

# Rubric-based dynamic assessment and multimodal feedback: A transformative model for doctoral supervision

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This study investigates the effectiveness of rubric-based dynamic assessment combined with multimodal feedback in enhancing the quality of doctoral dissertations and fostering long-term academic development. Using a mixed-methods approach, the research examines the impact of structured, multimodal feedback – delivered through written comments, audio, and video – on doctoral candidates' dissertation quality, feedback literacy, and critical writing skills. Quantitative results reveal statistically significant improvements across all dissertation components (Academic Writing Quality, Literature Review, Methodology, and Data Analysis) from initial to final submissions, as indicated by a repeated measures ANOVA ( $p < 0.001$ ). Qualitative findings highlight the importance of feedback clarity, relevance, and emotional support, with students and supervisors emphasizing the value of video feedback in providing actionable guidance and maintaining motivation. The integration of rubrics facilitated targeted revisions and enhanced feedback literacy, enabling students to independently interpret and apply feedback. The study contributes to the theoretical understanding of dynamic assessment, rooted in Vygotsky's Zone of Proximal Development, by demonstrating how iterative, multimodal feedback scaffolds students' learning and fosters self-regulated academic growth. Practical implications include recommendations for integrating multimodal feedback in doctoral supervision to promote both cognitive and emotional support. The findings underscore the potential of this feedback model to inform higher education policy and improve doctoral education globally.

**Key Words:** Doctoral Supervision, Dynamic assessment, Feedback literacy, Multimodal Feedback, Research Skills Development, Writing skills.

## 1. Introduction

Doctoral supervision plays a fundamental role in shaping the academic and professional development of researchers. However, there is ongoing debate regarding the effectiveness of different supervisory approaches. Traditional models of supervision, such as the hands-off approach, emphasize student independence, often leaving candidates to navigate their research with minimal structured guidance. Conversely, hands-on supervision provides more frequent feedback and direct involvement but may limit students' autonomy (Lee, 2008; Manathunga, 2005).

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Despite these variations, feedback remains a critical component of effective supervision. Conventional feedback mechanisms, including written annotations and periodic verbal discussions, often lack the consistency and depth required for meaningful academic development (Boud & Molloy, 2013; Nicol, 2014). The challenge of balancing timely, structured, and constructive feedback persists in doctoral education, contributing to prolonged completion times and heightened student anxiety (Guerin et al., 2015).

This study aims to address these challenges by proposing a novel approach that integrates rubric-based dynamic assessment with multimodal feedback. Rooted in Vygotsky's (1978) concept of the Zone of Proximal Development (ZPD), which emphasizes learning through scaffolded support, this approach leverages dynamic assessment to provide interactive, learner-centered feedback, while multimodal feedback – incorporating written, audio, and video formats – enhances clarity and engagement (Henderson et al., 2021; Poehner & Lantolf, 2013). The tenets of the ZPD underpin the use of rubrics as structured benchmarks to guide candidates within their potential, and multimodal feedback, particularly video, as a tool for initiating dialogic-like interaction to foster academic growth, shaping the research design to support both independence and scholarly development. In this context, the term dialogic-like is used to describe video and audio feedback that emulates the richness, tone, and explanatory depth of a face-to-face supervisory conversation, even when delivered asynchronously. By combining these elements, this research seeks to establish a structured yet flexible feedback model that supports doctoral candidates' academic progression while fostering both independence and scholarly engagement.

## **2. Literature review**

Doctoral supervision is a critical process that significantly influences the academic and professional development of research candidates. However, despite its importance, supervision models continue to present challenges, particularly in balancing student autonomy with structured guidance. This section reviews the literature on doctoral supervision, focusing on supervision models, feedback practices, and emerging approaches such as dynamic assessment and multimodal feedback. It engages with key debates and tensions in these areas to highlight unresolved issues that this study addresses. It concludes by identifying gaps in the literature and outlining the research questions guiding this study.

### **2.1. Supervision models and their challenges**

Effective doctoral supervision should support students' intellectual growth while fostering their independence as researchers (Lee, 2008; Manathunga, 2005). Supervision models vary widely, ranging from hands-off approaches that prioritize student autonomy (e.g., infrequent meetings, minimal written feedback on drafts, limited access to the supervisor, and a reliance on the student to initiate communication or request support (Lee, 2008)) to hands-on models that emphasize frequent guidance and interaction. The hands-off model encourages self-directed learning but can lead to challenges such as student isolation, unclear expectations, and delays in research progression (Manathunga, 2005). In contrast, hands-on supervision provides regular feedback and support but may hinder the development of students' self-regulatory skills, creating over-reliance on supervisors (Lee, 2008). These variations have sparked debates about their efficacy, with some arguing that hands-off approaches foster the resilience and critical thinking essential for independent research, while others contend they risk neglecting diverse student needs, particularly in interdisciplinary or globalized contexts (Hyland, 2013). Research highlights the need for balanced supervisory models that offer structured yet flexible support through iterative and engaging feedback mechanisms (Boud & Costley, 2007). Recent studies have emphasized the evolving nature of doctoral education, particularly in response to globalization, digitalization, and interdisciplinary research. For example, McKenna and Schalkwyk (2024) conducted a scoping review of the changing landscape of doctoral education, highlighting the increasing demand for supervisory practices that adapt to diverse student needs and emerging academic trends. However,

tensions persist over how to balance flexibility with consistency, as hands-on models may improve completion rates but risk over-standardizing supervision, potentially stifling innovation in interdisciplinary research (Manathunga, 2020). Their findings underscore the importance of rethinking traditional supervision models to better align with the complexities of modern doctoral education.

## **2.2. The role of feedback in doctoral supervision**

Feedback is a cornerstone of effective doctoral supervision, playing a crucial role in refining students' research and writing skills. However, traditional feedback methods, such as written comments on drafts or periodic verbal discussions, often lack consistency, clarity, and responsiveness to students' evolving needs (Guerin et al., 2015). Studies suggest that feedback should transition from a one-way, monologic process – where students passively receive comments – to a two-way, dialogic interaction that promotes engagement and active learning (Carless & Boud, 2018; Nicol, 2014). Morton et al. (2014) provide a nuanced account of this transition, highlighting the importance of relational trust and contextual sensitivity in feedback practices. They argue that effective feedback in doctoral supervision hinges on building a collaborative supervisor-student relationship, where feedback is tailored to students' disciplinary contexts and developmental stages, fostering greater engagement and ownership of the learning process. This relational perspective complements the dialogic approach, emphasizing the need for feedback to be not only clear and consistent but also empathetic and responsive to individual student needs.

Structured feedback mechanisms, such as rubric-based assessments, have been shown to enhance clarity and consistency while encouraging students to take ownership of their learning (Andrade, 2005). By aligning feedback with clear criteria, rubrics can operationalize the relational and contextual nuances highlighted by Morton et al. (2014), ensuring that feedback is both actionable and relevant to students' specific research goals. Yet, some argue that rubrics may oversimplify complex academic tasks, potentially limiting their adaptability to diverse disciplinary contexts (Hyland, 2013). Recent research has also highlighted the role of technology in facilitating more timely and interactive feedback, with tools like online platforms and learning management systems enabling supervisors to provide continuous and accessible feedback (Henderson et al., 2019; Zawacki-Richter et al., 2019). However, its integration into doctoral supervision is contested due to varying institutional access and supervisor training, raising questions about scalability and equity. Despite these advancements, the integration of such mechanisms into doctoral supervision remains underexplored, particularly in combination with innovative approaches like multimodal feedback.

## **2.3. Dynamic assessment as an alternative framework**

Dynamic assessment offers a promising alternative to traditional feedback methods by emphasizing adaptive and responsive feedback. Rooted in Vygotsky's (1978) concept of the Zone of Proximal Development, dynamic assessment focuses on scaffolding students' learning and research skills through interactive, iterative feedback (Lidz & Elliott, 2000; Poehner & Lantolf, 2013; Storch, 2018). Unlike traditional assessment methods, which focus solely on outcomes, dynamic assessment recognizes the developmental nature of doctoral research and encourages continuous improvement. Research has demonstrated its effectiveness in various educational contexts, yet its application in doctoral supervision remains limited (Shrestha & Coffin, 2012). This limited application has sparked debate, with critics arguing that dynamic assessment's resource-intensive nature limits its scalability in higher education, while proponents highlight its potential to foster critical thinking and problem-solving by tailoring feedback to students' developmental stages (Poehner & Infante, 2017; Poehner & Wang, 2021). Recent studies have explored the potential of dynamic assessment in higher education, showing that it can enhance students' problem-solving abilities and critical thinking skills (Poehner & Wang, 2021). However, further research is needed to examine how dynamic assessment can be integrated into supervisory

practices to enhance feedback effectiveness. However, tensions remain over how to integrate it into supervisory practices without overwhelming supervisors or students, particularly given the lack of empirical studies testing its efficacy in doctoral contexts.

#### **2.4. Multimodal feedback: Benefits and limitations**

A complementary approach to improving feedback effectiveness is the use of multimodal feedback, which incorporates written, audio, and video-based formats. Studies indicate that multimodal feedback enhances engagement, comprehension, and retention by providing students with diverse ways to interact with their supervisors' comments (Borup et al., 2015; Henderson et al., 2021). For example, video feedback has been shown to create a more personalized and meaningful connection between students and supervisors, allowing for richer explanations and better contextualization of feedback (Mahoney et al., 2019). Crook et al. (2012) found that video feedback significantly improved students' ability to interpret and apply feedback, particularly in complex tasks, while also fostering a stronger sense of connection between students and supervisors. Additionally, multimodal feedback enables students to revisit feedback multiple times, promoting deeper engagement and reducing potential misinterpretations (Winstone & Carless, 2019). Recent research has further explored the use of audio and video feedback in online learning environments, demonstrating their potential to enhance student satisfaction and learning outcomes (West & Turner, 2016). However, debates persist about their efficacy, with critics highlighting barriers such as technological access and the time required to produce varied feedback formats (Tyrer, 2021). Cultural differences in interpreting audio or video feedback further complicate its universal application (Winstone & Carless, 2019). Despite these advantages, empirical research exploring the long-term impact of multimodal feedback in doctoral supervision is still limited.

Despite the promising potential of dynamic assessment and multimodal feedback, their combined application in doctoral supervision remains underexplored. A rubric-based feedback system within a multimodal framework could address existing challenges by providing clarity, consistency, and iterative support while maintaining students' autonomy. Rubrics help define clear expectations, making feedback more transparent and actionable (Boud & Molloy, 2013). When used alongside multimodal feedback, rubrics can guide students through the revision process, ensuring that feedback is not only comprehensive but also effectively utilized throughout their research journey (Brookhart, 2018). However, debates about the scalability and cultural adaptability of such integrated approaches persist, as their resource-intensive nature and potential disciplinary variations pose challenges for widespread adoption.

Given these gaps, this study seeks to answer the following research questions:

1. How does the integration of rubric-based dynamic assessment with multimodal feedback impact the methodological rigor and clarity of doctoral candidates' dissertations over time?
2. What are the perceptions of doctoral candidates and their supervisors regarding the clarity, relevance, and effectiveness of rubric-based dynamic assessment combined with multimodal feedback?
3. How do doctoral candidates implement and respond to rubric-based multimodal feedback in revising their dissertation drafts, and what are the resulting changes in their research and writing skills?
4. What are the long-term effects of rubric-based dynamic assessment and multimodal feedback on doctoral candidates' feedback literacy and self-regulated learning?

By addressing these questions, this study aims to contribute to ongoing debates about effective feedback models, offering empirical insights into how integrated approaches can balance clarity, engagement, and scalability to support doctoral candidates' development as independent scholars.

### 3. Methods

#### 3.1. Research design

This study employed a mixed-methods design to evaluate the effectiveness of rubric-based dynamic assessment and multimodal feedback in doctoral supervision. The quantitative component assessed changes in dissertation quality and students' perceptions of feedback effectiveness, while the qualitative component explored participants' experiences and the long-term impact of the intervention.

A mixed-methods approach was chosen to fulfill two complementary objectives: to quantify measurable improvements in dissertation quality over time and to capture the nuanced, subjective experiences of participants – an essential consideration when evaluating an innovative intervention like multimodal feedback (Creswell & Plano Clark, 2018). This design was especially appropriate given the exploratory nature of the study, which required both statistical evidence and rich contextual insights.

To track changes over time, a repeated measures design was applied, following the same group of participants across initial, mid-year, and final submissions. This within-subjects approach controlled for individual differences – such as prior academic experience – and increased statistical power despite the small, purposively selected sample (Creswell & Plano Clark, 2018). The research design was informed by Vygotsky's (1978) ZPD concept, which guided the development of a dynamic, scaffolded feedback system to support candidates' progression within their potential, integrating rubrics and multimodal feedback as key intervention components.

The quantitative and qualitative strands were integrated using a convergent parallel design, whereby each dataset was analyzed separately – using repeated measures ANOVA, *t*-tests, and Bayesian analysis for quantitative data, and thematic analysis for qualitative data – and then merged during interpretation. This integration enabled the identification of convergences (e.g., improved rubric scores aligning with positive participant perceptions) and divergences (e.g., persistent challenges noted in interviews despite statistical improvement), thereby enhancing the validity and depth of the findings (Creswell & Plano Clark, 2018).

#### 3.2. Participants

The study involved 18 doctoral students and 3 supervisors from a research-intensive university in Iran, selected via purposive sampling based on their experience with traditional and dynamic-assessment-based multimodal feedback. The study was conducted in English for Humanities English majors (their language of instruction) and in Persian for social sciences and engineering students, with dissertation drafts and rubrics in English for all to meet international publication standards, supported by translated guidance where needed. Qualitative data from Persian interviews and surveys were transcribed, translated into English by a bilingual researcher, and back-translated for accuracy (Temple & Young, 2004). Students spanned second to fourth years across humanities, social sciences, and engineering, while supervisors offered experienced perspectives. The 18 students were assessed three times (baseline, mid-intervention, and post-intervention), contributing to 54 data points, supporting the study's repeated measures design. This design enhances statistical power by reducing between-subject variance, making the available sample adequate for repeated-measures ANOVA and Bayesian analysis. The overall sample size of 21 (18 students and 3 supervisors) further met qualitative standards for data saturation and aligned with recommendations for exploratory mixed-methods research (Field, 2018; Creswell & Plano Clark, 2018). This selection was intended to provide a focused exploration of feedback mechanisms in doctoral supervision.

#### 3.3. Intervention: Feedback and revision process

The intervention was designed to enhance doctoral supervision through a structured, iterative, and dynamic feedback process combining rubric-based dynamic assessment with multimodal feed-

back. It aimed to provide clear, actionable, and personalized feedback aligned with doctoral research standards.

The process began with a pre-feedback orientation session, where candidates were introduced to the rubric criteria (see [Appendix D](#)), ensuring alignment between student and supervisor expectations. Candidates then submitted initial drafts, which supervisors assessed using the rubric to identify strengths and areas for improvement. Feedback was delivered through written annotations, audio commentary, and video explanations, catering to diverse learning preferences.

After receiving feedback, candidates entered a reflection and planning phase, reviewing feedback, identifying priorities, and creating revision plans. During the revision and resubmission phase, candidates revised drafts guided by the rubric, followed by collaborative review meetings with supervisors to discuss revisions and clarify feedback.

The final submissions were evaluated using the rubric, assessing feedback incorporation and overall quality. The intervention concluded with a post-feedback reflection session, where candidates and supervisors reflected on the learning experience and long-term impact, providing valuable data for evaluating effectiveness. This intervention was structured based on Vygotsky's (1978) ZPD concept, with rubrics serving as scaffolding tools to set benchmarks within candidates' potential, and multimodal feedback – particularly video – facilitating dialogic interaction to support iterative growth and bridge the gap between current and potential performance.

### 3.4. Data collection

Data were collected through writing assessments, surveys, and semi-structured interviews. The writing assessments were evaluated using custom-designed rubrics developed through a rigorous, literature-informed process (Brookhart, 2013; Reddy & Andrade, 2010). Six domains were assessed – Introduction, State-of-the-Art, Methodology, Results and Discussion, Conclusion, and Critical Thinking – each with detailed descriptors across five performance levels (Excellent to Unacceptable). Table 1 summarizes the rubric structure, including sample criteria from the Introduction and Methodology sections, illustrating how clarity, relevance, and critical insight were operationalized. The full rubrics are provided in [Appendix D](#). Criteria such as clarity, relevance, technical rigor, and critical insight were defined based on established doctoral writing standards.

**Table 1.** Summary of rubric structure and performance levels.

Domain	Example Criteria	Performance Levels (1–5)
Introduction	Contextualization of topic; identification of research gap; clarity of purpose and rationale	5 (Excellent): Comprehensive, clearly contextualized, and compellingly justified. 4 (Good): Clear and relevant but may lack depth in some aspects. 3 (Satisfactory): Basic coverage with limited elaboration. 2 (Needs Improvement): Incomplete or vague articulation of ideas. 1 (Unacceptable): Missing or irrelevant content.
State of the Art	Coverage, currency, and synthesis of literature; critical evaluation	5: Comprehensive, current, and critically synthesized. 4: Broad and relevant with minor gaps. 3: Adequate but lacks depth or integration. 2: Superficial coverage or weak synthesis. 1: Outdated or poorly integrated review.
Methodology	Clarity and precision; technical rigor; validation and justification	5: Fully transparent, replicable, and well-justified methods. 4: Clear and mostly detailed with minor omissions. 3: Generally sound but lacks precision. 2: Ambiguous or weakly justified. 1: Unclear or unreliable methods.

Domain	Example Criteria	Performance Levels (1–5)
Results and Discussion	Clarity, relevance, interpretation, integration, and critical insight	5: Highly coherent, well-interpreted, and critically integrated. 4: Clear and relevant with minor gaps. 3: Adequate but somewhat descriptive. 2: Weak connection between results and interpretation. 1: Unclear or inconsistent reporting.
Conclusion	Summary of findings; implications; limitations; future research	5: Insightful synthesis with clear implications and directions. 4: Coherent and relevant but less innovative. 3: Adequate summary with limited reflection. 2: Weak or incomplete closure. 1: Lacks coherence or reflection.
Critical Thinking	Depth of analysis; originality; reflexivity	5: Demonstrates exceptional analytical depth and originality. 4: Shows solid critical engagement. 3: Some evidence of analysis but limited originality. 2: Minimal critical engagement. 1: No evidence of critical or reflective thinking.

Initial rubrics were drafted following a review of relevant frameworks and refined through expert consultation with five doctoral supervisors and assessment specialists, ensuring content validity and disciplinary relevance. The rubrics were then piloted in two stages with six doctoral students from various disciplines. The first round identified ambiguities and prompted revisions; the second confirmed clarity and usability.

To ensure scoring reliability, a norming session was held with the three raters to calibrate scores using anonymized samples. This resulted in high inter-rater agreement (Cohen's kappa = 0.85). Internal consistency was also strong (Cronbach's alpha > 0.80), indicating robust reliability.

The validated rubrics served both assessment and pedagogical functions, guiding revisions and supporting feedback literacy. Complementary data were gathered through piloted surveys (Likert and open-ended items) and interviews exploring participants' experiences. Data collection occurred over six months, aligned with iterative feedback cycles.

### 3.5. Data analysis

Quantitative data were analyzed using repeated measures ANOVA, paired t-tests, and Bayesian analyses to track changes in dissertation quality and students' perceptions of feedback effectiveness across intervention stages. Analyses were conducted using SPSS (Version 29.0). The repeated measures ANOVA assessed main effects for time across dissertation components ( $p < 0.001$ ), with Bayesian analyses providing robust support through substantial Bayes factors (e.g., 50.0 to 150.0), enhancing the reliability of the findings.

Qualitative data (interviews and open-ended survey responses) were analyzed using inductive thematic analysis (Braun & Clarke, 2006). Two researchers independently coded transcripts in NVivo, identifying patterns related to feedback clarity, revision strategies, emotional support, and academic development. Themes were refined through iterative discussions. Inter-coder agreement on a sample of transcripts yielded Cohen's kappa = 0.83, and discrepancies were resolved by consensus to enhance trustworthiness.

Data integration followed a convergent parallel design (Creswell & Plano Clark, 2018), with qualitative and quantitative strands analyzed separately and merged during interpretation. Patterns of convergence (e.g., rubric score gains aligning with positive feedback perceptions), corroboration (e.g., qualitative accounts affirming quantitative improvements), and divergence (e.g., emotional challenges despite score increases) were systematically examined to ensure validity and provide a richer understanding of the intervention's impact.

### 3.6. Ethical considerations

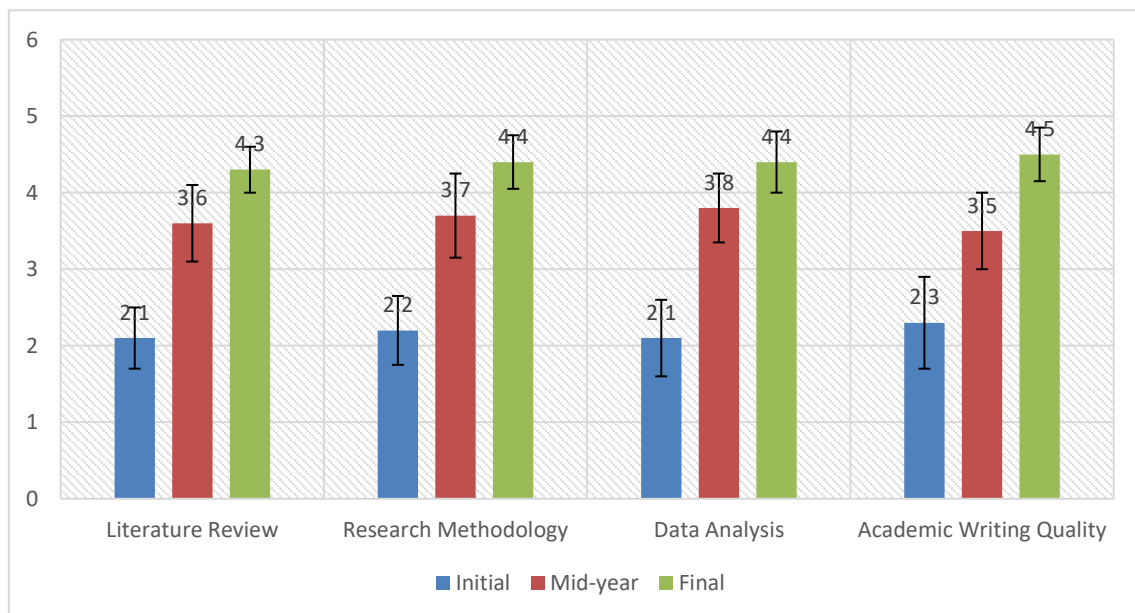
This study adhered to internationally recognized ethical principles, including the Declaration of Helsinki and the American Psychological Association (APA) Ethics Code. Formal ethics approval was not required, as the research-intensive university in Iran where the study was conducted does not have a formal ethics committee for any type of research. Instead, ethical oversight was provided by senior academic administrators at the institution, who monitored the research process to ensure full compliance with relevant ethical standards. Written informed consent was obtained from all participants, confidentiality and anonymity were maintained, participation was voluntary, and no physical, emotional, or psychological risk was posed to participants. Supporting documentation confirming the institutional context and oversight arrangements has been provided to the editor and is available upon request.

## 4. Results

This section presents the findings of the study in relation to the research questions, organized into quantitative and qualitative results.

### 4.1. Research Question 1: How does the integration of rubric-based dynamic assessment with multimodal feedback impact the quality of doctoral candidates' dissertations over time?

The descriptive statistics reveal a steady increase in mean scores across all components from the initial submission to the final submission (Figure 1), indicating a positive impact of the intervention on the quality of the dissertations. While the study does not include a control group or comparison with other feedback strategies, the consistent within-group gains across dissertation components suggest a positive association between the intervention and improved writing quality. Table 2 presents the ANOVA results, which demonstrate statistically significant improvements over time across all dissertation components. These improvements reflect the application of approaches aligned with Vygotsky's (1978) ZPD concept, where scaffolded support through the feedback intervention enabled candidates to progress toward their potential, as evidenced by the reduced variability in scores (as evidenced by the smaller *SDs*) by the final submission (Figure 1). However, it should be noted that the reduced variability seen in the final scores may in part be due to a ceiling effect (i.e. students could not score higher than 5).



**Figure 1.** Mean rubric scores with standard deviations ( $\pm SD$ ) across assessment points. Maximum possible score = 5.

Although total mean gains of 2.2–2.3 units were observed across all criteria, the final scores for the Literature Review ( $M = 4.30 \pm 0.49$ ) were somewhat lower than for the Academic Writing Quality ( $M = 4.50 \pm 0.50$ ). To explore whether this difference might indicate that improvement on the Literature Review component might be more difficult, a post-hoc paired  $t$ -test compared final Literature Review and Academic Writing Quality scores, revealing a marginally significant difference ( $t(17) = -2.15, p = .046$ , Cohen's  $d = -0.55$ ). This marginality, combined with potential ceiling effects (11% vs. 33% reaching a score of 5), likely explains the more gradual late-stage gains and reduced variability in the Literature Review component. A chi-squared test confirmed no significant association in ceiling attainment between components ( $\chi^2(1) = 1.69, p = .194$ ). Together, these tests suggest that while both components improved, the difference between them was small and partly constrained by ceiling effects inherent to the 5-point rubric. Within Vygotsky's (1978) Zone of Proximal Development, once students achieved the "Excellent" rubric level, further measurable progress was constrained, leading to condensed results.

The repeated measures ANOVA (Table 2) revealed significant main effects for time across all dissertation components ( $p < 0.001$ ), with substantial effect sizes indicating that the intervention had a significant positive impact on students' performance over time.

**Table 2.** ANOVA results for dissertation components assessing main effects for time.

Dissertation Component	$F(2, 34)$	$p$ -value	Effect Size (Partial $\eta^2$ )
Literature Review	14.56	< 0.001	0.46
Research Methodology	15.23	< 0.001	0.48
Data Analysis	16.12	< 0.001	0.50
Academic Writing Quality	17.85	< 0.001	0.52

#### 4.2. Research Question 2: What are the perceptions of doctoral candidates and their supervisors regarding the clarity, relevance, and effectiveness of rubric-based dynamic assessment combined with multimodal feedback?

The second research question explored the perceptions of doctoral candidates and their supervisors regarding the clarity, relevance, and effectiveness of rubric-based dynamic assessment combined with multimodal feedback. This investigation was conducted through a Feedback Effectiveness Survey and semi-structured interviews, both of which provided comprehensive insights into the participants' experiences with the feedback process.

Survey responses were analyzed to assess changes in students' perceptions regarding the feedback they received before and after the intervention. Paired  $t$ -tests and Bayesian analyses were employed to analyze the data, with the results summarized in Table 3. The survey results revealed statistically significant improvements in all areas measured, including clarity, relevance, impact on research skills, and overall satisfaction with the feedback.

The data indicate significant improvements in all areas measured by the survey, with particularly notable increases in the perceived relevance of feedback to students' work ( $\Delta = 1.3, t(17) = -5.77, p < 0.001$ , Cohen's  $d = 2.6, BF_{10} \approx 100.0$ ) and the impact of feedback on research skills ( $\Delta = 1.3, t(17) = -6.02, p < 0.001$ , Cohen's  $d = 2.6, BF_{10} \approx 120.0$ ). These enhancements in student perceptions underscore the effectiveness of the dynamic assessment-based multimodal feedback in fostering a more constructive and meaningful supervisory experience.

The Bayesian analysis, with substantial Bayes factors and credible intervals, further validates these findings, indicating strong evidence for the positive impact of the intervention. This is

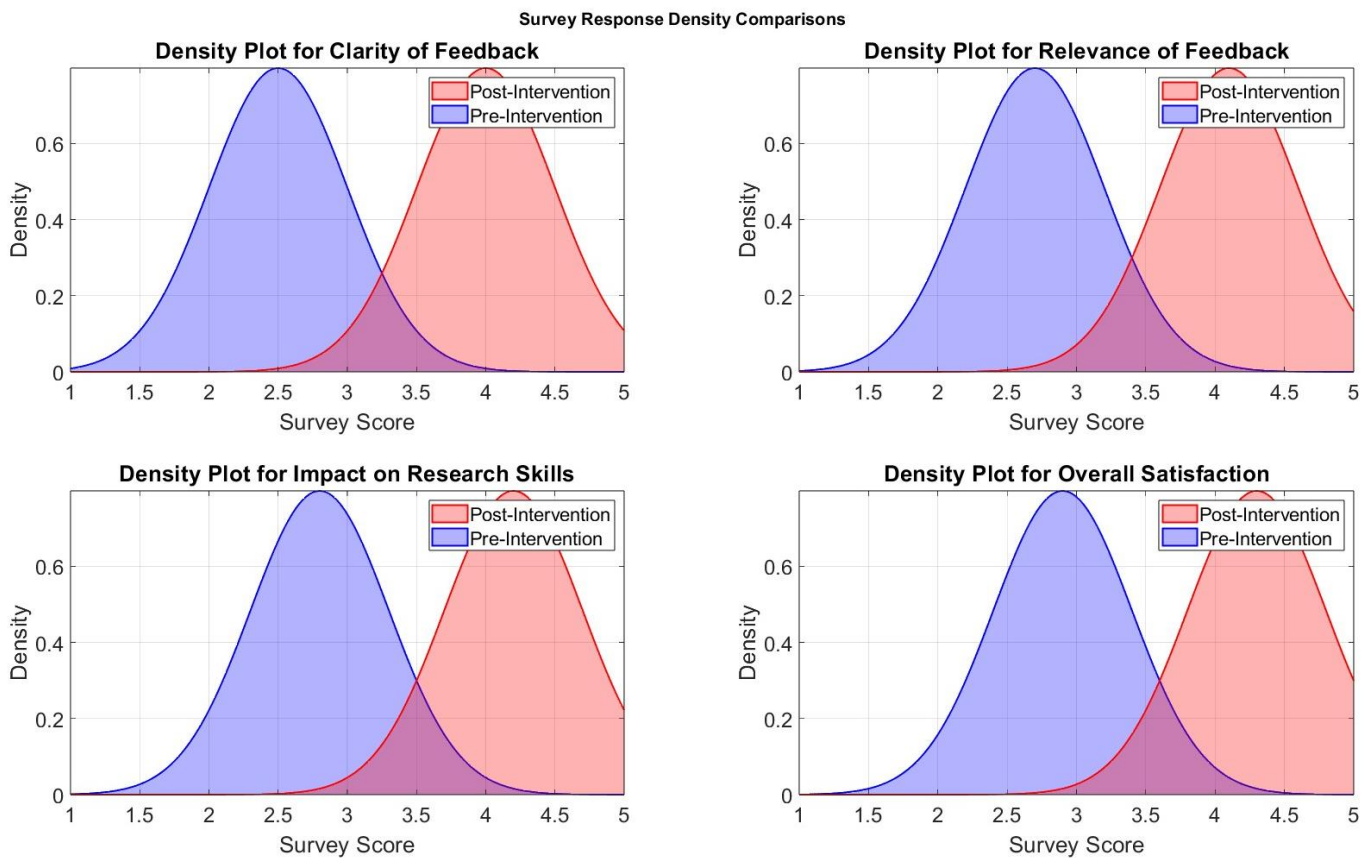
particularly evident in the large Bayes Factors (ranging from 50.0 to 150.0), which provide robust support for the observed improvements.

**Table 3.** Feedback effectiveness survey responses pre- and post-intervention using paired *t*-test and Bayesian analysis.

Survey Item	Pre-Intervention Mean	Post-Intervention Mean	<i>t</i> -value	<i>p</i> -value	Cohen's <i>d</i>	Bayes Factor (BF10)	Median Effect Size (95% CI)
Clarity of Feedback	3.2	4.1	-4.86	< 0.001	1.8	~50.0	~1.8 (1.2, 2.4)
Relevance of Feedback to My Work	3.0	4.3	-5.77	< 0.001	2.6	~100.0	~2.6 (2.0, 3.2)
Impact on Research Skills	3.1	4.4	-6.02	< 0.001	2.6	~120.0	~2.6 (2.0, 3.2)
Overall Satisfaction	3.0	4.5	-6.37	< 0.001	3.0	~150.0	~3.0 (2.4, 3.6)

Note: Survey responses were rated on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

The improvements in survey responses are visually represented in Figure 2, which presents density plots of survey scores before and after the intervention for various aspects of feedback. These plots show a clear shift in the distribution of scores towards higher ratings post-intervention, reflecting the enhanced perceptions of feedback clarity, relevance, and impact. The pre-intervention distributions are more spread out and centered on lower scores, whereas the post-intervention distributions are more concentrated at higher values, illustrating the overall increase in student satisfaction and the effectiveness of the feedback provided.



**Figure 2.** Density plots for survey responses pre- and post-intervention.

Qualitative data from the semi-structured interviews reinforced the quantitative findings, with both students and supervisors expressing positive perceptions of the clarity, relevance, and overall effectiveness of the feedback provided through the rubric-based dynamic assessment and multimodal approach. The feedback's clarity was frequently mentioned as one of the most appreciated aspects, especially the use of video explanations. As one student noted,

*The feedback was clear and directly applicable to my research, especially the video explanations, which made it easier to implement the suggested changes. I could revisit the video multiple times, which was incredibly helpful when I was revising my methodology.* (Student 3)

This clarity reflects the benefit of video feedback given in students' ZPD (i.e., providing personalized guidance to bridge the gap between current understanding and potential) while they are still revising their work – emulating dialogic-like interaction. Some participants, however, reported nuanced responses, such as initial difficulty accessing video feedback due to technical issues or mixed feelings about the rubric's structure, though these were less common and often resolved with support.

Another student highlighted how the multimodal feedback helped break down complex ideas:

*Sometimes, written feedback alone can be a bit vague or too dense. But having the feedback in multiple formats – like audio or video – really helped me understand what was expected. When I watched the video feedback, I could see exactly where my argument was weak, and the supervisor even referenced specific sections of my work while explaining it.* (Student 11)

This example emphasizes how students benefitted from having detailed, multimodal explanations that allowed for deeper engagement with the feedback.

In addition to clarity, students also praised the relevance of the feedback to their specific research contexts. One student stated,

*The feedback I received was very personalized, not just generic advice. It was clear that my supervisor was really engaging with the specifics of my dissertation, which made the feedback more meaningful. It felt like they were really invested in my progress.* (Student 15)

This quote highlights how the integration of rubrics into the feedback process ensured that feedback was aligned with clear evaluation criteria, making it highly relevant and actionable for the students.

Supervisors also commented on the increased effectiveness of the multimodal approach in enhancing communication and student engagement. One supervisor noted,

*Providing feedback in different formats – especially video – allowed me to explain complex points more effectively. Sometimes, you can only say so much in written comments, but with video feedback, I could walk the students through their drafts step by step, which they seemed to appreciate.* (Supervisor 2)

Another supervisor added,

*The rubric really helped me structure my feedback more effectively. I could clearly show students where they were excelling and where they needed to improve, based on concrete criteria. It made the whole feedback process more transparent.* (Supervisor 1)

The interviews also revealed how the dynamic nature of the feedback process, coupled with multimodal delivery, facilitated an iterative approach to revisions. One student reflected on how the feedback process encouraged active engagement:

*I didn't just receive feedback at one point; it was a continuous process. After every revision, I got feedback in different formats, which helped me stay on track. By the final submission, I felt much more confident in my work. (Student 8)*

Supervisors also acknowledged how this process fostered more productive interactions with their students. As one supervisor described,

*The students were much more responsive to the feedback this time. They would come back with specific questions or clarifications, especially after reviewing the video or audio feedback. It felt like a real dialogue, which is sometimes missing in traditional written feedback. (Student 8)*

This comment highlights how the multimodal feedback enhanced communication, making the supervisory relationship more interactive and responsive.

In addition to improving the clarity and relevance of the feedback, both students and supervisors noted how the intervention increased the perceived impact on students' research skills. One student explained,

*Before, I struggled to really understand how to improve my data analysis section. But after the feedback – especially the video where the supervisor walked me through some key points – I was able to restructure my analysis in a way that was much clearer and stronger. (Student 12)*

This finding underscores the direct impact of the feedback on helping students develop more robust research skills.

Supervisors echoed this sentiment, observing noticeable improvements in the quality of students' work as the feedback process progressed. One supervisor mentioned,

*I saw a real change in the way students approached their revisions. They were not just making surface-level changes; they were critically engaging with the feedback and making substantial improvements to their arguments and methodology. (Supervisor 2)*

This observation reflects how the feedback was not only clear and relevant but also effectively facilitated deeper learning and skill development.

Overall, these qualitative insights align closely with the survey data, providing a richer understanding of how the rubric-based dynamic assessment and multimodal feedback intervention positively influenced the doctoral supervision process. The consistent references to improved clarity, relevance, and student engagement demonstrate that the intervention enhanced the supervisory experience for both students and supervisors. These findings highlight the importance of adopting a dynamic, multimodal feedback approach in higher education, particularly for complex and individualized processes like doctoral supervision. These findings are underpinned by the concept of students' ZPD, where the structured use of rubrics and the dialogic-like nature of multimodal feedback supported candidates' growth within their potential.

#### **4.3. Research Question 3: How do doctoral candidates implement and respond to rubric-based multimodal feedback in revising their dissertation drafts, and what are the resulting changes in their research skills?**

The qualitative analysis of semi-structured interviews and document analyses revealed that doctoral candidates actively engaged with and responded to the rubric-based multimodal feedback, resulting in substantive revisions to their dissertation drafts. This engagement is consistent with Vygotsky's (1978) ZPD, where the structured feedback process facilitated growth within candidates' potential through scaffolded support. Within this ZPD framework, rubrics provided a supportive structure to guide revisions, while the clarity and revisability of video feedback, along with the development of feedback literacy, were key to these improvements. The key

themes identified – Feedback Clarity, Feedback Relevance, and the Revision Process – are depicted in Table 4 below.

**Table 4.** Key themes and sub-themes identified from qualitative analysis

Theme	Sub-themes
Feedback Clarity	Clear Instructions, Specific Examples, Consistent Language
Feedback Relevance	Alignment with Research Goals, Practical Utility, Contextualization
Impact on Research Skills	Enhanced Understanding, Skill Development, Critical Thinking
Emotional and Academic Support	Emotional Support, Academic Guidance, Motivational Effect
Revision Process	Incorporation of Feedback, Iterative Improvements, Reflection on Changes

Feedback Clarity emerged as a crucial factor in how effectively students were able to implement the revisions. Clear instructions, specific examples, and detailed explanations provided in multiple formats—written, audio, and video – ensured that students understood what was required of them. One student remarked, “*The feedback I received was incredibly clear. My supervisor always provided specific examples in the written comments, and the video explanations made it easier to understand where I needed to improve.*” (Student 1)

Multimodal feedback, especially video feedback, also allowed students to revisit feedback as needed, which contributed to more careful and thoughtful revisions. “*Being able to watch the video feedback multiple times helped me catch details I might have missed in a one-time meeting.*” (Student 2). This continuous access to clear, structured feedback was instrumental in helping students revise their work more effectively.

Feedback Relevance was also a key theme, with students emphasizing how feedback aligned with their research goals and provided actionable, practical guidance. One student highlighted how relevant and practical the feedback was:

*The feedback was always aligned with my research goals, which made it very practical and useful. The written comments provided clear action points, and the video feedback helped me see exactly how to implement them.* (Student 7)

The integration of rubrics ensured that feedback was tied directly to key criteria, making it easier for students to understand the relevance of the feedback to their work. Rubrics served as ZPD scaffolding tools, providing structured benchmarks to guide revisions within candidates’ potential. The combination of clear and relevant feedback resulted in a more focused and efficient Revision Process, where students were able to make iterative improvements. One participant described this process: “*Each round of multimodal feedback helped me refine my drafts further. The written comments, audio explanations, and video feedback were crucial in developing a high-quality dissertation.*” (Student 15)

Figure 3 provides a visual representation of how these themes interact. Feedback Clarity enhances Feedback Relevance, and both influence the Revision Process. Clear and relevant feedback led to more targeted revisions, improving the quality of dissertation drafts at each stage. Students expressed that having this clarity and relevance allowed them to engage more deeply with the feedback, make meaningful revisions, and develop their research skills over time. The interplay of these themes suggests that while rubrics supported the process, the iterative multimodal feedback and growing feedback literacy were central to the observed improvements. The limited direct

evidence linking rubrics to specific improvements suggests their role is primarily structural, necessitating further study to isolate their contribution from multimodal and dialogic effects.

The iterative Revision Process, supported by ZPD's framework, enabled candidates to progressively expand their capabilities, with multimodal feedback fostering dialogic growth. The revision process also included elements of reflection, where students revisited their work based on continuous rounds of feedback. This iterative nature was appreciated by participants: *"Incorporating the feedback from different modes into my revisions helped me see the progress I was making. It was a reflective process that made me appreciate the value of continuous improvement."* (Student 11)

Although emotional support is more directly related to Research Question 4, it played a role in students' ability to remain motivated during the revision process. The encouragement and personalized feedback from supervisors, delivered through video messages, helped students maintain confidence. One student explained: *"My supervisor's feedback wasn't just about my work; it was also about encouraging me. The personal touch in the video messages made me feel more confident in my abilities."* (Student 10) This emotional support created a conducive environment for learning and revision, making the process less daunting for students.

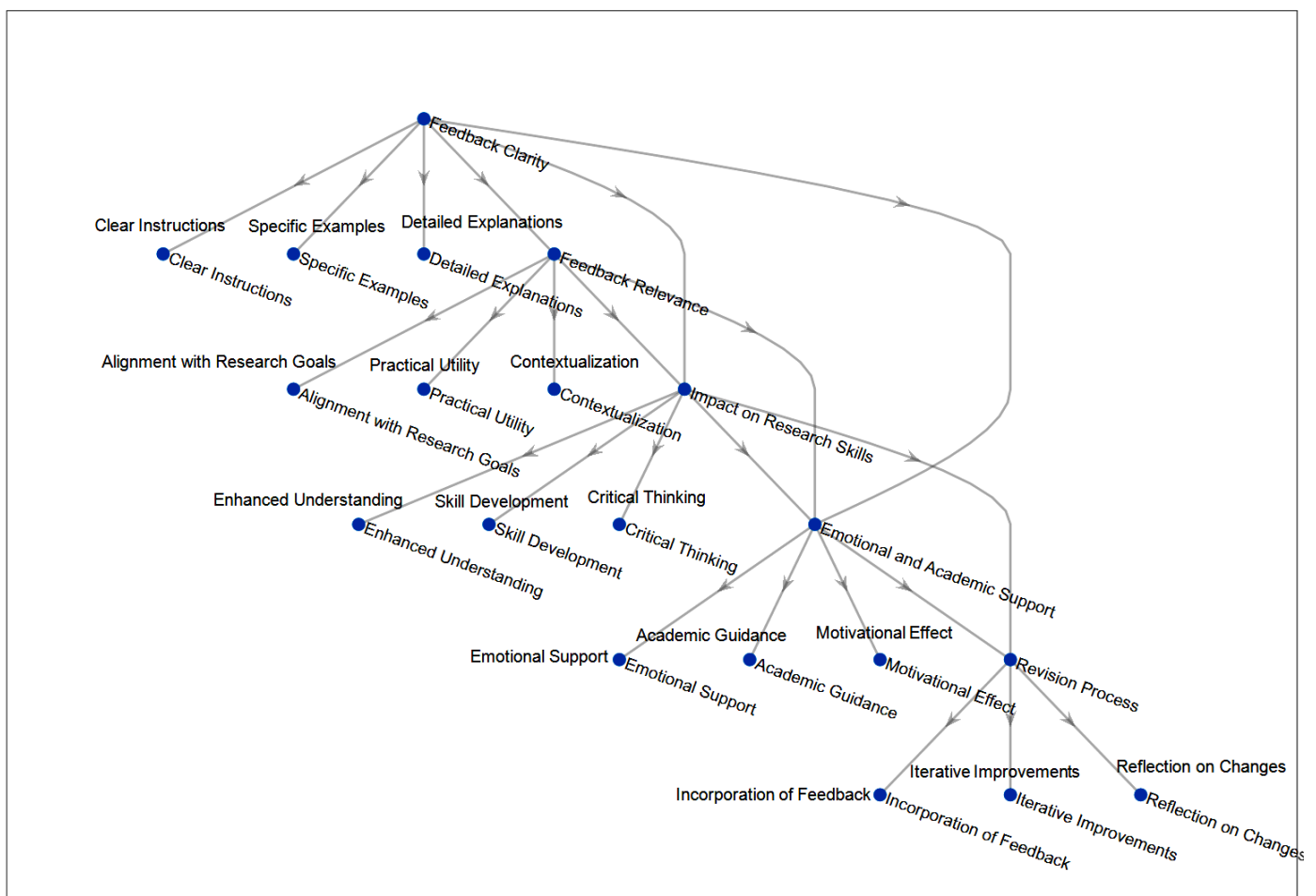


Figure 3. Interconnections of key themes.

#### 4.4. Research Question 4: What are the long-term effects of rubric-based dynamic assessment and multimodal feedback on doctoral candidates' academic development, including their feedback literacy and critical writing skills?

The long-term impact of the rubric-based dynamic assessment and multimodal feedback on doctoral candidates' academic development was explored through follow-up interviews conducted 6–12 months post-intervention and reflective accounts collected over the same period,

focusing on enhancements in feedback literacy (e.g., self-assessment skills) and critical writing skills (e.g., argumentative depth). The qualitative analysis revealed that the intervention had a lasting influence on students' ability to engage with and apply feedback, as well as their overall approach to academic writing. These long-term effects are consistent with Vygotsky's (1978) ZPD, where scaffolded support and dialogic-like feedback fostered sustained growth within candidates' potential.

#### 4.4.1. Development of feedback literacy

One of the most significant long-term effects of the intervention was the enhancement of students' feedback literacy – their ability to understand, interpret, and apply feedback effectively. This was a recurring theme in the interviews, where students described how their capacity to engage with feedback improved over time. As one student reflected:

*Before this process, I used to find feedback confusing, and sometimes I didn't know how to apply it. But after getting video feedback and seeing how my supervisor walked me through the revisions, I now feel much more confident in understanding and acting on feedback in general. (Student 10)*

This development reflects ZPD's focus on expanding potential through scaffolded learning, with feedback literacy emerging as a key outcome of the guided support process.

The iterative, multimodal feedback process not only clarified individual feedback sessions but also trained students to become more proactive in seeking and using feedback. As another student noted:

*I've learned how to anticipate what kind of feedback my work might need. Now, when I write, I think about the areas that might need improvement even before receiving feedback. This has definitely made me more self-sufficient and reflective. (Student 6)*

The thematic analysis, depicted in Figure 3, highlights how Feedback Clarity and Feedback Relevance, combined with the iterative Revision Process, contributed to the development of feedback literacy. These interconnected themes helped students internalize the feedback process, turning what was initially external guidance into an intrinsic part of their writing and revision strategies.

Supervisors also observed improvements in students' engagement with feedback, even beyond the dissertation work. One supervisor explained:

*By the end of the intervention, the students were not just passively receiving feedback. They were actively asking questions, reflecting on their work, and even predicting what feedback might be useful before they submitted their drafts. (Supervisor 2)*

This shift in feedback engagement represents a deeper transformation in how students approached academic work, moving from a dependent to a more independent, reflective stance.

#### 4.4.2. Enhancement of critical writing skills

The intervention also had a long-lasting impact on students' critical writing skills. Students reported that the feedback process, particularly the detailed, multimodal explanations provided through video and annotated documents, significantly improved their ability to structure and refine their arguments. One participant noted:

*The video feedback was incredibly helpful in showing me how to strengthen my arguments. My supervisor would point out areas that needed more evidence or explanation, and by seeing how to address those issues, I improved not just that section, but my writing overall. (Student 8)*

The Impact on the Research Skills theme, illustrated in Figure 3, shows how enhanced feedback processes contributed to skill development over time. The combination of rubrics, multimodal feedback, and an iterative revision process facilitated deep learning, enabling students to apply critical thinking more effectively in their writing. This process was further reinforced by regular, structured feedback cycles, as one student explained:

*I used to struggle with organizing my arguments clearly, but after several rounds of video feedback, I finally understood how to structure my ideas in a logical and convincing way. Now, when I write, I can more easily see where I need to improve.* (Student 9)

Students also developed a greater awareness of how to critique their own writing, a skill that has persisted beyond the dissertation. Another student reflected on how the feedback intervention changed their approach to academic writing:

*Before this process, I would rely on my supervisor to point out weaknesses in my writing. Now, I can spot them myself. The rubric and the feedback helped me develop a critical eye, and that has made a huge difference in how I approach any academic task.* (Student 4)

#### 4.4.3. Emotional and academic support in the long term

While Emotional and Academic Support played a key role in facilitating revisions during the intervention, its long-term effects – sustained confidence and improved academic engagement – were primarily driven by the personalized, revisable video feedback, with rubrics providing a consistent framework to support this process. The encouragement and personalized feedback, particularly in video format, provided a sense of ongoing support that students carried with them into other academic tasks. One student described how the motivational effect of the feedback persisted even after the dissertation was completed:

*The feedback wasn't just technical. My supervisor was supportive and encouraging, which gave me confidence in my abilities. That feeling stayed with me, and even now, when I work on other projects, I remember that I'm capable of pushing through challenges.* (Student 11)

This emotional growth is consistent with the supportive framework envisioned when working with students in their ZPD, where multimodal feedback fostered a conducive learning environment to bridge candidates' emotional and academic potential.

Supervisors also noticed that students seemed more motivated and confident in their abilities after the intervention. One supervisor reflected: *“It wasn't just about improving their dissertation. The students became more confident overall. They seemed more willing to tackle challenging projects, and I think the supportive feedback helped build that confidence.”* (Supervisor 3)

Figure 3 also shows how Emotional and Academic Support intertwined with Feedback Clarity and Feedback Relevance, creating a feedback loop that not only improved academic performance but also provided the emotional resilience needed to persist through academic challenges.

#### 4.4.4. Long-term reflections and future application

The feedback literacy and critical writing skills that students developed during the intervention were reported to have had lasting effects on their broader academic development, as evidenced by consistent themes in follow-up reflections and interviews conducted 6–12 months post-intervention. Many students expressed that they now feel better equipped to handle feedback in future academic and professional settings. One participant shared:

*I feel like I've grown so much as a researcher. I'm no longer intimidated by feedback, and I feel confident in my ability to keep improving. The skills I've learned will definitely help me in the future, whether it's for another research project or in my career.* (Student 13)

Supervisors also highlighted how students became more independent over time, engaging with feedback more critically and reflecting on their own work in ways that they hadn't before the intervention. One supervisor noted:

*By the end of the process, students were really taking ownership of their work. They didn't need me to hold their hand as much; they were able to apply feedback on their own and even anticipate potential areas of weakness in their drafts. (Supervisor 1)*

## 5. Discussion

The findings from this study, integrating both quantitative and qualitative analyses, provide significant insights into the effectiveness of rubric-based dynamic assessment combined with multimodal feedback in doctoral education. These insights also inform Academic Language and Learning (ALL) advisors, who can leverage rubrics and multimodal tools to support PhD students' writing and feedback interpretation, thereby extending the discussion initiated by Hyland (2009) on how academic discourse involves socialization into disciplinary practices. Hyland (2009) highlights that academic writing is not merely about mastering linguistic conventions but is also about participating in the communicative practices of a disciplinary community. Building on this foundation, the present study explores how multimodal and dialogic-like feedback, supported by rubric-based scaffolding, can facilitate this process of academic enculturation by integrating both cognitive and relational dimensions of supervision.

The evidence suggests that rubrics provided a structured foundation to support feedback delivery, while the clarity, emotional support, and revisability of multimodal feedback – particularly video – along with the development of feedback literacy, were central to enhancing doctoral candidates' academic development. These outcomes are underpinned by Vygotsky's (1978) concept of the Zone of Proximal Development (ZPD), where scaffolded support (e.g., rubrics as benchmarks) and dialogic-like interaction (e.g., video feedback for personalized guidance) facilitated candidates' progression within their potential, shaping the intervention's iterative design and fostering growth in feedback literacy. These results critically validate and extend existing literature by aligning with Carless (2019) on feedback efficacy while advancing the area of inquiry raised by Hyland (2009) through the novel integration of multimodal and relational elements, which prior studies have underemphasized, though the relative contributions of rubrics, multimodal delivery, and dialogic-like practices require further investigation to fully elucidate their impact. This study offers a structured feedback model that could inform higher education policy, particularly by guiding faculty training programs in multimodal techniques for both supervisors and ALL advisors to incorporate multimodal feedback techniques, revising institutional guidelines to prioritize emotional support, and allocating resources for video-based feedback tools to support doctoral candidates' cognitive and emotional development.

### 5.1. Integrated findings and their implications

The quantitative evidence of rising mean scores and reduced variability by final submission reflects the intervention's success in enhancing and standardizing dissertation quality across the cohort. These findings were complemented by qualitative themes of feedback clarity and relevance, where students noted that video explanations and rubrics reduced ambiguity and enabled targeted revisions, directly contributing to the area of disciplinary literacy development discussed by Hyland (2009). The considerable increases in the mean scores on all criteria suggests the targeted strategies were effective. However, while the Literature Review component showed a somewhat smaller final mean score as compared to Academic Writing Quality, this difference was marginal as confirmed by the marginal *t*-test difference reported in Section 4.1. Nevertheless, this pattern aligns with Boud and Molloy's (2013) and Carless and Boud's (2018) views on actionable feedback, suggesting that additional tailored approaches could further enhance Literature Review development. Qualitatively, the emotional support from video feedback, fostering

motivation and confidence, supports these gains, resonating with Henderson et al. (2019) on feedback's emotional impact. This integrated perspective, rooted in ZPD's scaffolding via rubrics and dialogic-like 'interaction via multimodal feedback, situates the study within the broader discourse on academic socialization (Hyland, 2009) highlighted by demonstrating a novel approach to bridging current supervisory practices and candidates' evolving disciplinary potential, an area prior research has underexplored, as illustrated by the iterative cycle's role in Student 7's ability to apply video feedback to research goals.

The iterative revision process, a qualitative strength, mirrors the quantitative trajectory of score improvements, suggesting a dynamic feedback cycle that enhances both immediate performance and long-term skills. This cycle, framed within ZPD, extends Borup et al.'s (2015) views on video feedback's clarity, advancing the concern highlighted by Hyland (2009) about how feedback mediates participation in disciplinary communication, for example, through Student 15's use of multimodal feedback to refine drafts. However, the secondary role of rubrics compared to multimodal feedback and feedback literacy highlights an area for refinement, warranting further study.

## **5.2. The role of rubrics in enhancing feedback literacy**

The integrated findings indicate that rubrics provided a structured framework enhancing feedback clarity and relevance, supporting students in aligning their work with expectations, though their role appears secondary to the iterative multimodal feedback and growing feedback literacy that drove substantive improvements. Within ZPD's scaffolding framework, rubrics guided revisions toward potential, responding to the pedagogical challenges discussed by Hyland (2009) about how students learn to navigate disciplinary expectations in academic writing, as exemplified by Student 4's development of a "critical eye" through rubric-guided self-critique. This aligns with Dawson (2017) on rubric transparency, proving valuable in the doctoral context. The study's international relevance stems from rubrics' adaptability across diverse systems.

A key contribution is the fostering of feedback literacy, where students became proactive in interpreting feedback. This growth, driven by ZPD's guided learning and supported by multimodal feedback, extends Hyland's (2009) broader argument that academic competence develops through participation in discursive practices, by showing how multimodal supervision can accelerate that process. As seen in Student 6's ability to "anticipate" feedback needs, this literacy enhances immediate dissertation quality and prepares students for future academic contexts, an aspect needing more attention per Middleton et al. (2024).

## **5.3. Theoretical contributions: Dynamic assessment and Vygotsky's ZPD**

The study advances dynamic assessment theory in doctoral education, rooted in Vygotsky's (1978) ZPD, emphasizing interactive scaffolding. The integrated quantitative/qualitative findings – score rises and themes of clarity, support, and iteration – demonstrate how rubric-based scaffolding and multimodal dialogic-like interaction build upon Hyland's (2009) conceptualization of academic discourse as socially mediated practice. This advancement extends dynamic assessment beyond traditional cognitive scaffolding to include emotional and social dimensions, as evidenced by the qualitative theme of emotional support fostering resilience, a dimension underexplored in Poehner (2008) and Lantolf and Poehner (2011) on ZPD applications. The study's novel contribution lies in integrating multimodal feedback as a dialogic-like tool within each student's ZPD, suggesting a redefinition of scaffolding that incorporates technology-mediated interaction, which could apply to other high-stakes educational contexts like medical training. Furthermore, the iterative feedback cycle, mirrored by quantitative score trajectories, proposes a dynamic ZPD model where student potential evolves through repeated, tailored interventions, challenging static assessment paradigms. This dynamic approach fosters immediate improvements and long-term growth in critical thinking and self-regulation, prompting future

theoretical work to explore how the concept of the ZPD can be adapted to digital learning environments and diverse disciplinary frameworks, enhancing its cross-disciplinary relevance.

#### **5.4. Practical implications for doctoral supervision**

The integrated findings inform doctoral supervision policy. Supervisors should use multiple feedback modes to enhance clarity and engagement, utilizing tools like screencast software (e.g., Camtasia) to deliver video feedback, while Academic Language and Learning (ALL) advisors can adopt these in workshops to clarify writing concepts, aligning with ZPD's dialogic principle to advance the pedagogical issues raised by Hyland (2009) concerning students' enculturation into disciplinary discourse. Feedback aligned with research goals supports growth, with supervisors and ALL advisors collaborating to set rubric-aligned milestones in coaching and training sessions to reinforce this, enhancing ZPD scaffolding. Emotional encouragement via personalized formats, reflecting ZPD's supportive framework, maintains motivation, and ALL advisors can integrate video check-ins or audio feedback to reduce student anxiety, building on qualitative insights of confidence gains from this type of feedback. Iterative feedback, embodying ZPD's scaffolding, enhances development, supported by scheduled revision cycles where supervisors and ALL advisors facilitate peer reviews to foster a supportive community, thereby extending the supervisory practices discussed by Hyland (2009) in relation to feedback and academic development.

Beyond supervision, institutions should integrate this model into doctoral curricula, with ALL advisors embedding multimodal training to enhance feedback literacy, aligning with the study's quantitative score improvements. Supervisor and ALL advisor training programs should expand to include workshops on multimodal techniques and ZPD principles, ensuring effective scaffolding across roles and extending the theoretical conversation initiated by Hyland (2009) on how students become active participants in academic discourse. Resource allocation policies should prioritize funding for video tools and technical support for both supervisors and ALL advisors, supported by the study's demonstrated impact on dissertation quality. Finally, peer support networks, co-facilitated by ALL advisors, should leverage the emotional support theme to create collaborative learning environments, potentially contributing to well-being – though further evidence is needed, as noted. This expanded model informs comprehensive policies, supporting academic success and laying a foundation for future well-being research.

#### **5.5. Limitations and future research directions**

While this study provides valuable insights, it is important to acknowledge its limitations. First, although the repeated measures design provided sufficient statistical power (54 data points), the relatively small number of participants and single institutional context may limit the generalizability of the findings. Future research could explore replication with larger, more diverse cohorts, including students from different cultural and disciplinary backgrounds, through a multi-site randomized controlled trial to assess broader applicability. Second, the study focused primarily on doctoral candidates in a specific academic context, and the findings may not be directly applicable to other educational levels or professional training programs. This focus may overlook curriculum or supervision factors, limiting transferability. Future studies should explore the effectiveness of this feedback model in undergraduate, master's, and professional development contexts using a comparative design with pre/post-assessments to adapt it.

Additionally, the study did not extensively explore the role of cultural differences in the reception of multimodal feedback. This gap could affect engagement and partly explain marginally smaller gains observed in the Literature Review component, which were likely influenced by ceiling effects rather than definitive evidence of less progress. Given that video feedback may be perceived differently across cultures, future research should investigate how cultural norms and communication styles influence the effectiveness of multimodal feedback through a mixed-methods study with three diverse groups to develop tailored strategies. Finally, while the study

demonstrated the benefits of rubric-based feedback, it did not address potential challenges in implementing rubrics across different disciplines or institutions. This may cause inconsistent application, compromising fairness across fields. Future research should explore strategies for adapting rubrics to diverse academic contexts and ensuring their accessibility to all students by conducting a multi-disciplinary pilot with adaptable templates and feedback to enhance equity. The integrated quantitative/qualitative findings highlight the need to disentangle rubrics, multimodal feedback, and dialogic practices within a ZPD framework to further extend the discussion of disciplinary discourse development initiated by Hyland (2009).

## 6. Conclusion

In conclusion, this study demonstrates the transformative potential of dynamic assessment-based multimodal feedback in doctoral education. By integrating rubric-based feedback with video and written comments, this approach not only enhances immediate academic performance but also fosters long-term feedback literacy and critical thinking skills. These findings have significant implications for higher education policy, particularly in the design of feedback systems that support both cognitive and emotional development. Future research should explore the scalability of this model across diverse educational contexts and investigate strategies for tailoring feedback to individual learning needs. Ultimately, this study contributes to a growing body of literature advocating for more personalized, iterative, and emotionally supportive feedback practices in doctoral education. These insights may also inform the practices of academic language and learning advisors who support doctoral candidates through writing development and feedback-focused interventions.

## Declarations

1. **Ethics approval:** the research adhered to internationally recognized ethical standards for conducting research involving human participants. The following measures were taken to ensure the ethical integrity of the study:
  - **Informed Consent**
    - All participants were provided with detailed information about the study's purpose, procedures, and their rights as participants.
    - Written informed consent was obtained from each participant before their involvement in the study.
    - Participants were informed that their participation was voluntary and that they could withdraw at any time without penalty.
  - **Confidentiality and Anonymity**
    - All data collected during the study were treated with strict confidentiality.
    - Participants' identities were anonymized, and any identifying information was removed from the data.
    - Data were stored securely, with access limited to the research team.
  - **Voluntary Participation**
    - Participants were assured that their decision to participate or withdraw from the study would not affect their academic standing or relationship with their supervisors or institution.
    - No incentives or coercion were used to encourage participation.
  - **Transparency and Honesty**
    - The research team maintained transparency throughout the study by clearly explaining the research objectives and procedures to participants.
    - Any questions or concerns raised by participants were addressed promptly and honestly.

- **Minimization of Harm**
    - Care was taken to ensure that the study did not cause any physical, psychological, or emotional harm to participants.
    - Feedback sessions were conducted in a supportive and constructive manner, and participants were encouraged to share any concerns they had during the study.
2. **Competing / conflict of interests:** The authors declare no conflict of interest.
  3. **Use of Generative AI:** During the preparation of this work, the authors used Microsoft Copilot in order to refine the language, improve readability, and enhance clarity. The authors have reviewed all content and wordings created by the generative AI tool used, edited this content as needed, and take full responsibility for the content of the publication.

## Appendix A: Feedback effectiveness survey

**Section 1:** Please indicate your level of agreement with the following statements using the scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

1. The feedback provided was clear and easy to understand.
2. The feedback was relevant to my dissertation goals and objectives.
3. The feedback helped me improve the quality of my dissertation.
4. The feedback was provided in a timely manner.
5. The feedback addressed my specific concerns and questions effectively.
6. I found the feedback process to be a valuable learning experience.

### Section 2:

7. In what ways did the feedback help you in refining your dissertation?
8. What aspects of the feedback process did you find most beneficial?
9. Were there any aspects of the feedback that you found challenging or unhelpful? If so, please explain.

## Appendix B: Semi-structured interview questions

**Instructions:** These interview questions are designed to gather insights into your experiences with the feedback process throughout your dissertation journey. Your responses will help us understand the effectiveness of the rubric-based dynamic assessment and multimodal feedback provided at different stages of your dissertation.

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### Section 1: General experience with feedback

1. How would you describe your overall experience with the feedback received during the dissertation process?
2. What aspects of the feedback process did you find most helpful?
3. Were there any specific challenges you encountered while incorporating feedback into your work?

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### Section 2: Effectiveness of multimodal feedback

4. How effective did you find the combination of written, audio, and video feedback in improving your dissertation work?
5. Did the multimodal feedback provide greater clarity compared to traditional feedback methods? Why or why not?

6. How did the different feedback formats influence your motivation and engagement with the revision process?

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### Section 3: Impact of rubric-based dynamic assessment

7. How useful did you find the rubric-based assessment in understanding the expectations for each section of your dissertation?
8. Did the rubric criteria align with your understanding of dissertation quality? Please elaborate.
9. Were there any aspects of the rubric-based assessment that you found confusing or difficult to apply?

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### Section 4: Feedback influence on academic development

10. How did the feedback influence your critical thinking and argumentation skills?
11. In what ways did the feedback contribute to your self-regulation and time management strategies?
12. Did you observe any improvements in your confidence and emotional resilience as a result of the feedback process?

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### Section 5: Suggestions for improvement

13. What suggestions do you have for improving the feedback process in future dissertation projects?
14. Are there any additional support mechanisms you believe should be incorporated into the feedback process?

## Appendix C: Examples of reflective journal entries

### Reflective journal entry 1: Engagement with feedback

*"The screencast feedback provided by my supervisor was incredibly helpful. Watching them walk through my argument structure and point out areas needing improvement clarified my understanding. It was like having a personal tutorial tailored to my work. I now realize that my methodology section needed more alignment with the research objectives, and I have revised it accordingly. This type of feedback not only showed me what to change but also why these changes are important."*

*"During the second round of feedback, the video my supervisor shared included annotated examples from other articles. This helped me see how professional researchers structure their arguments. I found it incredibly useful and applied the insights to my own introduction and literature review sections."*

*"The video feedback was helpful, but the audio was sometimes hard to follow due to background noise, which delayed my revisions. I had to request a written summary to catch up."*

*"The clarity provided by video feedback was unmatched. Watching my supervisor visually highlight the weak connections in my results section made it easy to identify the exact areas needing revision. This type of feedback felt more interactive and engaging than written comments."*

*"The video feedback allowed me to revisit specific critiques as needed. This flexibility was invaluable when revising my methodology section, as I could see step-by-step what adjustments were necessary."*

*"In one instance, my supervisor used screencast feedback to compare my analysis with a published article. This helped me identify key areas for improvement, such as integrating more robust statistical interpretations."*

### **Reflective journal entry 2: Development of self-regulation skills**

*"In the second cycle of feedback, I started anticipating the comments my supervisor might make. I reviewed my work against the rubric and identified areas where I fell short, such as providing stronger evidence for my claims in the discussion section. This proactive approach reduced the number of revisions needed. Using the audio feedback alongside the rubric made it easier to address specific points systematically."*

*"By the third feedback round, I began to self-assess my draft before submission. I used the rubric criteria and previous feedback to identify potential weaknesses. For example, I noticed my argumentation lacked depth in the literature review and worked on integrating additional sources to strengthen it before receiving new feedback."*

*"The iterative feedback process taught me to be more critical of my work. Before submitting my final draft, I revised it twice independently, checking for alignment with the rubric and addressing clarity issues in my writing. This habit of self-evaluation has greatly improved my confidence and efficiency."*

*"After receiving feedback in the first cycle, I started creating a checklist based on my supervisor's comments. This habit made it easier to ensure that my revisions addressed all major points before resubmitting my draft."*

*"By the final cycle, I felt more in control of the feedback process. Instead of waiting passively, I reviewed my work against past comments and proposed potential solutions during review meetings."*

### **Reflective journal entry 3: Emotional resilience and confidence**

*"I was initially intimidated by the extent of revisions suggested in the first round of feedback. However, hearing the tone of my supervisor's audio feedback, where they acknowledged the strengths in my work before addressing areas for improvement, made the critique feel less overwhelming. It gave me the confidence to tackle the revisions without feeling defeated. By the final draft, I felt proud of the progress I had made."*

*"The constructive tone of the feedback, especially the audio clips, made me feel supported. Even when there were many points to improve, my supervisor's encouragement gave me the motivation to keep refining my draft. This emotional support made a huge difference in how I approached revisions."*

*"After a challenging review session, the empathetic feedback helped me reframe my perspective. Instead of viewing revisions as failures, I began to see them as opportunities to improve. My confidence grew as I saw how implementing feedback led to noticeable improvements in my work."*

*"The audio feedback often included phrases like, 'This is a great start,' which helped me stay motivated. It was reassuring to know that my efforts were on the right track, even when there was room for improvement."*

*"Positive reinforcement in the feedback, such as acknowledging incremental progress, made the revision process feel rewarding rather than tedious. This approach helped me build confidence over time."*

**Reflective journal entry 4: Improvements in academic performance**

*"The written feedback was particularly useful for refining the clarity of my argumentation. My supervisor's comments highlighted repetitive points and areas where my logic was unclear. Incorporating these suggestions significantly improved the flow of my writing, as reflected in my rubric scores. The iterative process of revision and feedback has been challenging but incredibly rewarding."*

*"Feedback on my results section helped me restructure the data presentation. By including more detailed visual aids, such as graphs and tables, I was able to clearly convey key findings. This adjustment not only improved my scores but also made the section more comprehensible for readers."*

*"My supervisor's feedback on critical thinking encouraged me to deepen my analysis of the literature. By addressing counterarguments more robustly, I improved the quality of my discussion section. The increase in my rubric scores validated the effort I put into revising based on feedback."*

*"Through consistent feedback cycles, I learned how to present my methodology with greater clarity. This improvement was evident in my final scores, which showed significant progress compared to earlier drafts."*

*"One of the most helpful pieces of feedback was a suggestion to use subheadings in the discussion section. This not only improved readability but also ensured that my arguments were logically structured and easy to follow."*

*"While the rubric clarified expectations, I found it overwhelming to address all areas at once initially. Over time, breaking it into smaller tasks helped me manage the process."*

## Appendix D: Assessment rubrics

**Assessment Rubric for Introduction Section in PhD-Level Research**

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Needs Improvement (2)	Unacceptable (1)
<b>Contextualization of Topic</b>	You provide an outstanding contextualization of your topic, clearly situating it within the broader field of power electronics with comprehensive background information.	Your contextualization is strong, with relevant background information, though some minor aspects may lack depth.	You provide basic context for your topic, but more detailed or relevant background information is needed.	The context of your topic is unclear or too narrowly focused, lacking sufficient background information.	You fail to provide any meaningful context for your topic.
<b>Identification of Research Gap</b>	You excellently identify a clear, significant research gap in power electronics, demonstrating a deep understanding of the field's current state.	You identify a relevant research gap, though the significance or clarity could be enhanced.	Your identification of a research gap is present but not compellingly articulated or is too general.	The research gap is poorly defined, vague, or minimally relevant to the field.	You do not identify a research gap or it is entirely irrelevant.
<b>Purpose and Importance of Study</b>	The purpose of your study is articulated with exceptional clarity, and its importance and potential impact on the field are compellingly presented.	The purpose of your study is clear and its importance to the field is evident, though the impact could be more compelling.	The purpose of your study is stated, but its importance or impact on the field is not clearly conveyed.	The purpose of your study is unclear or lacks significance, with minimal impact on the field.	The purpose of your study is missing or irrelevant to the field of power electronics.
<b>Research Questions/Hypotheses</b>	You formulate precise, well-defined research questions or hypotheses that directly address the identified gap and are central to power electronics.	Your research questions or hypotheses are relevant and clear but could be more specific or directly tied to the research gap.	Research questions or hypotheses are present but lack precision or direct relevance to the identified gap.	Research questions or hypotheses are vague, poorly constructed, or only loosely related to the identified gap.	You do not present any research questions or hypotheses, or they are completely off-topic.
<b>Structure and Organization</b>	Your introduction is exceptionally well-structured, with a logical flow that guides the reader through the context, gap, purpose, and research questions seamlessly.	The structure of your introduction is coherent, with a logical progression, but minor improvements could enhance the flow.	The structure is adequate, but transitions between topics are abrupt or the logical progression could be clearer.	The introduction is poorly structured, lacking a clear progression or logical flow of ideas.	The introduction is disorganized, making it difficult or impossible for the reader to follow your line of reasoning.
<b>Engagement and Rationale</b>	You engage the reader with compelling rationale, demonstrating the study's significance and setting clear expectations for the research.	You provide a good rationale that engages the reader, though it lacks some compelling elements.	The rationale for your study is basic, providing minimal engagement or lacking a compelling nature.	The rationale is weak, failing to engage the reader or set clear expectations for the study.	There is no discernible rationale, or it fails to relate to your study or engage the reader.

**Assessment Rubric for State-of-the-Art Section in PhD-Level Research**

Criteria	Excellent (5 points)	Good (4 points)	Satisfactory (3 points)	Needs Improvement (2 points)	Unacceptable (1 point)
<b>Coverage and Depth</b>	You comprehensively cover all current and significant research in power electronics, providing an in-depth analysis that demonstrates a full grasp of the field.	Your coverage is broad, but some new or niche areas may not be as deeply explored.	You cover key areas of current research, but your analysis lacks depth in some sections.	Your coverage is too narrow, missing significant areas of current research, and your analysis remains superficial.	You fail to cover critical areas of current research, offering no real analysis.
<b>Currency of Literature</b>	Your literature is exceptionally current, including the latest significant publications and breakthroughs in power electronics.	Most of the literature you review is recent, though a few key recent works may be missing.	Your literature review includes relevant work but is not fully up-to-date with the latest research.	Much of the literature you review is outdated, lacking recent developments.	You rely on old sources, with no reference to current research trends.
<b>Relevance to Research Aims</b>	Every piece of literature you review is highly relevant to your research aims and is integrated into a coherent narrative that supports your study's direction.	The literature you review is relevant and supports your research aims, though some connections may be implicit rather than explicit.	While generally relevant, some literature does not clearly connect to your research aims or contribute to a coherent narrative.	The relevance of much of the literature to your research aims is unclear, with a narrative that feels disjointed.	The literature you review lacks relevance to your research aims, offering no clear narrative.
<b>Critical Evaluation</b>	You critically evaluate sources, identifying gaps in the research and offering insightful perspectives that underpin the necessity of your study.	You offer a critical evaluation of most sources, identifying some gaps, though deeper insights are limited.	Your critical evaluation is basic; you identify obvious gaps but offer little insight into their implications for your study.	You show minimal critical evaluation; sources are described rather than analyzed, and gaps are not addressed.	There is no critical evaluation; you merely summarize sources without analysis.
<b>Synthesis of Literature</b>	You synthesize the reviewed literature seamlessly, creating a compelling argument for your study's context and necessity.	You synthesize literature effectively but with minor lapses that do not detract from the overall argument.	Your synthesis is adequate but lacks the cohesion needed to build a strong argument for your study.	You attempt to synthesize literature, but the result is a disjointed argument with weak connections.	You fail to synthesize the literature, resulting in a fragmented or non-existent argument for your study.
<b>Referencing and Conformity to Standards</b>	Your referencing is impeccable and strictly adheres to the standards expected in power electronics research, enhancing the credibility of your review.	Your referencing is solid with only minor deviations from the standard format.	You reference appropriately, but there are noticeable inconsistencies with standard formatting.	Your referencing is inconsistent, with several errors affecting the readability and professionalism of your review.	You demonstrate a lack of understanding of proper referencing, with numerous errors and non-conformity to standards.

**Assessment Rubric for Methodology Section in PhD-Level Research**

Criteria	Excellent (5 points)	Good (4 points)	Satisfactory (3 points)	Needs Improvement (2 points)	Unacceptable (1 point)
<b>Clarity and Precision</b>	You articulate every step of your methodology with exceptional detail and precision, setting a clear path for others to replicate your work exactly.	You present your methodology clearly, detailing most steps well, though minor clarifications may be needed for replication.	Your methodology is described in general terms; key steps are covered, but some lack detail, leading to potential ambiguity.	Important details of your methodology are vague or missing, making replication uncertain without further explanation.	Your methodology is described so poorly that key steps are unclear or incorrect, preventing replication.
<b>Relevance and Justification</b>	Your methodology demonstrates a direct and highly relevant application to power electronics, with each choice strongly justified in relation to your research question.	Your methodology is relevant to power electronics, with most choices justified; however, some connections may not be fully explained.	Your methodology has a general relevance with a basic justification, but the link to your research question isn't compellingly argued.	Your methodology's relevance to power electronics is tenuous, with weak justifications that don't convincingly tie back to your research.	There's no clear relevance or justification for your chosen methodology in the context of power electronics.
<b>Technical Rigor</b>	You show mastery of technical concepts with a methodology that is robust, precise, and aligned with the highest standards of power electronics research.	Your technical approach is solid, with only minor errors or imprecisions that don't significantly impact your methodology's robustness.	Your methodology is technically sound but lacks the precision or detail that demonstrates a higher level of expertise.	Your methodology demonstrates a basic understanding of the technical aspects but with significant flaws or misapplications.	Your methodology shows fundamental misunderstandings of the technical principles required in power electronics.
<b>Innovation</b>	Your methodology contributes novel techniques or applications that could lead to significant advancements in power electronics.	You introduce new aspects or improvements to existing methods, showing original thought.	Your methodology applies standard techniques correctly, with minimal innovation.	Your methodology lacks originality, relying on well-established techniques without any customization or improvement.	Your methodology is outdated or commonplace, offering no new insights or advancements to the field.
<b>Validation and Verification</b>	You provide a comprehensive validation and verification of your methods, with results that are detailed, transparent, and replicable, showcasing the reliability of your work.	Your validation and verification are thorough, with minor aspects that could be further detailed to enhance transparency.	You perform basic validation and verification, but the process and results lack comprehensive detail.	Your attempts at validation and verification are minimal, with results that raise questions about their reliability.	You fail to provide any meaningful validation or verification, leaving the reliability of your methods in doubt.

**Assessment Rubric for Results and Discussion in Research**

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Needs Improvement (2)	Unacceptable (1)
<b>Clarity of Results</b>	Your results are exceptionally clear, detailed, and well-illustrated, making them easily interpretable.	Your results are clear with good illustrations, but some minor details may need clarification.	Results are understandable but could be presented more clearly or with better illustrations.	Results lack clarity and detail, making them difficult to interpret.	Results are unclear and not interpretable.
	Every result you present is directly tied to and effectively supports your research questions.	Most results are relevant, but there may be some unnecessary or loosely connected data.	Some results directly support your research questions, but others do not clearly contribute.	Many results seem irrelevant or poorly connected to your research questions.	Results do not relate to your research questions.
<b>Interpretation of Data</b>	You provide a deep, insightful interpretation, clearly relating findings to theoretical and practical implications.	Your interpretation is mostly insightful but lacks depth in some areas.	Interpretation is basic, missing some deeper insights into your findings.	Interpretation is superficial or somewhat incorrect.	No coherent interpretation is provided.
	Your discussion is seamlessly integrated with results, critically relating findings to existing literature and your research context.	The discussion relates to results, but connections to literature and research context could be deeper.	Discussion connects findings to existing research but lacks critical analysis or depth.	Discussion feels disconnected from results and lacks contextualization.	Discussion is missing, irrelevant, or incoherent.
<b>Critical Thinking and Insight</b>	Your discussion demonstrates advanced critical thinking, contributing new insights to power electronics.	You show good critical thinking, offering some new insights.	Critical thinking is present but does not offer significant new insights.	Critical thinking is minimal, with no new insights.	Your discussion lacks critical thinking and does not contribute new insights.
	Your narrative flows logically and coherently, building a compelling argument.	There is a good flow, though some points could be better connected.	Flow is adequate, but some jumps or disconnected points are present.	Flow is poor, making the narrative confusing.	The narrative is incoherent with no logical flow.

**Assessment Rubric for Conclusion Section**

<b>Criteria</b>	<b>Excellent (5)</b>	<b>Good (4)</b>	<b>Satisfactory (3)</b>	<b>Needs Improvement (2)</b>	<b>Unacceptable (1)</b>
<b>Summary of Findings</b>	You provide an exceptional summary of your key findings, clearly linking back to your research questions and hypotheses.	Your summary covers all major findings but may lack some details or connections to your initial questions.	You summarize the main findings, but the summary lacks depth or clear linkage to your research objectives.	The summary of findings is incomplete or vague, missing critical aspects of your research.	You fail to summarize your findings, leaving the reader without a clear understanding of your research outcomes.
<b>Interpretation and Implications</b>	You offer a deep and insightful interpretation of your findings, discussing their implications for the field of power electronics and beyond.	Your interpretation is solid, with relevant implications discussed, though it may lack depth in some areas.	Interpretation is present but basic, with minimal discussion of the broader implications.	The interpretation of your findings is superficial or unclear, with few or no implications discussed.	You do not provide any meaningful interpretation or discuss implications of your findings.
<b>Future Research Directions</b>	You propose clear, innovative, and feasible directions for future research, demonstrating forward-thinking and a deep understanding of the field.	You suggest relevant future research directions, but they may lack originality or feasibility.	Your suggestions for future research are basic and somewhat generic, lacking a strong foundation in your findings.	Future research directions are either too vague, unrealistic, or not well-connected to your findings.	You do not suggest any future research directions, or your suggestions are irrelevant or incoherent.
<b>Reflection on Limitations</b>	You critically reflect on the limitations of your study, providing a thoughtful and transparent analysis that enhances the credibility of your research.	You acknowledge limitations, but the reflection lacks depth or critical analysis.	You mention some limitations, but they are either not well-explained or lacking in significance.	The discussion of limitations is minimal or overly simplistic, failing to add to the research's credibility.	You do not discuss limitations, or the discussion is irrelevant or misleading.
<b>Coherence with Entire Paper</b>	Your conclusion effectively ties together all elements of your paper, creating a coherent and satisfying closure that reinforces your study's value.	Your conclusion ties most elements of your paper together well, though some aspects may be underemphasized.	The conclusion provides a basic closure but does not effectively integrate all elements of your paper.	The conclusion feels disconnected from the rest of your paper, missing key elements or coherence.	The conclusion is disjointed, failing to provide any sense of closure or connection to your paper.
<b>Impactful Closing</b>	Your closing remarks are impactful, leaving a strong and memorable impression of your study's significance and contributions.	Your closing is clear and somewhat impactful, but it may lack the memorability or strength of an excellent conclusion.	The closing is adequate but lacks a strong impact or memorability.	The closing of your paper is weak, adding little to the overall impact of your study.	You provide no real closing, ending your paper abruptly or without any impactful statements.

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