Constructing a Visual Classroom Framework for Critical Thinking

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Abstract: This study presents a classroom visualization framework for critical thinking that translates conceptual definitions into operable practice. Anchored in CER-L — claim, evidence, reasoning, and rebuttal/limitation (with optional reflection) — the framework standardizes minimal observable units, treats presentation modes as metrically equivalent, applies a restrained three-level quality scale, and aggregates traces into object-specific strength. Argumentative connections are represented as basic and strengthened chains, enabling structural analysis alongside quantitative signals to support instructional alignment, observation, and evaluation. Notwithstanding these contributions, several limitations remain, and lightweight tool support is proposed to enhance scalability.
***Keywords*:** critical thinking, classroom visualization, CER-L framework

1. Introduction

The "absence of critical thinking" in English-major education has become a widely shared concern[1][2][3][4]. As a core course for the major, Integrated English should, through structured dialogue and argumentation training, turn critical thinking from a mere concept into observable, recordable, and assessable classroom behaviors[5]. However, key components critical thinking instruction — Claim, Evidence, Reasoning, and Rebuttal/Limitation (hereafter CER-L) — often remain implicit. Without a common observation lens and alignable tools among lesson planners, instructors, and learners, it is difficult to produce a reviewable chain of classroom evidence.

To address this gap, this study develops a "visual classroom framework for critical thinking" to offer an operable, alignable set of tools for teaching design, classroom observation, and course evaluation.

2. Literature Review

Guided by two frequently quoted definitions of critical thinking by Facione[6] (the Delphi Report) and Ennis[7], this study focuses on their shared emphasis: evidence-based judgment with metacognitive monitoring, and reasonable, reflective thinking aimed at deciding what to believe or do. Accordingly, it operationalizes classroom-observable "visualization objects" into four elements — Claim, Evidence, Reasoning/Warrant, and Rebuttal/Limitation—supplemented by metacognitive reflection, anchoring "thinking visualization" to reviewable and assessable targets.

3. Visual Classroom Framework for Critical Thinking

To address inconsistent object definitions, unstratified presentation modes, and single-dimensional metrics, this paper constructs a visual classroom framework for critical thinking instruction, defines the CERL object dimension and applies a unified criterion from recognizable to recordable and assessable.

3.1 Framework Category

The framework centers on four argumentation components (CER-L) which together form the minimal argument chain; Metacognitive Reflection is a supporting, optional dimension that improves clarity and reviewability but is not counted toward object coverage. Each primary category encompasses several secondary types (e.g., central and supporting claims; textual, data, and case evidence; causal, analogical, and principled warrants

3.2 Operational Definitions

This section specifies the operational attributes of each CER-L element, building on the minimal observable units defined in Section 3.1. For clarity, each element is described with its intended scope and observability for classroom tagging; illustrative classroom examples appear in Table 1. These examples are quoted from Naguib Mahfouz's Half a Day, in Contemporary College English: Intensive Reading (Book 1) (Third Edition), published by Foreign Language Teaching and Research Press.

Table 1. Minimal Classroom Recording Examples for CER-L

Element	Example	Record ID
Claim	C-01: "Half a day" functions as a metaphor for a lifetime.	C-01
Evidence	E-01: "How could all this have happened in half a day, between early morning and sunset?"	E-01
Reasoning /Warrant	R-01: When a narrative juxtaposes drastic external changes and the narrator's astonishment within a compressed time frame, it typically signals symbolic time-compression; therefore E-01 supports C-01.	R-01
Rebuttal /Limitation	Rb-01: "A small boy… called out to me, 'Grandpa!'" "Grandpa" might be a polite address rather than literal aging; hence C-01 is a metaphorical crossing and needs multiple converging quotes.	L-01

4. Operationalizing the CERL Framework

This chapter moves from definition to use. Section 4.1 sketches where the CERL framework is applied in classrooms and programs; Section 4.2 summarizes how classroom traces are recorded, how quality is judged, and how dispersed entries are aggregated into comparable indicators that support feedback and improvement.

4.1 Application Scenarios

In instructional alignment, teachers embed CERL objects throughout goals, activities, products, and assessment. Objectives specify which components students are expected to produce; activities are designed to elicit those components through targeted tasks and scaffolds; products leave traces in the recordable forms; and assessment, built on the same components, judges coverage and quality. In classroom observation, observers capture occurrences at the minimal observable unit and attend to whether they form a microchain of at least two connected points, thereby locating breaks and weak links and maintaining a comparable basis for recording and judgment. With the object layer aligned in these ways, the next section introduces presentation modes and weights to construct objectstrength measures that connect the object dimension to a computational and diagnostic framework for visualized intensity and improvement decisions.

4.2 Operational Procedures

Recording focuses on four objects — claim, evidence, reasoning, and rebuttal/limitation — while treating classroom utterances, board work, written work, and data/figures as metrically equal presentation modes so that form does not confound content. Each entry is assigned to a single object category with minimal annotations for traceability: evidence cites its source; reasoning states how the evidence supports the claim; rebuttal/limitation specifies the target, the reason, and the response.

Quality is judged with a restrained threelevel scale $q \in \{0,1,2\}$. A score of 2 indicates that the content stands and is traceable; 1 indicates that it basically stands but the warrant or link is thin; 0 indicates that it does not stand or cannot be judged. Each entry is assessed for content validity and traceability

Dispersed traces are aggregated into an objectspecific strength for subject j and and object k: $V_{jk} = \left(\sum_i w_i f_{ijk} \right) \times q_{jk}$

where i indexes presentation modes, f_{ijk} is the count of entries, W_i the mode weight (default 1), and q_{jk} the quality level. Under equal weights, V_{jk} reads as "total entries × quality," enabling horizontal comparison and weakspot detection.

5. Conclusion

This paper proposes a classroom-ready critical-thinking visualization framework. It defines four CER-L objects with recognition criteria, treats presentation modes as equivalent, applies a restrained three-level quality scale guided by validity and traceability, and standardizes recording with minimal observable units. By distinguishing between basic and strengthened argumentative chains and synthesizing strength signals, it converts classroom traces into comparable, reviewable judgments, enabling a practical see–judge–improve cycle.

Limitations include the scale's limited resolution (not for high-stakes ranking) and the need for adaptation in metaphorical or narrative contexts. Future work will refine these aspects and build tool support. Nevertheless, the framework provides a common language that makes critical-thinking goals visible, discussable, and improvable.

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