

PENSAR-IA

Protocolo metodológico de supervisão humana, verificação e rastreabilidade no uso da inteligência artificial

A Methodological Protocol for Human Oversight, Verification and Traceability in the Use of Artificial Intelligence

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Authorship and provenance statement

This technical note documents the conception and initial structured formulation of the PENSAR-IA protocol by Lisandro Gonçalves. The protocol is presented here as an autonomous methodological object, independently from any later chapter, educational adaptation, institutional implementation or derivative resource. Its defining elements are the name PENSAR-IA, the six-stage sequence represented by the acronym, the human-responsibility principle, the methodological copilot metaphor, and the requirement that generated content be subjected to proportionate verification and authorial decision. This record concerns the PENSAR-IA method itself and does not claim authorship of any later book chapter or educational text that describes, discusses or applies the protocol; authorship of those works remains with their respective authors.

Any future version, translation, educational instrument, checklist, digital implementation or subsequent registration in the AXIS Scientific Asset Registry should cite this record and identify its relationship to version 1.0. Contributions by other persons to later adaptations should be acknowledged in the corresponding version without altering the provenance of the original protocol.

Purpose of the deposit

To create a public, citable and dated scholarly record of the written expression, architecture and first operational version of PENSAR-IA. The deposit does not replace legal assessment of trademarks, patents or contractual authorship matters.

Suggested citation

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Resumo

A inteligência artificial generativa amplia as possibilidades de apoio à pesquisa científica, mas também introduz riscos relacionados à fabricação de informações, à aparência de segurança, à opacidade dos processos e à transferência indevida de decisões intelectuais. O PENSAR-IA é um protocolo didático e metodológico concebido para orientar o uso crítico, verificável e responsável da inteligência artificial na elaboração de projetos, análises, textos e produtos científicos. O protocolo organiza a interação humano-IA em seis etapas: Precisar a tarefa; Explicitar contexto e limites; Navegar pelas possibilidades; Submeter à verificação; Assumir a decisão autoral; e Registrar e declarar. Sua premissa central é que a IA pode atuar como copiloto metodológico, oferecendo alternativas e apoio operacional, sem assumir autoria, julgamento científico, decisão ética ou responsabilidade pelo conteúdo final. O modelo busca reduzir a delegação acrítica, tornar a verificação proporcional ao risco e preservar a rastreabilidade das contribuições tecnológicas. Esta nota técnica apresenta os fundamentos conceituais, os componentes operacionais, os limites de aplicação e um modelo mínimo de registro do uso de IA.

Palavras-chave: inteligência artificial generativa; metodologia científica; integridade da pesquisa; escrita científica; verificação; responsabilidade autoral; colaboração humano-IA.

Abstract

Generative artificial intelligence expands the possibilities for supporting scientific research, while introducing risks related to fabricated information, unwarranted confidence, process opacity, and improper transfer of intellectual decisions. PENSAR-IA is a didactic and methodological protocol designed to guide the critical, verifiable and responsible use of artificial intelligence in research projects, analyses, manuscripts and scientific outputs. The protocol organizes human-AI interaction into six stages: Specify the task; Explain context and limits; Navigate possibilities; Submit outputs to verification; Assume the authorial decision; and Record and disclose. Its central premise is that AI may operate as a methodological copilot, offering alternatives and operational support without assuming authorship, scientific judgment, ethical decisions or responsibility for the final content. The model aims to reduce uncritical delegation, align verification with risk, and preserve traceability of technological contributions. This technical note presents the conceptual foundations, operational components, limits of application and a minimum model for recording AI use.

Keywords: generative artificial intelligence; research methodology; research integrity; scientific writing; verification; authorial responsibility; human-AI collaboration.

1. Background and rationale

Scientific inquiry has always been associated with instruments that extend human capacities for observation, recording, calculation and analysis. Optical devices, laboratory instruments, statistical software, databases and reference managers do not eliminate the role of the researcher; they reorganize what can be observed, compared and processed. Technology therefore belongs to a historical continuum of human amplification.

Generative artificial intelligence introduces a distinct form of assistance. Instead of only storing, retrieving or calculating according to explicitly defined procedures, these systems can produce language, reorganize information, compare formulations, suggest alternatives and respond to natural-language instructions. This capacity makes them useful across many stages of research,

but also creates a methodological difficulty: a fluent and plausible response may still be inaccurate, unverifiable, biased or incompatible with the study design.

Discussions about machines, language and thought predate current systems. Turing proposed the imitation game as an operational way to address machine behaviour in linguistic interaction. For contemporary scientific practice, however, the practical question is not whether a system truly thinks, but how researchers can use it without transferring the judgment, responsibility and decisions that belong to the authors of the research.

Foundational question

How can artificial intelligence be used without transferring to it the judgment, responsibility and decisions that belong to the researcher?

PENSAR-IA is proposed as a response to that question. It is not a theory of machine cognition and does not treat AI as an autonomous scientific source. It is a protocol for organizing human conduct when AI is used as an auxiliary instrument.

2. Conceptual principles

2.1 Technology as human amplification

Tools extend human performance by redistributing cognitive and operational demands. Notes preserve information, calculators reduce arithmetic burden, search systems facilitate location of content, and statistical programs execute specified procedures. Such support is not inherently problematic. The methodological problem begins when the tool replaces comprehension, masks uncertainty or becomes the unexamined basis of a scientific claim.

2.2 Cognitive offloading and the risk of substitution

Cognitive offloading refers to the use of external actions, objects or systems to reduce the cognitive demands of a task. In research, offloading can be productive when it preserves human oversight and increases consistency. It becomes unsafe when the researcher cannot explain, verify or justify the incorporated output. PENSAR-IA therefore distinguishes assistance from substitution: the former supports judgment; the latter displaces it.

2.3 The methodological copilot

The copilot metaphor defines the appropriate position of AI in the research process. A copilot can assist with orientation, alternatives, checks and workload distribution. It does not independently define the destination, assume command of the investigation or answer for the decisions taken. Under PENSAR-IA, the researcher remains responsible for the problem, sources, method, data protection, interpretation, limitations and final communication.

2.4 Proportionate verification

Not every AI contribution carries the same risk. A suggestion for reorganizing headings is different from a statement about clinical efficacy, a statistical interpretation or an ethical decision. PENSAR-IA adopts a principle of proportionate verification: the depth, independence and documentation of checking must match the nature of the output and the consequences of incorporating it.

3. What generative AI is - and is not

Generative AI systems produce content from patterns learned during training and from the instructions and context provided by the user. They do not necessarily consult a verified library of facts for each response. Their outputs are probabilistic constructions and may combine accurate

information with omissions, invented details or unjustified certainty. Linguistic quality must therefore never be treated as evidence of factual validity.

Resource	Primary function	Methodological caution
Scientific database	Locates indexed scholarly documents.	Indexing does not replace critical appraisal or reading of the original source.
Search engine	Locates web pages and available content.	Ranking and availability do not establish scientific quality.
Reference manager	Organizes references supplied or imported by the user.	Metadata may be incomplete or incorrect and must be checked.
Statistical software	Executes analyses specified by the user.	Validity depends on data quality, assumptions and analytical decisions.
Generative AI	Produces responses and content based on patterns, instructions and context.	Fluency does not guarantee truth, source existence or methodological adequacy.

Do not confuse support with evidence

Artificial intelligence may assist a search or explain a concept, but its response is not, by itself, a scientific source.

4. Possibilities and non-delegable responsibilities

AI may assist with	The researcher must retain
Exploring ideas and possible delimitations	Final selection and justification of the research problem
Suggesting keywords and search combinations	Selection, retrieval and critical appraisal of original sources
Organizing topics, outlines and comparison structures	The logical architecture and scientific argument of the work
Improving clarity, grammar and translation	Accuracy, meaning, authorship and approval of the final text
Explaining concepts or proposing examples	Verification of concepts against authoritative sources
Supporting code drafting and debugging	Validation, testing, reproducibility and interpretation of outputs
Flagging possible inconsistencies	Investigation and decision about whether an inconsistency exists

Non-delegable core

Scientific relevance, ethical judgment, definitive interpretation, authorship decisions and final approval cannot be transferred to AI.

5. The PENSAR-IA protocol

PENSAR-IA organizes AI-assisted research activity into six sequential and recursive stages. The protocol may be applied to a single prompt, a research task, a writing session, a coding activity or a broader project. When the risk or complexity increases, the cycle should be repeated with stronger verification and more detailed documentation.

Letter	Stage	Operational purpose
P	Precisar a tarefa	Define exactly what is being requested, why it is needed and what must not be invented.
E	Explicitar contexto e limites	Provides only the information necessary for the task while protecting confidentiality and delimiting scope.
N	Navegar pelas possibilidades	Uses AI to temporarily expand alternatives without turning suggestions into decisions.
S	Submeter à verificação	Checks accuracy, coherence, sources, currency, bias and methodological compatibility.
A	Assumir a decisão autoral	Records the human reasoning that accepts, modifies or rejects each relevant contribution.
R	Registrar e declarar	Preserves traceability and discloses AI use in proportion to its influence.

P - Precisar a tarefa

Before consulting AI, the researcher defines the objective, research stage, expected product, boundaries, response format and prohibited inventions.

- What is the specific objective?
- At which stage of the research will the output be used?
- What format and level of detail are expected?
- Which facts, data or references must not be invented?

Operational rule

Weak request: "Talk about artificial intelligence in education."

Improved request: "Present three possible delimitations for a study on generative AI use by university teachers. Do not create references or formulate conclusions."

E - Explicitar contexto e limites

The system receives enough context to perform the task, but not confidential, personal or unnecessary information. Context should improve relevance without expanding exposure.

- Scientific field and intended audience
- Population, object or preliminary design
- Purpose, period, language and restrictions
- Data that will not be shared

Operational rule

Do not insert identifiable personal data, medical records, confidential reviews, third-party manuscripts, protected institutional documents or unauthorized projects.

N - Navegar pelas possibilidades

AI is used as a temporary expansion mechanism. It may suggest alternative framings, keywords, explanations, hypotheses or structures. Generated alternatives remain provisional.

- Request more than one alternative
- Compare advantages and limitations
- Avoid immediate acceptance of the first fluent answer
- Classify each option as accepted, modified, rejected or pending

Operational rule

Navigation is exploratory. It broadens the decision space but does not establish scientific validity.

S - Submeter à verificação

Every relevant output is examined for accuracy, coherence, pertinence, source, currency, bias and compatibility with the method. This is the central safety stage of the protocol.

- Does the source exist?
- Was the original document consulted?
- Is the attributed conclusion actually present?
- Are there unsupported generalizations or vague certainty?
- Can the researcher explain the content independently?

Operational rule

A reference should only be incorporated after its existence, authorship, bibliographic data and relevance have been confirmed in the original source.

A - Assumir a decisão autoral

The researcher explicitly assumes the intellectual decision. AI may propose; the author must justify what was accepted, modified or rejected and why.

- What was suggested?
- What was accepted or modified?
- What was rejected?
- Which evidence and reasoning supported the decision?
- Who approved the final incorporation?

Operational rule

A decision becomes scientific only when responsible persons can explain, justify and defend it.

R - Registrar e declarar

AI use is documented in proportion to its influence on the work. The record should allow later reconstruction of the tool, purpose, supplied material, output used, verification and responsible decision.

- Tool and version or access date
- Research stage and purpose
- Material provided to the system

- Contribution incorporated
- Verification procedure
- Human decision-maker

Operational rule

Minor language support may require a concise disclosure; substantial analytical, coding or structural assistance requires more detailed documentation.

6. Minimum verification test

Before incorporating an AI-generated statement into a scientific product, the researcher should be able to answer the following questions affirmatively or explain why a different verification pathway is appropriate.

1. The claim is clear enough to be checked.
2. The relevant source or dataset has been located.
3. The original source, not only a summary, has been consulted.
4. The source supports the meaning attributed to it.
5. The information is current enough for the intended use.
6. Potential biases, omissions and alternative interpretations were considered.
7. The claim is compatible with the study design and analytical limits.
8. A responsible author can explain the claim without relying on the AI response.

7. Decision and traceability matrix

AI contribution	Evidence checked	Decision	Reason	Responsible person
[Describe suggestion or output]	[Source, data, test or comparison]	Accepted / Modified / Rejected / Pending	[Scientific or methodological justification]	[Name]

8. Minimum AI-use record

Element	Information to record
Tool	Name of the system or service used
Version/access date	Model/version when available and date of use
Research stage	Ideation, search planning, writing, translation, coding, analysis support or other
Purpose	Specific reason for using the tool
Material supplied	Type of information entered, with confirmation that restricted data were not disclosed
Output incorporated	Exact contribution used in the final work
Verification	Sources, tests, comparisons or human review performed

Element	Information to record
Decision	Accepted, modified, rejected or pending, with justification
Responsible author	Person who approved the incorporation

9. Suggested disclosure statement

Model for manuscripts and reports

Generative artificial intelligence was used as an auxiliary tool for [state the purpose and stage]. The authors reviewed, verified and edited all incorporated content, consulted the relevant original sources where applicable, and assume full responsibility for the final decisions and text. No authorship, ethical judgment or definitive interpretation was delegated to the system.

10. Scope and limitations

- PENSAR-IA is a general methodological framework and does not replace discipline-specific standards, reporting guidelines, ethical review or institutional policy.
- The protocol does not validate a particular AI system and does not guarantee the correctness of outputs.
- Verification must be adapted to the stakes of the task, especially in clinical, legal, statistical and safety-critical contexts.
- The protocol should not be used to justify disclosure of confidential, personal, proprietary or restricted material.
- AI systems should not be listed as authors because responsibility and accountability remain human functions.
- Future empirical studies may be needed to evaluate usability, adherence, educational outcomes and effects on research quality.

11. Versioning and future development

Version 1.0 establishes the conceptual core and the first operational sequence. Later versions may include validated checklists, educational worksheets, prompt-design templates, audit forms, discipline-specific extensions and digital implementations. These developments may subsequently receive a Scientific Asset Passport in the AXIS Scientific Asset Registry. Each version should retain a version number, date, change log and explicit relationship to the original DOI.

Version	Date	Status	Main content
1.0	2026-08-03	Initial public version	Conceptual principles; six-stage protocol; verification test; traceability matrix; disclosure model.

12. Rights and legal scope of this record

This record is intended to document and timestamp the original written expression, organization and presentation of the PENSAR-IA protocol. Copyright generally protects the concrete expression of a work rather than the underlying idea, method, procedure or system as such. The DOI identifies

the deposited research object and supports citation and attribution, but does not by itself create exclusive rights over the method or the name.

If exclusive protection of the sign “PENSAR-IA” is strategically important for educational, publishing or digital services, trademark assessment and, where appropriate, a separate application to the Brazilian National Institute of Industrial Property should be considered. Contractual alignment is also advisable before the protocol is reproduced in works authored or edited by third parties.

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Appendix A - Zenodo metadata, ready to paste

Zenodo field	Recommended entry
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Related identifiers	After the Scientific Asset Passport is issued by the AXIS Scientific Asset Registry, add its canonical record URL as “is supplemented by” or “is version of”, as appropriate.

Zenodo description

PENSAR-IA is a didactic and methodological protocol created by Lisandro Gonçalves to guide the critical, verifiable and responsible use of generative artificial intelligence in scientific research. The protocol is organized into six stages represented by its acronym: Precisar a tarefa; Explicitar contexto e limites; Navegar pelas possibilidades; Submeter à verificação; Assumir a decisão autoral; and Registrar e declarar. Its central premise is that AI may act as a methodological copilot, supporting exploration, organization, language revision, coding and preliminary checking, while scientific judgment, ethical decisions, source verification, interpretation and final responsibility remain human. Version 1.0 documents the conceptual foundations, operational sequence, proportionate-verification principle, decision matrix and minimum AI-use record. This deposit is an independent technical note and the first public version of the protocol. Future educational or digital implementations, as well as any Scientific Asset Passport subsequently issued in the AXIS Scientific Asset Registry, should cite this record and preserve its version history.

Notes for the record

Conceptual authorship and protocol creation: Lisandro Gonçalves. This record documents the initial public formulation of PENSAR-IA as an autonomous methodological protocol. The deposited files should not contain confidential information or third-party manuscript content. DOI: 10.5281/zenodo.21782288.