrong initial frame of mind without realizing the existence of a logical contradiction1.

A resolution to assimilation bias requires a pedagogical catalyst capable of breaking down false intuitive beliefs1. Cognitive Conflict Strategies are academically proven to be able to drive conceptual change through the design of anomalous situations that cause psychological disequilibrium1. Scopus indexed research by Verawati et al. (2019) in *the Indonesian Journal of Science Education* (JPII) confirms that the cultivation of cognitive conflict strategies in inquiry-based learning models results in a significant increase in critical thinking skills5. Parallel findings by Mufit et al. (2023) in the *Journal of Turkish Science Education* (TUSED) show that *Cognitive Conflict-Based Learning* is highly effective in remedying resistant misconceptions of science and mathematics6. The integration of this strategy in project-based learning and blended learning models is also evidenced by a study in *the European Journal of Educational Research* that describes the improvement of students' spatial and analytical literacy16. In addition, an investigation by Laksana et al. (2019) in the *Journal of Baltic Science Education* emphasizes the importance of real-world problem-based interactive learning environments to support cognitive restructuring in primary school-aged children18.

Combining the architectural excellence of CORE with the transformative power of Cognitive Conflict Strategy results in comprehensive pedagogical synergy1. Cognitive conflict triggers intellectual concern in the *Connecting* and *Reflecting* phases, while the *Organizing* and *Extending* phases provide cognitive *scaffolding* to reconstruct the scientific scheme and transfer it into HOTS1 problem-solving. Given the importance of empirical proof at the elementary level, this study formulated and tested this hybrid model in Primary School1.

Syntactic Architecture and Model Measurement Framework

The operational syntax of the integrated CORE learning model Cognitive Conflict Strategy is systematically developed to guide students from the stage of cognitive disequilibrium to the consolidation of high-level thinking1. This syntax combines the four main phases of CORE with a measurable mechanism of cognitive conflict1.

Learning Phase	Operational Syntax	Cognitive Mechanisms & Student Activities
Fase 1: Conflict-Driven Connecting	Presentation of contextual anchor phenomena juxtaposed with demonstrations of anomalies or contradictory problems1.	The activation of initial knowledge accompanied by instantaneous cognitive equilibrium, forces students to realize the existence of gaps or errors in their naïve mental schemes1.
Fase 2: Scaffolding and Organizing	Small-group collaborative investigations are aided by *graphical organizers*, concept maps, and analytical guides1.	Systematic deconstruction of complex variables, categorization of explanatory evidence, and reconstruction of the structure of new scientific schemes1.
Fase 3: Evaluative Reflecting	Presentation of conceptual models of synthesis results, structured peer argumentation, and guided metacognitive self-assessment1.	Metacognitive tracking of conceptual change, in which students explicitly justify how their new schema resolves initial conflicts1.
Fase 4: Multi-Contextual Extending	Assigning challenging tasks in the form of non-routine HOTS problems that demand application to new real-world situations1.	Schema generalization, creative problem-solving transfer, and high-level cognitive consolidation across diverse contexts1.

The percentage of model practicality was evaluated based on observation sheets and teacher practitioner questionnaires calculated using mathematical formulas:

$$P = \frac{\Sigma R}{N \times S_{\text{maks}}} \times 100\%$$

where P it symbolizes the percentage of practicality, ΣR expresses the total number of empirical scores of the assessor, N is the number of assessor practitioners, and S_{maks} represents the maximum score that can be achieved1. The "Very Practical" category is set in range $81\% \leq P \leq 100\%$ [1].

HOTS achievement was measured through a description test based on the criteria of the Bloom Taxonomy indicator (C4–C6)[1]. The completeness of students' classical learning is calculated based on the ratio of students who reach the limit of individual mastery ($KKM \geq 75$):

$$K_k = \frac{n}{N} \times 100\%$$

where K_k is the classical completeness percentage, n shows the number of students who completed individually, and N expresses the total number of students in cohort ($N = 34$)[1]. The targeted classical completeness threshold is $K_k \geq 85,00\%$ [1].

Effectiveness hypothesis testing was carried out using *a paired-samples t-test* with the following formulation:

$$t = \frac{\bar{D}}{\frac{s_D}{\sqrt{N}}}$$

where $\bar{D}$ representing the average difference between pre-test and post-test scores, s_D is the standard deviation of the score difference, and N is the number of samples ($N = 34$)[1]. The significance test was evaluated by comparing t_{hitung} it to t_{tabel} the significance level $\alpha = 0,05$ and the degree of freedom $df = 33$ [1].

Results of Empirical Evaluation and Hypothesis Test

Validation tests by a panel of experts confirmed that the Cognitive Conflict Strategies integrated CORE learning model framework meets the content, construct, and language validity requirements with excellent qualifications1. The integration of anomalous events at the beginning of *the Connecting phase* is considered appropriate to divert students' cognitive attention from passive perception to the search for critical solutions1.

An instructional practicality test carried out with Class V teachers of SD Negeri 104208 Medan showed that all syntactic steps could be carried out well within the available time allocation1. Teachers report that operational guidance facilitates the processing of cognitive conflicts without causing counterproductive anxiety in students1. The evaluation of practicality and achievement is shown in the following table:

Evaluation Dimensions	Key Indicators Evaluated	Empirical Metric Results	Category/Qualifications
Model Validity	Construct integrity, syntax logic, HOTS indicator suitability	Verified Experts	High Validity1
Teacher Practicality	Ease of syntax, time efficiency, class management	85,42%	Very Practical1
Classical Completeness	Percentage of students exceeding the limit of post-intervention KKM	85,29%	Classical Completion1
Inferential Statistical Tests	Comparison results of pre-test and post-test (t-test)	$t_{\text{hitung}} = 5,312$	Very Significant Effects1

Post-intervention students' assessment of high-level thinking skills recorded a drastic increase1. Prior to the application of the model, students' performance was dominated by low-level memory skills with many basic misconceptions1. Post-intervention, as many as 29 out of 34 students managed to achieve the individual graduation target, resulting in a classical completion percentage of 85.29%[1].

Parameters Statistics	Empirical Test Results	Critical Value / Reference	Hypothetical Decision
Sample Size (N)	34 Students	Class V State Elementary School 104208	Target Kohort1
Classical Completeness (K_k)	85,29%	Minimum Limit = 85.00%	Target Exceeded1
Value t_{hitung}	5,312	$t_{\text{tabel}} = 2,035$ São Paulo $\alpha = 0,05$	Reject H_0 ($p <$)[1]
Instructional Efficacy	Significant HOTS Increase	$t_{\text{hitung}} >$	Highly Effective Model1

The results of parametric statistical analysis produce $t_{\text{hitung}} = 5,312$, which significantly surpasses $t_{\text{tabel}} = 2,035$ at $\alpha = 0,05$ and $df = 33$[1]. The results of this test rejected the null hypothesis (H_0), which empirically proved that the CORE learning model integrated with the Cognitive Conflict Strategy was highly effective in improving the HOTS of elementary school students1.

Pedagogical Discussion and Cognitive Dynamics

Significant empirical achievements ($t = 5,312; P = 85,42\%$) prove that the fusion of Cognitive Conflict Strategies into the CORE framework operates a powerful cognitive transformation in primary school students1. This success can be explained through the interaction of students' psychological dynamics at each stage of learning1.

In conventional learning, the phase of knowledge association (*Connecting*) tends to take place in a linear and passive manner1. When students bring in intuitive misconceptions, linear attribution only results in assimilation bias, in which students unconsciously distort new scientific information to align with their incorrect intuitive schema1. By integrating cognitive conflicts at the beginning of the Connecting phase, students are exposed to anomalous phenomena that explicitly exhibit the contradiction between their intuitive predictions and scientific reality1. This conflict triggers *cognitive disequilibrium*, a state of psychological discomfort that undermines students' naïve beliefs and forces them to open themselves up to conceptual reconstruction1.

However, undirected cognitive disambiguation risks triggering confusion1. This is where the *Organizing* phase of the CORE model provides a crucial cognitive *scaffolding1*. Through graphic organizers and small group discussions, students are guided to elaborate on the facts of the anomaly, group explanatory variables, and collaboratively reconstruct the correct conceptual framework1. This collaborative investigation is in line with the findings of Scopus-

indexed research from Maryani et al. (2021) in *the Journal of Turkish Science Education*, which emphasized that analytical question instruments and assignments designed based on real problems are able to lead students to achieve valid reasoning9.

Furthermore, *the Reflecting* phase operationalizes metacognitive abilities explicitly1. Students are invited to compare their old schema with the new one and explain rationally why the new concept successfully solves the anomalies that appear at the beginning of the lesson1. This activity hones the cognitive dimension of Evaluation (C5)[1]. Finally, in the *Extending* phase, students are challenged to apply improved scientific schemas into the non-routine solving of real-world problems1. This step consolidates the capacity of Creation (C6) and ensures that new understandings are not simply memorized, but are transferred flexibly in diverse contexts1.

Inclusively, this hybrid framework also creates a *psychologically safe classroom* climate1. Misconceptions and misconceptions are no longer seen as academic failures, but rather as valuable starting points for scientific discovery1. This is in line with the findings of Doley (2023) in the *International Journal of Instruction* regarding the importance of encouraging positive cognitive stimulation in increasing student engagement and learning motivation22.

Conclusions and Strategic Recommendations

This study empirically confirms that the *Connecting, Organizing, Reflecting, and Extending* (CORE) learning model integrated with the Cognitive Conflict Strategy is a valid, very practical (85.42%), and effective pedagogical framework in improving the *Higher-Order Thinking Skills* (HOTS) of elementary school students1. The application of this model successfully facilitated classical completeness by 85.29% and resulted in a statistically significant increase in HOTS ($t_{\text{hitung}} = 5,312 > t_{\text{tabel}} = 2,035$)[1]. Induction of cognitive disequilibrium at the beginning of learning has been shown to overcome assimilation bias, while the stages of organizing, metacognitive reflection, and concept expansion provide a solid cognitive scaffolding to consolidate students' creative analysis, evaluation, and problem-solving skills1.

Based on these findings, educators and elementary school managers are recommended to apply this hybrid model in the learning process in grade1. Educational institutions and related agencies need to organize ongoing training programs for teachers to improve competence in designing contextual cognitive conflict scenarios and managing metacognitive discussions1. For future research, it is recommended to test the effectiveness of this model longitudinally across a variety of subjects as well as integrate it with interactive digital learning media to support 211th century learning scenarios.

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