Claim, Evidence, and Reasoning (C-E-R) Framework: Application in Dissertation and Thesis Writing for Music Education Research and Cross-Disciplinary Contexts

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ABSTRACT

This article examines the Claim, Evidence, and Reasoning framework, detailing its historical development and theoretical underpinnings. It elucidates the core components of CER and provides practical guidance on its application in crafting robust arguments within dissertations and theses, particularly within the domain of music education research. The utility of CER extends beyond this specific field, demonstrating its broad applicability across various disciplines for enhancing argumentative clarity and rigor. This framework, adapted from Toulmin's model of argumentation, provides a structured approach for students to construct scientific explanations and justify their claims based on empirical data and logical inferences. Specifically, the Claim, Evidence, Reasoning model, developed by McNeill and Krajcik, simplifies Toulmin's more complex argumentation model to make it more accessible for science education contexts, enabling students to articulate not just what occurred, but also the underlying reasons. This pedagogical framework fosters critical thinking by guiding students to substantiate assertions with empirical data and sound justification. By requiring students to evaluate evidence for ill-defined or complex problems rather than simply confirming theories, CER promotes a deeper engagement with scientific inquiry and argumentation. This approach not only aids in structuring scientific explanations but also encourages students to link these components coherently, ensuring that evidence supports the claim and reasoning connects the evidence to that claim.

Keywords: Claim, Evidence, Reasoning, argumentation, dissertation, thesis, music education, research, cross-disciplinary applications.

INTRODUCTION

The Claim, Evidence, and Reasoning (CER) framework, derived from Stephen Toulmin's argumentation model (Allen et al., 2025), streamlines complex arguments into three core elements: claim, evidence, and reasoning. CER promotes structured argumentation and critical thinking in education, enhancing scientific literacy (Allen et al., 2025; LOZADA & CORTEZ, 2025). By linking claims with empirical evidence and logical reasoning, the framework supports analytical skills essential for rigorous argumentation (Magnussen & Elming, 2017; Reamy, 2021; Haudek & Zhai, 2023). Originally simplified from Toulmin's model for K–12 science education, CER has since expanded across educational contexts, promoting higher-order thinking and scientific understanding in multiple disciplines (Allen et al., 2025; Kartika & Budiarto, 2022). CER also supports evidence-based explanations crucial for college and career readiness (Long, 2014) while improving student engagement and reasoning through structured argumentation (LOZADA & CORTEZ, 2025). By ensuring assertions are supported by empirical data and justification, CER strengthens academic writing practices (Loch, 2018). This paper reviews the historical development of CER, explains its components, and demonstrates its

application in dissertations and theses, particularly within music education and broader cross-disciplinary contexts.

Historical Context of Argumentation in Academic Writing

The intellectual roots of academic argumentation trace back to ancient Greek philosophy, particularly Aristotle's syllogistic logic, which formalized deductive reasoning (Velandia-Mesa et al., 2019). Building on these foundations, Stephen Toulmin's the Uses of Argument proposed a model addressing real-world argumentation through claims, data, warrants, backing, qualifiers, and rebuttals, criticizing formal logic as overly simplistic and context-blind (Duran, 2024; Liu & Xiong, 2024; Rapanta & Macagno, 2023; Yang, 2021). This framework underpins the simplified CER model widely used for pedagogical purposes (Allen et al., 2025; Robles et al., 2022). CER enables students to articulate claims, support them with empirical data, and connect both through logical reasoning, fostering scientific argumentation rather than mere theory confirmation (Mathis et al., 2016; Mehl et al., 2019). By bridging data and theory, it cultivates critical thinking and scholarly skills, evolving classical rhetoric into tools suitable for modern research across disciplines, including music education (DİREKÇİ et al., 2022; Ramadhani et al., 2023).

The ability to formulate and evaluate arguments remains central to higher education, supporting critical analysis and substantiated research (Rapanta & Macagno, 2019). CER also helps students identify arguments within unfamiliar texts, encouraging active investigation of logical structures rather than passive reading (Jacobson et al., 2016; Yasuda, 2023). Such understanding is essential for navigating academic inquiry and knowledge production (Rapanta & Macagno, 2019; Velandia-Mesa et al., 2019). Toulmin's emphasis on warrants, qualifiers, and rebuttals acknowledges the defeasible nature of arguments, making the model adaptable to practical reasoning contexts (Kock & Lantz, 2022; Rapanta & Macagno, 2023; Yang, 2021). CER retains these principles while simplifying them for educational use, fostering argumentation and critical thinking skills among students (Andrews, 2015; Rohayati et al., 2024).

Understanding the Claim-Evidence-Reasoning (C-E-R) Framework

The Claim–Evidence–Reasoning framework structures scientific explanations and arguments by guiding users to state claims clearly, support them with empirical data, and logically connect evidence to claims (Yao et al., 2016). Derived from Toulmin's model, CER scaffolds arguments by addressing what is known, how it is known, and why evidence supports a claim (Jacobson et al., 2016; Su et al., 2021). A claim represents a conclusion requiring verifiable evidence (Wallon et al., 2017), evidence consists of relevant data or observations, and reasoning explains how evidence supports the claim (Hong & Talib, 2018; Sasseron, 2019). In education, CER strengthens argumentative writing and communication of scientific findings (Pichette, 2019; Samosa, 2021), promotes coherent arguments, and deepens understanding of inquiry processes ("The Toulmin Argumentation Framework," 2023). CER fosters critical thinking by requiring justification of evidence relevance and promotes rigorous knowledge production and communication (Rapanta & Macagno, 2023; Wallon et al., 2017). However, students often struggle to provide sufficient evidence and construct reasoning that explicitly connects data to claims (Jacobson et al., 2016), highlighting the need for explicit instruction and scaffolded practice (Su et al., 2021). Evaluating evidence quality and articulating logical connections remain sophisticated skills requiring sustained academic training (Pichette, 2019; Simon, 2008; Jimenez et al., 2024). Nevertheless, CER may be less suited to research contexts emphasizing interpretive or creative inquiry where arguments are not strictly evidence-driven, suggesting the framework should be applied flexibly rather than prescriptively.

Defining Claim

A claim is the primary assertion or conclusion responding to a scientific query, often expressed as an answer, agreement, refutation, or classification (Gotwals & Songer, 2013; Laliyo et al., 2023). Within CER, a claim should be declarative, debatable, and testable, providing focus for supporting evidence and reasoning (Gotwals & Songer, 2010). It forms the foundation of the argument by guiding evidence selection and interpretation (Gotwals & Songer, 2009). Effective claims precisely identify entities and phenomena under investigation while using appropriate scientific language (Moore & Wright, 2023). They should allow empirical investigation while contributing meaningfully to broader knowledge (Moore & Wright, 2023).

Defining Evidence

Evidence refers to data or factual information directly supporting a claim (Sari & Islami, 2020). It may originate from observations, measurements, or modeling and must be appropriate and sufficient to support the argument (Moore & Wright, 2023). Insufficient or inappropriate data weaken claims (Magnussen et al., 2017), making careful evidence selection essential (Moore & Wright, 2023). For example, roller coaster design relies on calculations demonstrating compliance with safety regulations (Subramaniam et al., 2024), while social science research may use survey data or interview transcripts to support sociological or psychological claims.

Defining Reasoning

Reasoning explains why evidence supports a claim by invoking scientific principles or theoretical models (Bachtiar et al., 2022; Du et al., 2022). It establishes logical connections between data and claims, justifying evidence through established knowledge (Magnussen & Elming, 2017; Wallon et al., 2017). Reasoning links observations to theoretical explanations, distinguishing facts from causal or correlational interpretations (Martorell et al., 2024). Derived from Toulmin's model (Siverling et al., 2018), CER applies across disciplines. Evidence-Centered Design similarly aligns assessment purposes, evidence, and claims to produce valid inferences (Foster & Schleicher, 2022; Kubsch et al., 2022).

Application of C-E-R in Dissertation and Thesis Writing

In dissertation and thesis writing, CER provides a scaffold for constructing rigorous arguments (Lins et al., 2023). It helps researchers organize ideas, findings, and interpretations into coherent narratives (Leshem & Bitzer, 2021; Zhang et al., 2023). By clearly presenting claims, evidence, and reasoning, authors enhance clarity and persuasiveness (Marino, 2020; Rogers, 2000). CER also supports articulation of research problems, methodology, results, and discussions, ensuring each component contributes to a defensible argument (Baş & Sevım, 2020; Moore & Wright, 2023). This organization enhances readability and logical flow while strengthening scholarly contributions. It is particularly valuable when research findings allow multiple interpretations, enabling systematic justification of conclusions. For practical guidance, the application of the CER framework in dissertation and thesis writing is summarized in Table 1 below.

Table 1. Application of the Claim–Evidence–Reasoning Framework in Dissertation and Thesis Writing

CER Component	Role in Dissertation Writing	Example in Music Education Research
Claim	Main argument or research conclusion	Gamified folk-song instruction improves student engagement
Evidence	Data supporting the claim	Observation results, assessment scores, interview data
Reasoning	Explains why evidence supports the claim	Gamification increases motivation, leading to greater participation
Integration	Links findings to theory or literature	Supports motivation and constructivist learning theories

The following sections further illustrate how the CER framework operates across key components of academic writing, including literature reviews, methodology, and discussion sections.

Integrating C-E-R in Literature Reviews

In literature reviews, CER supports critical analysis of prior scholars by identifying claims, evaluating evidence, and examining reasoning. This reveals consensus, debates, and knowledge gaps that justify new studies (Heston, 2023). CER strengthens argumentation by integrating prior work, refining research questions, and demonstrating field mastery (Boell & Hovorka, 2019). It supports development of conceptual frameworks through synthesis

rather than summary (Rocco & Plakhotnik, 2009; Adeoye, 2024) and helps construct clear research narratives aligned with examiner expectations (Leshem & Bitzer, 2021).

Structuring Argumentation in Methodology

In methodology sections, CER helps justify research design, data collection, and analysis methods. Researchers claim methodological suitability, support choices with scholarly practices, and explain alignment with research objectives (Williyan et al., 2023). This strengthens credibility, transparency, and reproducibility (Andrews, 2015; Leshem & Bitzer, 2021). CER clarifies how methods generate relevant data, producing defensible designs and valid findings (Long, 2014). It also aligns methodological decisions with disciplinary norms, reinforcing academic rigor (Mosquera & Sierra, 2019; Adeoye, 2024).

Developing Robust Discussion Sections

CER supports discussion sections by structuring presentation and interpretation of findings. Claims summarize outcomes, evidence refers to results, and reasoning links findings to theory and literature. This moves discussion beyond description toward analytical interpretation, identifying implications, contributions, and research gaps (Heston, 2023). It also supports evaluation of limitations and future research directions while enhancing clarity and credibility. Structured discussions help readers understand the significance and implications of findings.

C-E-R in Music Education Research: Illustrative Examples

While the CER framework applies across disciplines, music education research demonstrates its value in structuring arguments and promoting deeper analysis. In education, CER supports critical thinking, student engagement, and conceptual understanding (LOZADA & CORTEZ, 2025), linking observed outcomes to pedagogical or cognitive processes. In qualitative studies, CER supports claims that learning frameworks enhance creativity using evidence such as engagement levels and creativity indicators (Aoonlamai & Kwangmuang, 2025). This approach moves music education research beyond description toward explanation and enables systematic evaluation of interventions through data-driven analysis. Recent developments further illustrate how structured argumentation strengthens empirical inquiry. For example, music therapy research using the Rational-Scientific Mediating Model links neuroscientific mechanisms with therapeutic musical interventions, grounding outcomes in scientific reasoning (De L'Etoile et al., 2012). Similarly, digital platforms and learning analytics increasingly inform pedagogical improvement, allowing engagement and performance gains to be empirically evaluated and theoretically interpreted (Arini & Adi, 2024; Verma et al., 2025). Motivation research in instrumental learning likewise benefits from structured argumentation, where learner persistence and achievement are explained through socio-educational mechanisms shaping engagement (MacIntyre et al., 2012). Collectively, these studies demonstrate the growing reliance on evidence-supported reasoning to guide pedagogical and institutional innovation.

Analyzing Pedagogical Approaches

In music education, CER helps evaluate pedagogical strategies by clearly stating learning outcomes, supporting them with data, and linking results to educational theory. For example, studies integrating digital music technology report increased engagement and skill development supported by classroom observations, surveys, and assessments (Sularso et al., 2024). This shifts research from description to analysis of mechanisms and impacts, supporting evidence-based curriculum development and instructional refinement (LOZADA & CORTEZ, 2025). CER also supports evaluation of improvisation-based instruction, where creativity gains are evidenced through student performance outputs and explained through theories of cognitive and musical development. Research shows improvisation integrates theory, ear training, and performance skills (Biasutti, 2015), and CER enables empirical evaluation by linking outcomes to cognitive-musical processes (McPhail et al., 2022).

Evaluating Performance Practices

CER supports evaluation of performance-based teaching strategies by linking rehearsal techniques and feedback mechanisms to measurable outcomes. For example, ensemble cohesion improvements may be supported by

acoustic performance analyses and musician feedback, explained through theories of group dynamics and motor learning. CER also clarifies how informal music programs promote lifelong learning through program evaluations (Martínez-Albiñana et al., 2023) and supports claims regarding pedagogical value of classical repertoire using engagement and achievement data interpreted through cultural frameworks (Schiavio et al., 2023). It further applies to performative education approaches enhancing engagement and skill development through embodied interaction (Bajunid & Tony, 2025). Collaborative learning strategies similarly demonstrate improved performance and attitudes when supported by performance data and engagement theories (Gui et al., 2024). CER also helps analyze evolving concepts of musical virtuosity through evidence from collaborative practices and identity theories (MacDonald & Saarikallio, 2024). Overall, CER enables rigorous evaluation of music education innovations.

Cross-Disciplinary Applicability of C-E-R

CER applies across disciplines beyond music education by providing a flexible structure for evidence-based argumentation (Allen et al., 2025). In engineering, it supports design decision-making by linking scientific knowledge to practical solutions (Feijoo-Garcia et al., 2024; Subramaniam et al., 2024). In literature and art history, CER-like approaches analyze works through claims supported by textual or visual evidence and interpretive theories (Rainey, 2017). This versatility positions CER as a framework for rigorous reasoning across academic and everyday contexts (Almpani & Stefaneas, 2023). It promotes evidence-based reasoning essential for college readiness (Long, 2014) and strengthens problem-solving by requiring justification of reasoning steps (Allen et al., 2025). Studies show students increase use of evidence and reasoning after CER instruction (Loch, 2018), supporting transferable analytical skills across fields (Reamy, 2021). CER also supports scaffolded development of scientific explanation skills across educational levels (Yao et al., 2016).

C-E-R in STEM Fields

In STEM education, CER strengthens scientific literacy and evidence-based discussion skills (Jimenez et al., 2024). It structures claims about scientific phenomena using supporting data and explanations grounded in scientific principles (Mathis et al., 2016). For example, students may claim increased light intensity accelerates photosynthesis based on oxygen production data and explain results through light-dependent reactions (Shin et al., 2011). Similarly, chemistry students may explain catalyst effects using experimental evidence and activation energy theory (Fatihah et al., 2022). CER strengthens conceptual understanding, critical thinking, and problem-solving (LOZADA & CORTEZ, 2025), guiding explanations in writing and discussion (Magnussen & Elming, 2017) while supporting justification of reasoning steps in complex problem-solving (Allen et al., 2025).

C-E-R in Humanities and Social Sciences

CER is equally effective in humanities and social sciences for developing analytical argumentation. Arguments are structured through claims supported by textual or empirical evidence and linked to theoretical or contextual reasoning. In history, for instance, claims about event causes draw on primary sources interpreted through socio-political frameworks, shifting analysis beyond description toward evidence-based interpretation. CER's adaptability promotes critical thinking and prepares students for academic discourse (Allen et al., 2025). Studies confirm its effectiveness in strengthening argumentative skills across educational contexts (Pedersen et al., 2018; Pichette, 2019). Consequently, students develop deeper understanding and decision-making skills through structured reasoning (Sánchez & González, 2025).

CONCLUSION

The Claim–Evidence–Reasoning framework is a versatile pedagogical tool applicable across STEM and humanities disciplines. It strengthens argumentative writing, critical thinking, and problem-solving skills required for contemporary challenges (Samosa, 2021; Yindeemak et al., 2025). By requiring claims supported by evidence and logical reasoning, CER enables coherent arguments and critical evaluation of information (Arias, 2015; Dolapçıoğlu, 2021; Pichette, 2019). It supports deeper disciplinary understanding through authentic learning practices (Robles et al., 2022; Subramaniam et al., 2024) and collaborative decision-making (Mathis et al., 2016; Thorne et al., 2024). Aligned with Rogerian argumentation and inference to the best

explanation, CER equips learners to engage in socio-scientific discourse, evaluate information critically, solve analytical problems, and develop metacognitive awareness (Fredrick, 2025; Guamanga et al., 2023; Martorell et al., 2024; Perdana et al., 2025; Surin & Damrongpanit, 2024; Cojorn & Sonsupap, 2024a, 2024b; Dahnuss et al., 2023; Jamil et al., 2024; Maryanti et al., 2025; Sánchez & González, 2025).

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