

Supervising the Master's Thesis in the Age of Generative AI: A Model of Distributed Sociocognitive Regulation

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Abstract

This article examines the supervision of the Master's thesis in a context shaped both by a growing complexity of cognitive demands and by the increasing integration of generative artificial intelligence. While the literature tends to treat relational, cognitive, and technological dimensions separately, this study puts forward an integrative approach grounded in the notion of distributed sociocognitive regulation. Based on a triangulated qualitative corpus—student productions, mediated interactions, AI uses, and self-reported data—the findings bring to light recurrent discursive blockages (enunciative instability, argumentative fragility), as well as a dynamic of co-vulnerability between students and supervisors, within a technodiscursive environment marked by fragmentation and hybridization of writing forms. Within this framework, the article develops a multilevel typology of regulatory processes and proposes an empowering supervision model, grounded in metacognitive scaffolding and in a reflective integration of artificial intelligence.

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1. Introduction

The supervision of the Master's thesis is most often conceptualized as an asymmetrical pedagogical relationship, structured by the transmission of methodological competencies and by a gradual guidance toward research autonomy. The supervisor is thus assigned a guiding role intended to ensure both the scientific quality of student work and its conformity with academic norms, notably through functions of supervision, regulation, and validation of scholarly production (Grant, 2005; Lee, 2008). However, such a representation tends, in actual practice, to homogenize supervisory situations which, in reality, appear far more contrasted—shaped by sometimes significant cognitive, interactional, and contextual variability.

A number of studies have shown that academic writing cannot be reduced to a mere activity of reproduction. It constitutes a complex process of knowledge construction. Ken Hyland (2013) thus underlines that academic writing operates simultaneously as a cognitive and social activity, structured by disciplinary expectations and by the conventions specific to academic communities. In a similar vein, Dominique Maingueneau (2014) reminds us that discourse cannot be dissociated either from its conditions of enunciation or from the institutional frameworks that organize it. These perspectives lead us to view writing difficulties not as simple linguistic deficits, but rather as manifestations of ongoing conceptualization processes, sometimes still unstable.

At the same time, contemporary transformations in academic work contribute to redefining the conditions of supervision. The intensification of workloads, the multiplication of follow-up interactions, and the increasing mediation of exchanges through digital devices expose supervisors to forms of pressure that are both organizational and cognitive (Halse & Bansel, 2012). From a cognitive standpoint, such situations can be illuminated by the cognitive load theory developed by John Sweller (2011). Certain modes of instructional design may generate an extraneous load likely to hinder—or at times slow down—learning processes. In the case of scientific writing, the intrinsic complexity of tasks combines with extrinsic constraints linked

to the very modalities of supervision. This evolution now unfolds within an environment marked by the rise of generative artificial intelligence, which also contributes to reshaping the conditions of knowledge production and appropriation.

1.1. Research gap

Despite these contributions, a significant blind spot remains in the literature. Existing research most often addresses separately the relational dimension of supervision (Grant, 2005; Lee, 2008), the cognitive processes involved in learning (Sweller, 2011), or the effects of educational technologies on academic practices (Selwyn, 2019). Truly integrative approaches—capable of capturing the concrete articulation of these dimensions within supervisory situations—remain limited. Yet it is precisely within this articulation that a substantial part of learning processes is constructed, or fails to stabilize, along with many of the difficulties observed.

This gap becomes even more apparent in the current context, marked by the expansion of generative artificial intelligence. As systems capable of producing coherent and context-sensitive texts, these technologies contribute to redefining writing processes, regimes of authorship, and modes of knowledge appropriation. Emily M. Bender and colleagues (2021) point out that such systems function as “stochastic parrots,” that is, models capable of generating statistically plausible utterances without genuine semantic understanding; this observation directly raises questions about their use in academic contexts. From a complementary perspective, Marie-Anne Paveau (2017) shows that digital environments constitute genuine technodiscursive ecologies, within which linguistic productions emerge—sometimes in diffuse ways—from interactions between human actors and technical devices.

1.2. Research objectives

This article seeks to address this gap by proposing an integrative approach grounded in the notion of distributed sociocognitive regulation. Inspired by Edwin Hutchins’ (1995) work on distributed cognition, this notion refers to a process in which cognitive operations—understanding, structuring, textualization, and reflexive adjustment—are not exclusively carried out by an individual subject. Rather, they are distributed across human actors and technical mediations, embedded within institutionally constrained environments.

We hypothesize that the difficulties observed in thesis supervision—whether they take the form of writing blockages, interactional misalignments, or discursive instabilities—do not stem from isolated individual shortcomings. Instead, they correspond to situated sociocognitive configurations, produced through the interaction between cognitive constraints, regulatory modalities, and technodiscursive environments.

A triangulated qualitative corpus, combining student written productions, mediated supervisory interactions, exchanges with conversational agents, and self-reported data, makes it possible to pursue three objectives:

- to identify the discursive manifestations of sociocognitive blockages;
- to analyze regulatory dynamics within the supervisory relationship;
- to examine the effects of technodiscursive mediations and artificial intelligence on processes of authorship and knowledge appropriation.

1.3. Contributions

On this basis, the article advances three main contributions, each directly addressing the fragmentation identified in the literature.

- First, it proposes the concept of distributed sociocognitive regulation as an integrative theoretical framework, making it possible to articulate dimensions that have, until now, been treated separately.
- Second, it highlights a multilevel typology of regulatory processes, differentiated according to their degree of explicitness and their transformative potential.
- Third, it develops an empowering model of supervision, in which explicit metacognitive scaffolding and the reflective integration of artificial intelligence tools constitute central levers for the development of autonomy.

These contributions can be summarized as follows:

Table 1. Contributions of the article

Type of contribution	Content
Theoretical	Concept of distributed sociocognitive regulation
Analytical	Multilevel typology of regulatory processes
Applied	Empowering supervision model

This structuring more clearly highlights the complementarity between the theoretical, analytical, and applied contributions of the article, while also helping to move beyond the compartmentalization of existing approaches. By articulating these different dimensions, the article thus offers a renewed understanding of academic supervision, as it unfolds within environments marked by complexity, technological mediation, and the persistence—difficult to reduce—of a certain degree of uncertainty.

2. THEORETICAL FRAMEWORK

2.1. Fragmentation of approaches in the literature

Research on academic supervision has undeniably generated substantial contributions; yet it remains structured around three traditions which, more often than not, continue to be approached in a relatively separate manner. Relational approaches conceive supervision as a situated practice, shaped by tensions of an institutional, temporal, and, to some extent, ethical nature (Grant, 2005; Halse & Bansel, 2012). At the same time, work devoted to academic writing emphasizes its dual cognitive and constructive dimension, stressing that producing a text ultimately amounts to elaborating knowledge rather than merely reproducing it (Hyland, 2013). Finally, research focusing on the digital highlights the transformations brought about by technological environments, both in learning practices and in the very modalities of discursive production (Selwyn, 2019).

Despite their complementarity, these approaches remain, in practice, relatively compartmentalized. Relational models tend to underestimate the cognitive constraints actually at play, whereas cognitive approaches often leave the interactional dimension in the background; as for technodiscursive analyses, they are frequently confined to a descriptive aim. Such fragmentation limits our understanding of supervisory situations, even though these simultaneously articulate all three dimensions. It prevents, in particular, a clear grasp of how these dimensions co-determine one another in real supervisory contexts. Under these conditions, adopting an integrative approach appears not only relevant, but likely necessary, if one is to account for the effective dynamics of adjustment.

2.2. Rethinking asymmetry: situated interactional regulation

Classical models of supervision generally rely on the assumption of a relatively stable asymmetry between supervisor and student, grounded both in academic expertise and in a form of institutional legitimacy (Grant, 2005). However, this asymmetry, although formally established, does not necessarily guarantee—within concrete situations—the effective stability of processes of understanding and interpretation. In practice—and this is perhaps a decisive point—supervisory interactions appear rather as spaces of negotiation, sometimes implicit, within which expectations, norms, and meanings are subject to ongoing adjustments, even revisions, over the course of exchanges (Halse & Bansel, 2012), often in ways that are difficult to verbalize and with effects that vary depending on interactional configurations.

From this perspective, supervision can be understood as an activity of situated interactional regulation. Drawing on an ethic of care (Tronto, 1993) makes it possible to move beyond a strictly normative logic and to consider the concrete conditions of learning. Attention to real constraints—cognitive, temporal, organizational—thus becomes constitutive of both pedagogical activity and the supervisory relationship.

In this sense, asymmetry does not disappear; rather, it is reconfigured. It coexists with forms of cognitive and interactional instability that make continuous regulation necessary. Supervision, then, appears less as a simple top-down transmission than as an ongoing process of adjustment.

2.3. Supervision as regulation of cognitive load

Cognitive load theory provides, in many respects, a particularly relevant framework for analyzing the complexity inherent in scientific writing (Sweller, 2011). It distinguishes, in a now well-established way, intrinsic load—linked to the complexity of the task itself—extraneous load, which relates to modes of presentation and organization, and germane load, engaged in learning and cognitive structuring processes. Within the context of thesis work, these three dimensions tend, in practice, to accumulate: one must simultaneously conceptualize a research object, organize the argument, write coherently, and, at the same time, comply with academic norms.

From this viewpoint, supervision can be interpreted as an activity aimed at regulating this load. It seeks to render tasks more manageable, notably through processes of explicitation, segmentation, and prioritization. Such interventions indeed help to limit cognitive overload while supporting—sometimes gradually—the structuring of cognitive processes.

However, this regulation also concerns supervisors themselves, who are exposed to organizational constraints and to the multiplicity of follow-up interactions (Halse & Bansel, 2012). Difficulties, therefore, do not pertain solely to students; they emerge from an interactional configuration subject to shared constraints. This perspective invites us to conceive cognition as distributed across actors, practices, and technical mediations (Hutchins, 1995), rather than as purely individual. In doing so, it opens the way toward an understanding of adjustment that is no longer centered exclusively on the individual, but distributed across actors and devices.

2.4. Technodiscursive environment and distributed cognition

Supervisory practices are now embedded in digital environments that contribute, sometimes quite markedly, to restructuring the conditions under which academic discourse is produced. These devices cannot be regarded as neutral. They alter the temporalities of work, reshape interaction formats, and more broadly influence the modalities of appropriation, circulation, and legitimation of knowledge (Selwyn, 2019).

Following the work of Edwin Hutchins (1995), cognition can be approached as a distributed dynamic, unfolding across actors, practices, and artefacts, without any clear-cut boundary between these levels. For her part, Marie-Anne Paveau (2017) shows that digital environments constitute genuine technodiscursive ecologies, within which language and technology appear tightly intertwined—at times even difficult to disentangle. From this perspective, academic writing can be seen as a hybrid process, continuously mediated by digital tools and technological forms of interaction, which partly condition how it unfolds.

The emergence of generative artificial intelligence tends, in fact, to reinforce this dynamic. Such systems intervene directly in textual production by externalizing, at least in part, certain operations of formulation, organization, and reformulation of discourse. However, as Emily M. Bender and colleagues (2021) point out, they generate statistically plausible utterances without guaranteeing any real understanding of their content; this mode of functioning thus introduces a tension between facilitating written production and fostering genuine knowledge appropriation.

2.5. Toward an integrative model of distributed sociocognitive regulation

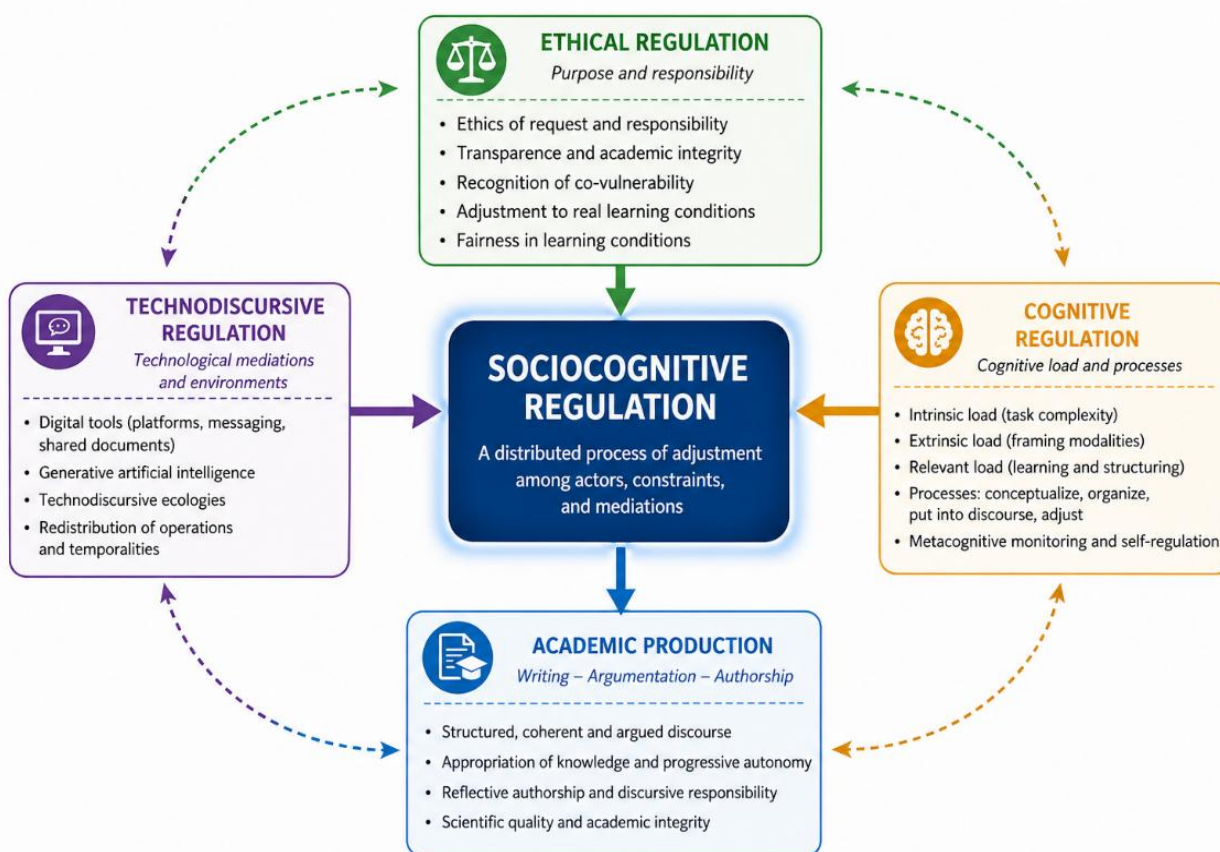
Articulating the ethical, cognitive, and technodiscursive dimensions leads to viewing supervision as a configuration of distributed sociocognitive regulation. Within this perspective, the model assumes that learning processes emerge from the interaction between actors, cognitive constraints, and technical mediations, where interactional regulations may either alleviate or, conversely, amplify cognitive load, while technodiscursive mediations modulate its form and temporality. The effects of this interaction are not always immediately stabilized.

In this model, writing difficulties are no longer considered isolated deficits but rather the result of misalignments between these different levels of regulation. They thus appear as emergent effects of a system under tension. Such misalignments may manifest, in particular, through discursive blockages, interactional misunderstandings, or instrumental uses of technological tools.

The aim is no longer to oppose autonomy and guidance, nor human and technology, but to think through their co-organization within complex environments. Supervision thereby becomes a multilevel dynamic, structured by interactional regulations, cognitive adjustments, and technological mediations.

This modeling is synthesized in Figure 1, which makes explicit the interactions between the different levels of regulation.

Figure 1. Integrative model of distributed sociocognitive regulation



This framework provides a unified theoretical basis for analyzing supervisory dynamics. In particular, it makes it possible to shed light on difficulties no longer merely as individual shortcomings, but as emergent effects of a complex regulatory system, subject to multiple constraints and whose equilibria remain, in practice, inherently unstable.

3. METHODOLOGY

3.1. Epistemological positioning and qualitative design

This study adopts an interpretive qualitative design aimed at analyzing thesis supervision as a system of distributed sociocognitive regulation. This choice aligns with a perspective that seeks to understand complex processes—cognitive, interactional, and technodiscursive—as they unfold in context, without reducing them to isolated variables. The approach thus favors a form of analytical generalization, grounded in the identification of recurrent and theoretically informed configurations,

in accordance with established standards in qualitative research (Denzin, 2011; Lincoln & Guba, 1985), which, more broadly, helps to clarify its conditions of validity.

3.2. Field, sampling, and corpus

The field corresponds to a Francophone university context (a Master's program in language sciences within a public university "Echahid Cheikh Larbi Tebessi University- Tebessa - Algeria"), examined over a longitudinal timeframe spanning one academic year, involving 28 Master's students and several supervisors engaged in thesis guidance. This framing makes it possible to capture supervisory dynamics in their gradual evolution. The sampling is purposeful and guided by a criterion of analytical relevance (Patton, 2002). The corpus relies on a relatively robust triangulation of four sources. This combination allows for the cross-analysis of actual practices, discourse, and representations, thereby contributing, to some extent, to strengthening the credibility of the interpretations (Flick, 2018).

To make the composition of the triangulated corpus more readable, the following table presents its detailed structure:

Table 2. Corpus composition

<i>Data source</i>	Number (n)	Description
<i>Student written productions</i>	28	Drafts and intermediate versions
<i>Mediated supervisory interactions</i>	146	Emails, messages, written exchanges
<i>Uses of generative AI</i>	52	Interaction sequences with AI
<i>Self-reported data</i>	64	Questionnaires and self-assessments
<i>Total</i>	290	Triangulated corpus

Each unit corresponds respectively to a working document (for written productions), a complete interactional sequence (for supervisory exchanges), a structured interaction with a conversational agent (for AI uses), and an individual response (for self-reported data).

This structuring highlights the complementarity of the sources mobilized and ensures analytical coverage of the cognitive, interactional, and technodiscursive dimensions of the phenomenon under study.

3.3. Data collection procedures and ethical considerations

Data were collected in a natural setting, in order to preserve, as far as possible, a high level of ecological validity. Ethical principles were strictly respected: informed consent from participants, systematic anonymization of data, secure storage of the corpus, and non-interference in academic evaluation processes.

The researcher's dual position—as both supervisor and observer involved in the setting—was addressed through an explicit methodological reflexivity, supported by a research journal and an audit trail, which ultimately contributes to strengthening the confirmability of the findings (Lincoln & Guba, 1985).

3.4. Analytical strategy and validation of results

The analysis is based on a controlled inductive approach (Miles, Huberman & Saldaña, 2014). It combines an iterative exploration of the corpus, a multilevel thematic coding (cognitive, interactional, technodiscursive) relying on a coding framework developed progressively through several cycles of analysis—bringing together emergent categories and previously defined theoretical dimensions—and a gradual construction of interpretive categories.

The identified phenomena—blockages, regulatory processes, co-vulnerability—are then related to the theoretical framework in order to produce an integrated model. Rigor is ensured through the triangulation of sources, the saturation of categories, the stability of inferences, as well as through cross-checking procedures in coding.

This analytical process is summarized in Figure 2, which outlines the articulation between data collection, coding, and modeling.

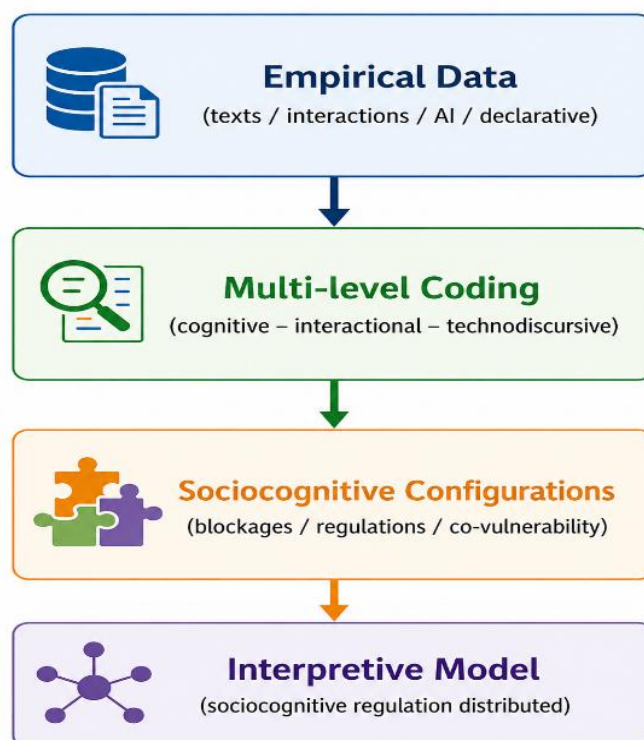
4. RESULTS

The analysis of the triangulated corpus reveals discursive and interactional regularities that are sufficiently recurrent to be interpreted as relatively stabilized sociocognitive configurations. These regularities, however, cannot be reduced to isolated occurrences; rather, they point to a supervisory system subject to multiple constraints, structured through the interplay of cognitive overload, technodiscursive mediations, and interactional adjustments. Within this perspective, the results are organized around two complementary—though closely related—axes: on the one hand, the discursive manifestations of sociocognitive blockages, and on the other, the distribution of vulnerability within the supervisory relationship.

4.1. Discursive manifestations of sociocognitive blockages

The analysis of student productions reveals a relatively coherent set of recurrent discursive markers, observed in a significant portion of the corpus and interpreted as observable indicators of sociocognitive blockages. These phenomena cannot be reduced to isolated errors; rather, they reflect a difficulty in jointly stabilizing processes of conceptualization, structuring, and textualization, revealing a persistent tension in the coordination of the cognitive processes mobilized in academic writing.

4.1.1. Enunciative instability and indeterminacy of intention

Figure 2. Methodological framework and multilevel analytical chain of the triangulated corpus

This design ensures a close articulation between empirical data, analytical procedures, and theoretical construction, enabling an empirical and analytical operationalization of distributed sociocognitive regulation in supervisory practices.

At the micro-discursive level, the analyzed drafts reveal recurrent hesitations in the qualification of the cognitive activity underway:

Excerpt 1 (student draft)

« Dans cette partie nous allons parler de... enfin analyser... c'est-à-dire expliquer... »

(“In this part, we will discuss... or rather analyze... that is to say, explain...”)

The non-stabilized succession of metadiscursive verbs does not seem to correspond simply to a strictly argumentative progression; rather, it reflects a form of terminological oscillation, which may be interpreted as a difficulty in precisely identifying the cognitive operation being mobilized. This indeterminacy also appears, in a comparable way, in the use of scientific metalanguage, at least in certain segments of the corpus:

Excerpt 2 (student draft)

« La méthodologie utilisée... la méthode... la démarche adoptée... »

(“The methodology used... the method... the approach adopted...”)

These successive reformulations seem to point to a form of conceptual instability and to a process of categorization that is still in progress—perhaps, in some respects, incomplete. Taken together, these indicators suggest that discursive intention remains, to a certain extent, only partially determined, which does not fully support the stabilization of academic discourse, at least in the analyzed segments.

4.1.2. Argumentative fragility and cognitive overload

The data also highlight difficulties in organizing logical and argumentative relations:

Excerpt 3 (intermediate thesis version)

« Ce phénomène est important parce que... donc... mais aussi... »

(“This phenomenon is important because... therefore... but also...”)

The juxtaposition of connectors without explicit hierarchical structuring seems to reflect a fragile argumentative organization. This discursive configuration may correspond to a situation in which several cognitive operations—conceptualizing, organizing, and formulating—are activated simultaneously, yet without truly stable coordination, which leads, to some extent, to a saturation of available cognitive resources and to reduced argumentative clarity.

4.1.3. Interactional discontinuities and avoidance strategies

Blockages also manifest in the temporality of the work and in the dynamics of interactions:

Excerpt 4 (student message)

« Désolé pour le retard, j'étais bloqué. »

("Sorry for the delay, I was stuck.")

Excerpt 5 (subsequent message)

« J'ai changé complètement mon plan. »

("I completely changed my outline.")

The shift from a state of blockage to a complete reconfiguration of the work may be interpreted as a form of circumvention, which does not resolve the initial difficulty but temporarily displaces its cognitive load. These discontinuities reflect an unstable cognitive progression, marked by weakly cumulative regulation and by recurrent breaks in the continuity of the writing process.

4.1.4. Dependence on validation and heteroregulation

The analyzed interactions reveal a strong dependence on external validation:

Excerpt 6 (interaction)

« Est-ce que c'est correct comme ça ? »

("Is this correct like this?")

« Est-ce que je peux garder cette idée ? »

("Can I keep this idea?")

These recurrent formulations point to a persistent cognitive insecurity and to difficulty in internalizing academic evaluation criteria. Writing activity thus appears strongly heteroregulated, with the student continuously seeking external confirmation to stabilize their discursive choices.

Taken together, these different phenomena—enunciative instability, argumentative fragility, interactional discontinuities, and dependence on validation—interact to form a coherent system of indicators of sociocognitive blockages. The writing difficulties observed are therefore embedded in unfinished processes of stabilization rather than in isolated individual deficits.

All these manifestations can be synthesized in the form of a typology of sociocognitive blockages, as shown in the following table:

Table 3. Manifestations of sociocognitive blockages

Type of blockage	Discursive indicators	Sociocognitive interpretation
Enunciative instability	Verbal hesitation, reformulations	Indeterminacy of cognitive intention
Argumentative fragility	Poorly structured connectors	Cognitive overload
Interactional discontinuity	Delays, breaks in progression	Non-cumulative regulation
Dependence on validation	Frequent requests for confirmation	Dominant heteroregulation

This synthesis confirms that the observed difficulties stem from incomplete stabilization processes rather than from simple individual shortcomings.

4.2. Distributed sociocognitive vulnerability

Beyond student productions alone, the analysis seems to reveal a form of sociocognitive vulnerability that affects both students and supervisors jointly. While institutional asymmetry structures the supervisory relationship, it does not necessarily translate—at least not systematically—into a stable cognitive asymmetry. The data, on the contrary, suggest an interactional dynamic marked by partial adjustments, interpretive gaps, and forms of regulation that remain incomplete.

4.2.1. Variability of feedback and supervisory constraints

Feedback provided by supervisors displays significant variability:

Excerpt 7 (supervisor feedback)

« Révisez la problématique de recherche. »

("Revise the research problem.")

Excerpt 8 (supervisor feedback)

« Distinguez entre le cadre théorique et l'état de l'art, puis clarifiez votre positionnement. »

("Distinguish between the theoretical framework and the state of the art, then clarify your positioning.")

This heterogeneity, both in terms of precision and level of explicitness, appears to be embedded in a broader set of cognitive and organizational constraints weighing on supervisory activity. It may also be linked to the conditions under which feedback is produced and seems, to some extent, to influence both the quality of the proposed regulations and their uptake by students.

4.2.2. Interpretive misalignments

The exchanges reveal recurrent discrepancies in the interpretation of instructions:

Excerpt 9 (supervisor)

« Vous devez approfondir la problématisation. »

("You need to further problematize.")

Excerpt 10 (student)

« J'ai ajouté des définitions. »

("I added definitions.")

Such responses cannot be reduced to a simple, isolated misunderstanding; rather, they seem to reflect a difficulty in operationalizing instructions that are often formulated implicitly, or, in some cases, insufficiently contextualized. As a result, a gap emerges—at least to some degree—between the intended regulation and its actual effects on the student's work.

4.2.3. Non-resolutive interactional loops

Certain interactional sequences are characterized by the absence of effective transformation:

Excerpt 11 (exchange)

« Reformulez votre question. »

("Reformulate your question.")

« Je ne vois pas ce qui ne va pas. »

("I don't see what is wrong.")

These configurations illustrate non-resolutive adjustment loops, in which interactions do not lead to cognitive stabilization. Regulation remains partial and does not make it possible to overcome the initial difficulties.

4.2.4. Toward sociocognitive co-vulnerability

Taken together, these observations invite us to move beyond a strictly individualizing reading of difficulties. Sociocognitive vulnerability appears as a distributed phenomenon, emerging from the interaction between cognitive constraints, regulatory modalities, and the organizational conditions of supervision. Within this dynamic, student hesitations call for regulatory responses that are sometimes incomplete, which, in turn, may contribute to maintaining instability.

Supervision can thus be understood as a system of co-regulation under constraint, in which difficulties are co-produced rather than localized. The tensions observed are therefore less exceptional dysfunctions than ordinary properties of supervision in complex contexts, which calls for a rethinking of support practices from a systemic and interactional perspective.

4.3. Technodiscursive environment and interactional dynamics

Beyond interpersonal interactions, the analysis points to the structuring role of the technodiscursive environment in shaping sociocognitive dynamics. Digital devices—emails, instant messaging, and institutional platforms—do not merely mediate exchanges; they tend, in fact, to redefine their temporalities, formats, and the very conditions under which meaning stabilizes. This reconfiguration seems to produce, to some extent, observable effects on the continuity of interactions, the coherence of writing processes, and the gradual construction of knowledge.

4.3.1. Interactional fragmentation and cognitive discontinuity

The exchanges analyzed are characterized by discontinuous sequences, marked by prolonged interruptions and limited consolidation of prior work:

Excerpt 12 (message sequence)

« Je ne comprends pas comment relier cela à la section précédente. »

("I don't understand how to connect this with the previous section.")

(Three days later)

« Je suis toujours bloqué(e). »

("I'm still stuck.")

The persistence of the difficulty, without notable transformation, seems to indicate a lack of inter-sequential stabilization. Interactions do not generate genuinely cumulative cognitive progression and tend, in effect, to reactivate the same points of blockage. This has consequences for the fragmentation of the learning process and for the more limited integration of feedback over time.

4.3.2. Document instability and non-linearity of writing

The data also reveal the simultaneous circulation of multiple versions of texts, reflecting a form of document instability:

Excerpt 13 (student message)

« Je vous envoie la dernière version... enfin presque. »

("I'm sending you the latest version... well, almost.")

This visibly hesitant formulation points to a difficulty in stabilizing the state of the document and in determining what may be considered a finalized version. Writing thus appears as a distributed process, somewhat fragmented across different supports and temporalities, which partly compromises the construction of a progression that is both linear and cumulative.

4.3.3. Reduced explicitness in feedback

Some feedback instances take on a minimal form, centered on rapid validation:

Excerpt 14 (supervisor feedback)

« *OK pour cette section.* »

("OK for this section.")

While this type of response facilitates the flow of exchanges in a constrained environment, it simultaneously reduces the visibility of evaluation criteria as well as that of implicit expectations. This under-explicitness contributes to reinforcing interpretive misalignments and limits, to some extent, students' possibilities for appropriation.

Taken together, these observations suggest that the technodiscursive environment introduces a structural tension between communicational acceleration and cognitive fragmentation. Supervision thus tends to be reconfigured as an asynchronous, distributed, and partially unstable process, in which cognitive continuity depends heavily on the actors' capacity to explicate, structure, and connect the different interactional sequences.

4.4. Generative artificial intelligence and the hybridization of authorship

The analysis reveals an increasingly marked integration of generative artificial intelligence into student writing practices, particularly for operations of reformulation, stylistic enhancement, and, more broadly, textual production. In practice, this may be seen as a relatively direct form of cognitive mediation by AI, intervening at the very core of the writing process. In doing so, it contributes, at least in part, to reconfiguring the modes through which academic discourse is produced.

4.4.1. Stylistic shifts and cognitive externalization

Comparisons between successive versions of texts reveal sometimes abrupt stylistic transformations:

Excerpt 15 (draft vs. revised version)

« *On peut dire que c'est important...* »

("We can say that it is important...")

« *Ce phénomène revêt une importance particulière...* »

("This phenomenon is of particular importance...")

This rapid shift seems to indicate an externalization of the reformulation process, without visible intermediate traces of elaboration or gradual appropriation. The transition from an informal register to a standardized academic style thus occurs without any clear continuity, which raises questions—at least to some extent—about the depth of cognitive integration of the transformations produced.

4.4.2. Discursive hybridization and enunciative instability

The analyzed texts frequently display a co-presence of heterogeneous styles, revealing a form of discursive hybridization:

Excerpt 16 (student statement)

« *J'ai utilisé l'IA pour améliorer le style, mais j'ai conservé mes idées.* »

("I used AI to improve the style, but I kept my ideas.")

This dissociation between content and form remains, however, only partially stable. It produces a fragmented authorship, in which the student's voice coexists with generated or reformulated segments, without always achieving a fully integrated whole.

4.4.3. Shift in discursive responsibility

Data from questionnaires suggest a shift in criteria for discursive judgment:

Excerpt 17 (questionnaire)

« *Je l'ai corrigé avec l'IA parce que cela sonnait mieux.* »

("I corrected it with AI because it sounded better.")

The use of artificial intelligence as a form of stylistic validation seems, to some extent, to shift part of the discursive responsibility onto the tool itself. This form of delegation may, in practice, lead to a relatively marked dissociation between the formal quality of the text and conceptual understanding, insofar as stylistic conformity does not necessarily guarantee an effective mastery of content.

These findings thus highlight the ambivalent character of AI as a technodiscursive agent. While it can alleviate certain cognitive loads associated with formulation, it may also weaken processes of conceptual appropriation and, in doing so, reconfigure forms of authorship, now distributed between the writing subject and algorithmic mediation.

4.5. Typology of regulation: from local treatment to metacognitive scaffolding

The analysis of interactions makes it possible to identify a multilevel typology of sociocognitive regulation, differentiated according to their degree of explicitness and their transformative scope. These forms of regulation function as central operators in the stabilization—or, conversely, the persistence—of the blockage dynamics observed.

4.5.1. Pragmatic regulation: local stabilization

Excerpt 18 (supervisor feedback)

« Corrigez cette phrase. »

(“Correct this sentence.”)

This type of intervention allows for immediate and targeted resolution, yet without making the underlying principles explicit. The result is a form of local effectiveness, limited in its transferability to other writing contexts, since the criteria for correction remain implicit.

4.5.2. Guided regulation: partial framing

Excerpt 19 (supervisor feedback)

« Précisez les étapes méthodologiques. »

(“Specify the methodological steps.”)

Such instructions render certain academic expectations visible while leaving their operationalization open. They establish an intermediate form of guidance, which may support progression but still requires active interpretation on the part of the student.

4.5.3. Metacognitive regulation: durable transformation

Excerpt 20 (interaction)

« Qu'est-ce que vous cherchez à démontrer ici ? Comment cela se rattache-t-il à votre hypothèse ? »

(“What are you trying to demonstrate here? How does this relate to your hypothesis?”)

These interventions make explicit the cognitive operations at stake and invite reflection on the underlying reasoning. They foster a deeper reconfiguration of writing practices and present a strong potential for durable transformation, contributing to the internalization of criteria of scientificity.

In order to synthesize the different levels of regulation identified, the following table proposes a typology organized according to their scope and effects.

Table 4. Typology of sociocognitive regulation

Type of regulation	Level	Main characteristics	Effect on learning
Pragmatic regulation	Local	Isolated correction, limited explicitness	Immediate resolution, low transfer
Guided regulation	Intermediate	Partial orientation, framing	Support for progression
Metacognitive regulation	Global	Explication of cognitive processes	Durable transformation

This typology thus highlights a form of hierarchical structuring of regulation, ranging from local interventions to forms of scaffolding capable of fostering more sustained transformations in practice.

4.5.4. Distribution of regulation under constraint

The analysis reveals a differentiated distribution of regulatory types, which cannot be reduced to a uniform organization of observed practices. Pragmatic regulation tends to dominate in highly constrained contexts, marked both by time pressure and by a heavy supervisory load that often orients exchanges toward rapid—sometimes immediate—adjustments. By contrast, metacognitive regulation appears more sporadically, most often at moments considered critical in the process or requiring a certain degree of distance. This distribution brings into view, rather clearly, a structural tension between the demand for operational immediacy and the need for deeper, more demanding reflective structuring, which is less directly mobilized in action.

From this perspective, regulation can be seen as a key lever of sociocognitive stabilization, whose effectiveness depends on its capacity to articulate local problem resolution with the explication of underlying processes. When this articulation is lacking, blockages tend to persist; when it is achieved, however, it supports more durable transformations in practice and a progression toward greater cognitive autonomy.

5. DISCUSSION

Toward a situated ethics of sociocognitive regulation

The findings invite us to move beyond a fragmented reading of supervision. The difficulties observed do not stem exclusively

from cognitive variables, nor solely from interactional dynamics, nor even from simple technological effects. Rather, they take shape within a distributed sociocognitive system where processing constraints, interactional adjustments, and technodiscursive mediations are intertwined. Such a perspective extends situated approaches to cognition (Hutchins, 1995) and models of distributed cognition (Salomon, 1993), while suggesting—perhaps more clearly still—that academic activity remains inseparable from its interactional and instrumental ecology.

This positioning addresses a notable gap in the literature on academic supervision, which often remains compartmentalized between pedagogical, cognitive, and technological perspectives (Lee, 2008; Bastalich, 2017). Supervision thus appears as a multilevel regulatory activity under constraint, where the stabilization of learning depends on an unstable—and at times fragile—balance between guidance, autonomy, and mediation.

5.1. Rethinking asymmetry: co-vulnerability as a regulatory resource

Classical models of supervision rely on a relatively stabilized asymmetry between expert and novice, generally framed in terms of knowledge transmission or pedagogical scaffolding (Vygotsky, 1978; Wood, Bruner & Ross, 1976). Yet the data show that this asymmetry, although institutionally established, guarantees neither the cognitive stability of situations nor the actual effectiveness of the regulations implemented.

A distinction therefore becomes necessary between institutional asymmetry—linked to status, academic legitimacy, and evaluative power—and sociocognitive asymmetry, which is more fluctuating, situated, and closely dependent on the concrete conditions of interaction. This distinction sheds new light on the misalignments observed, by reinserting them into a situated relational dynamic rather than a strictly deficit-based logic. It resonates with, though does not reduce to, approaches that conceive supervision as a continuously negotiated relational practice (Grant, 2005; Wisker, 2012).

Within this framework, vulnerability appears as an emergent property of the interaction itself. This sociocognitive co-vulnerability is tied to task complexity (Sweller, 2011), organizational constraints, and also to the technological mediations that structure supervisory activity. Supervisors themselves are not immune to these tensions: cognitive overload, interpretive uncertainty, and difficulties of adjustment are all factors likely to affect, in practice, the precision and stability of the regulations they provide.

The shift is significant. Tensions are no longer viewed as exceptional dysfunctions but as ordinary properties of supervision in constrained contexts. Recognizing this co-vulnerability thus becomes operational: it makes it possible to clarify expectations, negotiate objectives, and adjust—sometimes quite finely—the levels of demand.

This leads, almost logically, to an ethical redefinition of supervision. It can no longer be conceived as mere conformity to implicit norms, but rather as a situated practice of adjustment to the actual cognitive conditions of learners. Such a perspective aligns with a reflective pedagogy (Schön, 1983), in which academic rigor remains central, yet is mediated, modulated, and made more explicit through forms of guided support.

5.2. Supervision as Cognitive Load Engineering

The results converge toward an interpretation in terms of insufficiently regulated cognitive overload, echoing cognitive load theory (Sweller, 1988; Sweller, Ayres & Kalyuga, 2011). The observed difficulties — enunciative instability, argumentative fragility, and interactional fragmentation — reflect insufficiently regulated competition among several cognitive processes mobilized simultaneously.

From this perspective, supervision can be understood as a form of cognitive load engineering. Its central function consists in making intellectual tasks manageable, and then progressively appropriable. This involves three essential operations: making expectations as well as the mobilized intellectual processes explicit (Chi et al., 1989), segmenting complex tasks, and hierarchizing writing processes. The issue is not so much to artificially simplify academic work as to organize, in practice, the conditions of its realization.

A hierarchy of regulations gradually emerges. Pragmatic regulations offer local solutions, often effective in the short term, but poorly transferable from one situation to another. Metacognitive regulations, by contrast, make the mobilized processes explicit and support more durable transformations of learning practices (Zimmerman, 2002). It is at this level, no doubt, that the truly empowering nature of supervision becomes apparent.

However, this engineering is today being reconfigured by the integration of generative artificial intelligence. AI acts as a technodiscursive mediator: it redistributes cognitive operations, modifies production temporalities, and redefines discursive responsibilities (Floridi et al., 2018). While it can indeed reduce extraneous load — there is little doubt about that — it simultaneously introduces a risk of misalignment between textual production and effective appropriation of content.

Consequently, academic responsibility can no longer be limited to the final product. It must incorporate the processes and mediations that condition knowledge production. In this perspective, supervision entails an explicit problematization of the uses of artificial intelligence: not as a substitute for intellectual activity, but as a support for elaboration, embedded within a dynamic of controlled co-construction.

5.3. Toward an Empowering Supervision Model

The transition from analysis to modeling emerges almost naturally. In response to the identified limitations (Bastalich, 2017), an empowering supervision model is proposed, centered on the development of sociocognitive self-regulation.

Three interdependent levers structure it. First, explicit metacognitive scaffolding, which makes scientific operations visible (Vygotsky, 1978; Zimmerman, 2002). Second, the structuring of cognitive processes, which organizes complexity without reducing it. Finally, technodiscursive regulation, including AI, embedding learning within an expanded ecology.

This articulation redefines autonomy. It is no longer prior, but emergent. It is constructed through guidance, and not through its withdrawal.

Figure 3. Empowering supervision model based on multinilevel sociocognitive regulation

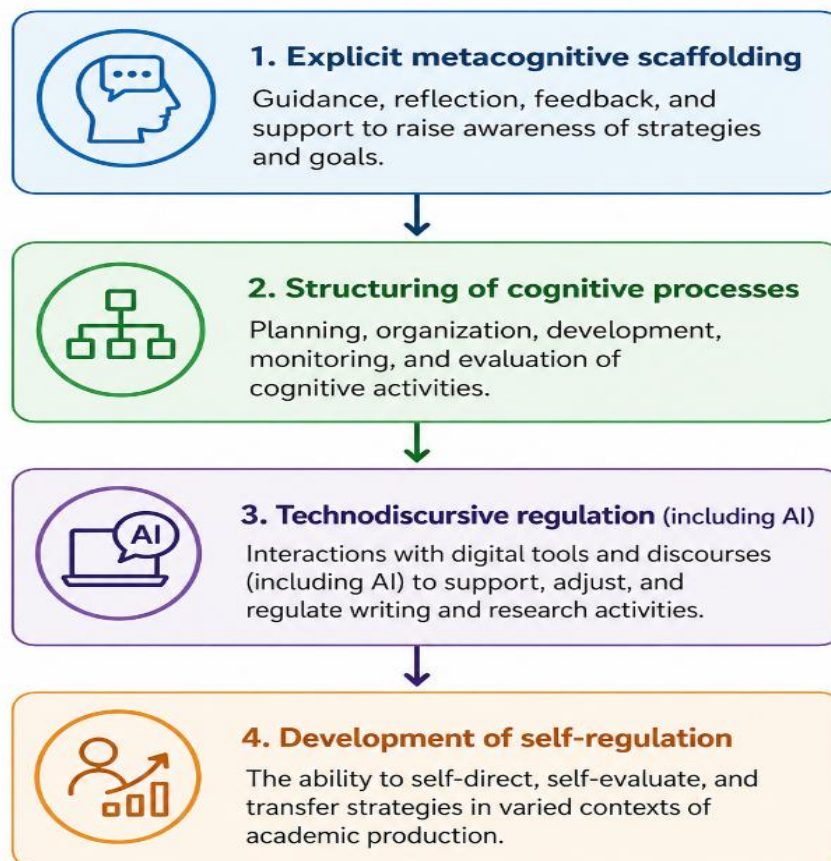


Figure 2. Integrative model of metacognitive scaffolding and sociocognitive regulation

The integration of AI constitutes a decisive point here: it allows one to think simultaneously about efficiency gains and risks of disappropriation, within a logic of regulation rather than opposition.

5.4. Institutional and Deontological Implications

The operationalization of the model closely depends on institutional conditions. Supervision can no longer be reduced to a simple extension of disciplinary expertise. It mobilizes specific competencies – pedagogical, cognitive, and interactional (Lee, 2008).

This implies explicit professionalization, beyond the still dominant tacit models (Wisker, 2012). Moreover, the observed limitations largely stem from structural constraints: overload, time pressure, fragmentation. The quality of supervision therefore depends as much on organizational conditions as on individual competencies.

The integration of AI finally introduces a deontological reconfiguration. In line with digital ethics (Floridi et al., 2018), discursive responsibility extends to processes and mediations. Three principles emerge: transparency of uses, effective appropriation, and cognitive integrity.

These elements call for explicit institutional frameworks – not as instruments of control, but as regulatory mechanisms adapted to contemporary transformations.

Overall, a theoretical shift takes place. Supervision appears as a system of distributed sociocognitive regulation: asymmetry reconfigured by co-vulnerability, cognition structured through load engineering, technology integrated as active mediation. A demanding yet adjustable framework – and undoubtedly more realistic – for thinking about contemporary academic supervision.

To synthesize the main contributions of this analysis, the following table proposes a mapping between identified problems and proposed solutions.

Table 5. Synthesis of the proposed model

Dimension	Identified problem	Proposed solution
Cognitive	Overload	Task structuring
Interactional	Misalignments	Metacognitive regulation
Technological	Fragmentation / AI	Technodiscursive regulation

This synthesis makes it possible to visualize the articulation of cognitive, interactional, and technological dimensions within the proposed model.

6. Conclusion: Contributions, Limitations, and Perspectives

This article aimed to fill a central gap in the literature: the absence of an integrative framework capable of jointly addressing the cognitive, interactional, and technodiscursive dimensions of thesis supervision in the era of generative artificial intelligence. Based on a triangulated qualitative corpus, the results show that the observed difficulties do not stem from individual deficiencies, but emerge from situated sociocognitive configurations structured by the co-presence of cognitive overload, digital mediations, and partial interactional adjustments.

On the theoretical level, the main contribution lies in the formalization of the concept of distributed sociocognitive regulation, which makes it possible to move beyond segmented approaches to academic supervision. This framework is extended by three major contributions:

1. the identification of sociocognitive co-vulnerability, which reconfigures pedagogical asymmetry;
2. the hierarchization of regulations (pragmatic vs. metacognitive), shedding light, in practice, on the effective conditions for the development of autonomy;
3. the elaboration of an empowering supervision model, articulating metacognitive scaffolding, cognitive structuring, and technodiscursive regulation.

The study also shows that generative artificial intelligence cannot be reduced to a simple tool: it acts rather as a technodiscursive agent, redistributing cognitive operations as well as associated responsibilities. Such a reconfiguration leads to the proposal of the concept of augmented discursive responsibility, which constitutes, in this respect, an original contribution for thinking about contemporary issues in academic writing.

On the practical and institutional level, these results imply a more explicit professionalization of supervision, as well as an adjustment of organizational conditions and the formalization of ethical frameworks adapted to the uses of AI. Supervision thus appears as a form of distributed sociocognitive engineering, requiring specific competencies and genuinely sustainable environments.

Certain limitations must nevertheless be acknowledged. The situated nature of the field and the involvement of the researcher invite caution regarding empirical generalization. However, the robustness of the design (triangulation, analytical traceability) allows for analytical generalization toward comparable contexts.

Finally, several research perspectives emerge. Comparative studies, particularly across disciplines, would make it possible to test the transferability of the empowering model. Experimental designs could also be used to assess the impact of explicit metacognitive regulations on the development of autonomy. More broadly, the rapid evolution of artificial intelligence technologies calls for longitudinal research in order to analyze their lasting effects on learning processes and forms of authorship.

Ultimately, this article proposes a major theoretical and empirical shift: to think of supervision not as a stable relationship or simple support, but as a dynamic system of distributed sociocognitive regulation, at the heart of contemporary transformations in research training.

DECLARATIONS

Ethical Considerations

This study complies with internationally accepted research ethics standards (<https://imcra-az.org/journal/publication-ethics/>).

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Conflict of Interest

I declare that there is no conflict of interest related to this study.

AI Use Statement. I remain fully responsible for the content and the ethical use of AI tools in this manuscript.

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