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Beyond IMRAD: an integrated framework for scientific writing, statistical analysis, and research reporting

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ABSTRACT

Purpose: to develop an integrated conceptual-methodological framework that connects scientific writing, research design, statistical analysis, interpretation, and research reporting to enhance the coherence, methodological rigour, transparency, and quality of scholarly articles.
Method: this study employs a conceptual-methodological approach through literature synthesis to develop an integrated framework for scientific writing, methodological decision-making, statistical analysis, and research reporting.
Findings: the study produces an integrated framework that connects research problem formulation, theoretical development, methodological design, statistical analysis, result interpretation, and scientific reporting. It also provides practical guidelines and a manuscript-readiness checklist to promote coherence, methodological rigour, transparency, and academic integrity in scholarly writing.
Implications: the framework provides practical guidance for students, educators, and researchers to improve methodological decision-making, statistical interpretation, and the quality, coherence, and transparency of scientific publications.
Originality: lies in integrating scientific writing, methodological decision-making, statistical analysis, result interpretation, and research reporting into a unified framework that bridges conceptual reasoning and practical research procedures.

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Introduction

Scientific articles constitute the primary medium through which researchers communicate knowledge, disseminate empirical evidence, and advance theoretical understanding within the academic community (Guo et al., 2026). The quality of a

scholarly article, however, is determined not merely by the novelty of its topic, the sophistication of its analytical techniques, or its conformity to journal formatting requirements, but fundamentally by the logical coherence and methodological consistency connecting the research problem, theoretical foundations, research design, empirical evidence, interpretation, and conclusions (Dumka et al., 2025; Joseph & Sengul, 2025). In this regard, scientific writing should be understood as an integrated intellectual and methodological process rather than a mechanical activity of assembling manuscript sections according to the conventional introduction, methods, results, and discussion (IMRAD) structure (Eriksson, 2024). Although IMRAD provides a widely recognised organisational framework, it does not necessarily explain how researchers should establish the logical connections among research questions, theoretical arguments, methodological choices, statistical procedures, and substantive interpretations (Stošić & Trpeski, 2023). This distinction highlights the need to move beyond structural compliance toward a more comprehensive understanding of scientific article development as a coherent process of research reasoning and knowledge construction (Souza et al., 2025).

In research practice, decisions often fragment across stages of scientific inquiry (Bakhtiar et al., 2025). Researchers may identify research gaps without sufficiently demonstrating their theoretical or empirical relevance, formulate hypotheses without establishing convincing conceptual relationships, select analytical techniques based primarily on software availability or methodological popularity, and report statistical outputs without adequately explaining their substantive implications. These weaknesses can create inconsistencies between what a study intends to investigate, how its variables are operationalised, which analytical procedures are employed, and what conclusions can legitimately be drawn from the findings. These challenges are particularly evident in quantitative research involving regression analysis, mediation and moderation analysis, partial least squares structural equation modelling (PLS-SEM), and covariance-based structural equation modelling (CB-SEM), where each approach involves distinct assumptions, objectives, measurement requirements, and inferential capabilities. Consequently, access to sophisticated statistical software does not automatically guarantee methodological rigour or reliable scientific conclusions. Rather, research quality depends on the researcher's ability to make theoretically justified, methodologically appropriate, and statistically defensible decisions throughout the research process (Hair et al., 2019; Hayes, 2018; Igartua & Hayes, 2021).

Existing literature has provided a strong foundation for improving individual components of scientific research and manuscript preparation. Reporting standards, particularly the journal article reporting standards (JARS), emphasise transparency, completeness, and methodological accountability in quantitative, qualitative, and mixed-methods research (APA, 2020). Similarly, methodological literature has extensively discussed research design, sampling strategies, measurement assessment, statistical modelling, and interpreting empirical findings. In quantitative research, established contributions have explained the appropriate application of regression-based mediation and moderation analysis (Firmansyah et al., 2024; Firmansyah & Wahdiniwaty, 2023; Hayes, 2018; Igartua & Hayes, 2021), the methodological foundations and reporting requirements of PLS-SEM (Hair et al., 2011, 2012, 2019; Sarstedt et al., 2022), and the assessment of reliability, convergent validity, and discriminant validity in structural equation modeling (Cheung et al., 2024; Fornell & Larcker, 1981; Rönkkö & Cho, 2022). Furthermore, research on statistical inference emphasises that scientific interpretation should extend beyond statistical significance to consider effect sizes, uncertainty,

predictive performance, and the substantive meaning of empirical relationships (Cohen, 1988; Shmueli et al., 2019; Wasserstein et al., 2019). These contributions provide essential methodological guidance; however, they generally focus on specific research components or analytical procedures rather than integrating these elements into a unified manuscript development process.

Beyond methodological and statistical considerations, conceptual research has also emphasised the importance of developing clear theoretical arguments and meaningful scholarly contributions. Jaakkola (2020) identifies alternative approaches to designing conceptual articles, while MacInnis (2011) explains how conceptual contributions can advance knowledge through the development, clarification, and integration of theoretical ideas. Similarly, Torraco (2005) highlights the importance of systematic integration and critical synthesis in developing meaningful literature-based contributions. These perspectives show that scientific writing requires more than presenting information; it demands a traceable chain of reasoning that explains why a research problem matters, how existing knowledge informs the investigation, why particular methodological decisions are appropriate, and how the resulting arguments or findings advance knowledge. Nevertheless, guidance on reporting standards, research methodology, statistical analysis, and conceptual development does not necessarily give researchers a practical way to connect these dimensions throughout the process of preparing a scientific article. This limitation is particularly important for students, early-career researchers, and interdisciplinary scholars who must translate theoretical ideas into defensible research designs and communicate their findings transparently and with academic rigour.

Based on this synthesis, the central research gap concerns the limited integration of scientific writing principles, theoretical development, methodological decision-making, statistical analysis, empirical interpretation, and research reporting within a single, logically connected framework. Existing publications have made important contributions to individual methodological domains. However, researchers still require an overarching framework that explains how decisions at one stage influence and constrain subsequent stages of scientific article development. In particular, the relationship between research questions and analytical methods needs to be explicitly connected to theoretical justification, construct operationalisation, measurement quality, statistical assumptions, result interpretation, and the validity of research conclusions. Addressing this gap is important because methodological decisions cannot be evaluated independently of the research objectives and the types of inferences a study seeks to establish. Therefore, the novelty of the present article does not rest on proposing new statistical techniques or claiming that its constituent principles have never been discussed previously. Instead, its originality lies in synthesising and organising established principles into an integrated, sequential, and interconnected framework that positions alignment between research questions and analytical methods as the central organising principle, while explicitly linking this alignment to theoretical coherence, measurement quality, analytical rigour, transparent reporting, and academic integrity.

Accordingly, this article aims to develop an integrated framework that guides researchers through the interconnected stages of scientific article preparation, from identifying and formulating research problems to theoretical development, research design, data analysis, interpretation of findings, and the formulation of conclusions and research implications. The framework focuses primarily on quantitative research, particularly regression analysis, mediation and moderation analysis, PLS-SEM, and CB-

SEM, while acknowledging that its underlying principles can also be adapted to qualitative research, mixed-methods studies, secondary-data analysis, and literature-based investigations. Specifically, the article explains how researchers can establish a defensible relationship between research questions and methodological choices, determine the appropriateness of analytical techniques based on research objectives and data characteristics, evaluate measurement and analytical quality, and translate statistical results into meaningful scientific interpretations. Rather than presenting these activities as isolated technical procedures, the proposed framework conceptualises them as mutually dependent stages in which each decision's quality contributes to the overall credibility, coherence, and explanatory value of the resulting scholarly article.

This framework matters because the growing availability of analytical software, methodological innovations, and diverse research designs has expanded researchers' technical options while also increasing the need for sound methodological judgment and transparent reporting. Without an integrated understanding of the research process, the growing complexity of analytical options may encourage procedural rather than conceptual decision-making, potentially resulting in inappropriate method selection, incomplete reporting, overinterpretation of statistical findings, and conclusions that exceed the available evidence. By emphasising alignment among research objectives, theoretical arguments, research design, analytical procedures, and empirical interpretations, this article seeks to strengthen the methodological foundations of scientific writing and promote greater consistency between research intentions and reported conclusions. Its underlying theoretical foundation draws on established perspectives concerning scientific reporting and transparency (APA, 2020), conceptual development and theoretical contribution (Jaakkola, 2020; MacInnis, 2011), and methodological rigour in statistical modelling and inference (Hair et al., 2019; Hayes, 2018; Wasserstein et al., 2019). These complementary perspectives provide the intellectual basis for understanding scientific article preparation as an integrated process in which theoretical reasoning, methodological appropriateness, analytical validity, and transparent communication jointly determine research quality.

This article is expected to make three interconnected contributions to scientific research and academic practice. First, it offers a conceptual contribution by proposing an integrated framework that connects the principal stages of scientific article development and clarifies the relationships among research problems, theoretical foundations, methodological decisions, statistical analysis, interpretation, and reporting. Second, it provides a methodological contribution by offering systematic guidance for selecting, justifying, implementing, and reporting analytical techniques in accordance with research questions, data characteristics, measurement requirements, and intended inferences. Third, it offers a practical contribution through a structured checklist to help students, lecturers, supervisors, early-career researchers, and experienced scholars evaluate the coherence, methodological consistency, analytical transparency, and academic integrity of manuscripts before journal submission. By bringing together principles that are often discussed separately, the proposed framework is intended to serve as an accessible yet methodologically grounded reference for improving the quality of scholarly communication across research disciplines. Ultimately, this framework is presented as a proposed integrative guide rather than a universally validated standard, providing a foundation for future empirical evaluation, disciplinary adaptation, and further refinement in response to developments in research methodology and scientific publishing.

Method

Research approach

This article adopts a conceptual-methodological approach that synthesises and integrates established principles of scientific writing, research methodology, statistical analysis, and academic reporting. This approach is appropriate because the primary objective is not to empirically test relationships among variables or evaluate the effectiveness of a particular research intervention, but to develop an integrated framework that provides systematic guidance for preparing scholarly articles. The proposed approach emphasises the logical connections between research problem formulation, theoretical development, methodological design, analytical procedures, interpretation of findings, and scientific reporting. In developing a conceptual contribution, Jaakkola (2020) emphasises the importance of establishing a clear conceptual design, clarifying the role of theory, and explaining how different sources of knowledge are integrated to generate meaningful scholarly insights. Accordingly, this article treats conceptual framework development as a structured process of knowledge organisation and methodological reasoning rather than a descriptive compilation of existing literature.

Conceptual synthesis in this article refers to identifying, organising, examining, and connecting relevant methodological principles into a coherent framework that explains the relationships among the essential stages of scientific article development. Unlike meta-analysis, which statistically combines quantitative findings from multiple empirical studies, the present approach focuses on conceptual integration and methodological clarification. Furthermore, this article is not intended to constitute a systematic literature review (SLR) or a PRISMA 2020-based review because it does not employ a predefined database search protocol, formal eligibility criteria, or a systematic study-selection and screening procedure. Although integrative literature reviews can generate new perspectives by synthesising existing knowledge (Torraco, 2005), the present study uses conceptual-methodological synthesis in a narrower sense to describe the integration of selected methodological principles. This distinction is important to ensure transparency about the article's nature, scope, and methodological claims.

Developmental materials and knowledge sources

The primary developmental material for this framework originated from preliminary teaching and learning materials designed for lectures and practical sessions in Statistics II and Research Methods courses. These materials were developed to help students and researchers understand the relationship between conceptual research development, methodological decision-making, statistical analysis, and scientific manuscript preparation. The initial content covers the structure of scientific articles, identification of research problems and gaps, theoretical development, hypothesis formulation, research design, sampling considerations, selection of analytical techniques, measurement quality assessment, interpretation of statistical findings, research reporting, and academic integrity. The educational context provides a practical foundation for identifying recurring methodological challenges and organising the topics into a more comprehensive framework for scholarly writing.

The framework's development was further informed by relevant methodological publications, conceptual research contributions, statistical guidelines, and established reporting standards. These knowledge sources encompass literature on conceptual article development (Jaakkola, 2020; MacInnis, 2011), scientific reporting standards

(APA, 2020), regression-based mediation and moderation analysis (Hayes, 2018; Igartua & Hayes, 2021), and structural equation modelling, particularly PLS-SEM (Hair et al., 2019; Sarstedt et al., 2022). Additional methodological references address measurement assessment, discriminant validity, predictive evaluation, and statistical inference. The selection of these sources was guided by their relevance to the framework's principal domains and their contribution to methodological clarification. However, the sources were not obtained through an exhaustive or protocol-driven literature search. Therefore, they should be understood as foundational and illustrative knowledge sources supporting conceptual development rather than as a comprehensive representation of all available publications in the field.

Stages of framework development

Developing the proposed framework involved four interconnected conceptual stages. The first stage involved identifying and classifying the key domains of scientific article development. At this stage, the developmental materials and relevant methodological principles were organised into seven principal domains: research problem formulation, theoretical foundations, research design, statistical analysis, interpretation of findings, scientific reporting, and academic integrity. This classification was intended to establish a comprehensive scope that extends beyond statistical procedures and recognises the interdependence of conceptual, methodological, analytical, and reporting activities throughout the research process.

The second stage involved establishing the logical relationships and sequence among the identified domains. Research questions were positioned as the central starting point because they determine the appropriate research objectives, theoretical arguments, research design, and analytical methods. The selection of statistical techniques was then linked to variable characteristics, data structure, measurement properties, analytical assumptions, and intended research inferences. Similarly, the interpretation of analytical results was connected to theoretical expectations, measurement quality, statistical uncertainty, effect sizes, and research design limitations. Through this process, the framework was structured as an interconnected sequence in which decisions made at earlier stages justify and constrain subsequent research activities.

The third stage focused on translating the conceptual relationships into operational guidelines that could be applied in academic writing and research practice. General methodological principles were transformed into practical explanations, analytical method-selection guidance, reporting recommendations, examples of statistical interpretation, and structured evaluation checklists. Particular attention was given to distinguishing the requirements of different analytical techniques, including descriptive statistics, regression analysis, mediation and moderation analysis using the PROCESS Macro, and PLS-SEM using SmartPLS. This differentiation was necessary because the assumptions, evaluation criteria, analytical objectives, and reporting requirements associated with each technique are not interchangeable. Accordingly, the framework was designed to help researchers select and report analytical procedures based on methodological appropriateness rather than software availability or procedural convenience.

The fourth stage consisted of a conceptual consistency assessment of the proposed framework. This assessment involved examining whether the relationships among research problems, objectives, theoretical foundations, methodological decisions, analytical procedures, findings, discussion, conclusions, and implications were logically

aligned. Particular emphasis was placed on ensuring that the proposed guidelines did not encourage analytical procedures that were inconsistent with the research questions or conclusions that exceeded the available empirical evidence. The framework was also examined for clarity, completeness of its principal domains, consistency of methodological terminology, and practical applicability as a research and manuscript preparation guide. This assessment represents an internal conceptual review conducted during framework development; it does not constitute empirical validation, psychometric testing, experimental evaluation, or an assessment of learning effectiveness.

Analytical scope and methodological coverage

The proposed framework primarily addresses scientific articles involving quantitative research and statistical analysis. Its methodological coverage includes descriptive statistics, regression analysis, mediation and moderation analysis using the PROCESS Macro, and partial least squares structural equation modelling (PLS-SEM) using SmartPLS (Dijkstra & Henseler, 2015; Henseler, 2018). These techniques were selected because they represent common analytical approaches in quantitative research, particularly for studies examining associations, explanatory mechanisms, conditional relationships, and complex relationships among latent constructs. The framework emphasises matching each analytical technique to the research question, variable characteristics, data structure, measurement requirements, and intended analytical objectives. It also addresses the need to distinguish between statistical significance, practical relevance, explanatory performance, predictive capability, and the limitations of statistical inference.

Although the primary emphasis is on quantitative research, the underlying principles of conceptual coherence, methodological justification, analytical transparency, and evidence-based interpretation may also be adapted to qualitative research, mixed-methods studies, secondary-data investigations, and literature-based research. Nevertheless, specialised methodological procedures associated with covariance-based structural equation modelling (CB-SEM), including its implementation through analysis of moment structures (AMOS), as well as time-series analysis, panel-data analysis, and systematic literature reviews, may require additional guidance beyond this article's specific operational coverage. Consequently, the framework is intended to provide a general foundation for integrated scientific writing while acknowledging that individual research designs and analytical traditions require context-specific methodological considerations.

Methodological limitations

The methodological approach adopted in this article has several limitations that should be acknowledged when interpreting its contribution. First, the framework draws on conceptual synthesis and selected methodological literature rather than an exhaustive systematic review of all publications on scientific writing, research methodology, and statistical analysis. Therefore, the framework does not claim to represent every available methodological perspective or resolve all differences in analytical recommendations across research disciplines. Second, the framework originates partly from preliminary educational materials developed for Statistics II and Research Methods courses, so its initial organisation reflects an instructional and practical orientation. Although this provides a foundation for developing accessible research guidance, further refinement may be necessary to accommodate the

methodological diversity and reporting expectations of different academic fields.

Third, the proposed framework has not been empirically validated through expert surveys, experimental studies, instrument reliability testing, or comparative evaluations involving researchers and students. Accordingly, no empirical claims are made regarding its effectiveness in improving manuscript quality, strengthening statistical competence, increasing publication acceptance rates, or enhancing research outcomes. Its contribution should instead be interpreted as a theoretically and methodologically informed conceptual guide that organises established research principles into a coherent, practical structure. Future research may evaluate its conceptual completeness, usability, and applicability through expert assessment, educational implementation, and empirical investigations across different academic disciplines and research contexts.

Results and discussion

Development of the integrated scientific writing framework

The conceptual synthesis produced an integrated framework that frames scientific article preparation as a sequence of interconnected intellectual, methodological, analytical, and reporting decisions. Although the framework retains the conventional introduction, methods, results, and discussion (IMRAD) structure, it goes beyond manuscript organisation by emphasising the reasoning processes behind each section. The framework is founded on five principles: coherence, methodological appropriateness, transparency, proportionality of interpretation, and academic integrity. These principles provide a common foundation for connecting research problems, theoretical arguments, research designs, analytical procedures, empirical findings, and conclusions. As summarised in Table 1, each principle serves a distinct but complementary function in maintaining the overall quality and credibility of a scholarly article.

Table 1 core principles of the integrated scientific writing framework

Principle	Operational meaning	Expected application
Coherence	Maintaining logical consistency across research stages	Aligning research questions, theory, methods, results, and conclusions
Methodological appropriateness	Selecting procedures according to research objectives and data characteristics	Justifying research design, sampling, measurement, and statistical techniques
Transparency	Providing sufficient information to evaluate research procedures	Reporting data sources, instruments, analytical procedures, and results
Proportionality of interpretation	Matching conclusions to the strength and limitations of evidence	Avoiding unsupported causal claims and overgeneralization
Academic integrity	Maintaining honesty, accountability, and responsible scholarship	Accurate citation, complete reporting, disclosure of limitations, and ethical compliance

Source: secondary data.

The framework begins with formulating a research problem and progresses through theoretical development, research design, data collection, measurement, statistical analysis, interpretation, and manuscript preparation. These stages are not entirely linear because research may require revisions when empirical evidence, measurement results, or analytical diagnostics reveal inconsistencies. Nevertheless, research questions function as the central reference point for determining the

appropriateness of subsequent decisions. The framework therefore treats manuscript development as an iterative but logically structured process in which each stage must remain consistent with the overall research objectives.

Research problem, theoretical development, and methodological alignment

The first component involves developing a defensible research problem. Researchers are expected to distinguish between an empirical phenomenon and a scientific research gap. A phenomenon describes an observable condition supported by relevant evidence, whereas a research gap identifies limitations in existing knowledge that require further investigation. The framework identifies five possible forms of research gaps: empirical, theoretical, contradictory empirical findings, methodological, and synthesis gaps. Identifying a gap must be supported by a critical examination of previous research, not by the simple absence of studies in a particular geographical setting.

The subsequent stage involves synthesising relevant literature and establishing an appropriate theoretical foundation. Literature synthesis should identify conceptual relationships, compare empirical findings, explain inconsistencies, and establish the mechanisms underlying the proposed relationships. Hypotheses must emerge from these arguments rather than from mechanically accumulating supporting references. In mediation research, theoretical justification must explain the proposed indirect mechanism (Wahdiniwaty et al., 2025; Wahdiniwaty & Firmansyah, 2026), whereas moderation research must establish why a relationship is expected to vary under particular conditions. The resulting conceptual model must accurately represent the constructs, hypothesised relationships, and analytical specifications.

The framework then connects the research objectives to appropriate research designs, sampling procedures, measurement strategies, and analytical methods. Table 2 maps common research objectives to analytical techniques. This mapping is intended as a decision-support guide rather than a universal classification because the final choice depends on the research design, data characteristics, analytical assumptions, and intended inferences.

Table 2 alignment between research objectives and analytical methods

Research objective	Methods to consider	Main methodological considerations
Describing data characteristics	Descriptive statistics	Variable distributions, missing data, and extreme observations
Comparing groups	Parametric or non-parametric tests	Measurement scale, independence, and distributional assumptions
Estimating relationships with continuous outcomes	Linear regression	Functional form, residual diagnostics, heteroscedasticity, and multicollinearity
Modeling binary outcomes	Logistic regression	Outcome coding, sample adequacy, and model specification
Estimating indirect relationships	Mediation analysis using PROCESS or SEM	Specific indirect effects and bootstrap confidence intervals
Examining conditional relationships	Moderation or interaction analysis	Interaction coefficients, conditional effects, and simple slopes
Modeling latent constructs and structural relationships	PLS-SEM	Measurement model, structural model, and predictive objectives
Testing covariance-based theoretical models	CB-SEM	Model identification, estimation assumptions, and model fit
Analyzing temporal or unit-level observations	Time-series or panel-data analysis	Temporal dependence, stationarity, and unit-specific effects
Synthesizing previous studies	Systematic review or meta-analysis	Search protocol, eligibility criteria, quality assessment, and synthesis procedures

Source: secondary data.

An important implication of this mapping is that analytical complexity should not be treated as an indicator of research quality. Regression, mediation, moderation, PLS-SEM, and CB-SEM serve different analytical purposes and cannot be selected interchangeably. Similarly, cross-sectional survey designs can examine associations and theoretically specified indirect relationships but generally cannot establish temporal precedence or causal mechanisms on their own. Sample size, sampling techniques, measurement specifications, and data collection procedures must therefore be justified according to the selected design and analytical objectives (Firmansyah & Dede, 2022).

Statistical analysis and reporting guidelines

The framework provides differentiated analytical guidance for regression analysis, regression-based mediation and moderation, and PLS-SEM. For regression analysis, the process begins with data screening, variable coding, missing-data examination, and model specification. Relevant diagnostics include functional form, independence, homoscedasticity, multicollinearity, residual behaviour, and influential observations. Interpret regression coefficients by considering their magnitude, direction, uncertainty, and substantive relevance rather than relying solely on statistical significance. Reporting should include sample size, coefficient estimates, standard errors, confidence intervals where available, p-values, and relevant measures of explanatory performance, including R^2 and adjusted R^2.

For mediation and moderation using the PROCESS Macro, the framework emphasises the distinction between indirect effects and conditional relationships. Mediation analysis requires reporting specific indirect effects and their bootstrap confidence intervals, together with direct and total effects where relevant. A statistically supported indirect effect does not automatically establish a causal mechanism, particularly when the research design does not establish temporal ordering or adequately address confounding. Moderation analysis requires reporting interaction coefficients and interpreting conditional effects through simple slopes or, when appropriate, the Johnson–Neyman procedure. The statistical significance of separate relationships across groups is not sufficient evidence of an interaction (Hayes, 2018; Hayes et al., 2017; Igartua & Hayes, 2021).

For PLS-SEM, the framework distinguishes between measurement model assessment and structural model evaluation. Reflective measurement models require consideration of indicator reliability, internal consistency, convergent validity, and discriminant validity. Formative measurement models require different assessment procedures, particularly indicator collinearity, the significance and relevance of outer weights, and, where appropriate, redundancy analysis. Structural model assessment includes predictor collinearity, path coefficients, bootstrap confidence intervals, explanatory power, effect sizes, and predictive performance when prediction is an explicit research objective. Table 3 summarises the principal analytical criteria and reporting considerations.

For reflective PLS-SEM constructs, outer loadings around or above 0.70, composite reliability and rho_A around or above 0.70, and AVE of at least 0.50 are commonly used as reference values. However, these values should not be applied mechanically; indicator retention must also consider content validity, theoretical relevance, and the consequences of indicator deletion. Discriminant validity should be examined primarily using HTMT, with thresholds such as 0.85 or 0.90 selected based on the conceptual similarity of the constructs and the analytical context. The Fornell–Larcker criterion may provide supplementary information but should not be the sole

basis for establishing discriminant validity (Fornell & Larcker, 1981; Franke & Sarstedt, 2019; Henseler et al., 2016; Rönkkö & Cho, 2022).

Table 3 statistical evaluation and reporting considerations for quantitative analysis

Analytical component	Relevant evaluation	Reporting considerations
Linear regression	Model specification, residual diagnostics, VIF, influential observations	Coefficients, SE, CI, p-values, R^2, adjusted R^2
Mediation	Specific indirect effects and bootstrap confidence intervals	Indirect, direct, and total effects where relevant
Moderation	Interaction coefficient and conditional effects	Interaction estimates, CI, simple slopes or Johnson–Neyman results
Reflective PLS-SEM	Outer loadings, composite reliability, rho_A, AVE, HTMT	Indicator and construct reliability and validity results
Formative PLS-SEM	Indicator collinearity, outer weights, redundancy analysis	VIF, weight estimates, significance, and substantive relevance
Structural PLS-SEM	Inner VIF, path coefficients, R^2, f^2, predictive assessment	Estimates, bootstrap uncertainty, explanatory and predictive results
PLS-SEM model fit	SRMR, NFI, d_ULS, and d_G where appropriate	Index values, bootstrap procedures, and interpretation limitations
Common method bias	Procedural remedies and appropriate statistical assessments	Research design measures and limitations of diagnostic tests

Source: secondary data.

Structural model interpretation should consider the magnitude and direction of path coefficients, their bootstrap confidence intervals, R^2, f^2, and, when relevant, predictive performance. Common reference values for f^2 are 0.02, 0.15, and 0.35, representing small, medium, and large effects, respectively, although substantive interpretation remains context-dependent (Cohen, 1988; Hair et al., 2022). When out-of-sample prediction is claimed, PLSpredict can provide additional evidence through prediction errors and comparison with a linear model benchmark. In particular, do not infer predictive performance solely from in-sample R^2 (Shmueli et al., 2019).

Model fit indices in PLS-SEM should be interpreted cautiously. SRMR and NFI can be reported as supplementary information, but neither independently establishes adequate model specification. The d_ULS and d_G indices require bootstrap-based assessment rather than universal fixed cutoffs. Their original values are compared with the relevant bootstrap upper bounds, such as HI95 or HI99. Table 4 provides an illustrative interpretation of these indices.

Table 4 illustration of bootstrap-based interpretation of d_ULS and d_G

Index	Original value	HI95	HI99	Interpretation
d_ULS	0.120	0.150	0.180	The original value is below both upper bounds; the exact-fit criterion is not rejected at either selected level
d_G	0.160	0.150	0.190	The original value exceeds HI95 but remains below HI99; the exact-fit criterion is not supported at the 95% level but is not rejected at the 99% level

Source: secondary data.

Regarding common method bias, the framework recommends addressing potential bias in research design through anonymity, careful questionnaire construction, separating measurement sources or occasions where feasible, and other appropriate procedural remedies. Full collinearity VIF can be considered a supplementary

diagnostic, but a value below 3.3 does not definitively establish the absence of common method bias (Kock, 2017, 2023, 2024; Kock & Dow, 2025).

Results presentation, discussion, and manuscript readiness

The framework further establishes that statistical analysis must be followed by transparent and appropriately structured result presentation. Results should be organised according to research questions or hypotheses, with measurement assessment and diagnostic information presented before structural model findings when required by the analytical approach. Tables should be editable, internally consistent, and accompanied by explanatory text rather than presented as screenshots of software outputs. Statistical reporting should avoid inappropriate numerical representations, such as reporting $p = 0.000$ instead of $p < 0.001$, and must include statistically non-significant findings where relevant.

The discussion should interpret the direction, magnitude, and uncertainty of the findings, relate the evidence to theoretical arguments and previous research, and explain the potential implications for the relevant context. Alternative explanations, measurement limitations, selection bias, potential common method bias, and statistical power should also be considered. Conclusions must directly address the research objectives and remain proportional to the research design and available evidence. Theoretical and practical implications should be distinguished from speculative explanations, while limitations should be translated into specific recommendations for future investigations. To facilitate implementation, the framework concludes with a manuscript readiness checklist that integrates conceptual, methodological, analytical, reporting, and ethical considerations. Table 5 summarises the principal evaluation dimensions and provides a practical instrument for reviewing manuscript consistency before submission.

Table 5 integrated scientific article readiness checklist

Dimension	Main evaluation questions
Research problem	Is the phenomenon supported by verifiable evidence, and is the research gap clearly established?
Novelty and contribution	Is the originality explained beyond contextual differences, and is the contribution proportionate?
Theory and hypotheses	Are constructs, mechanisms, hypotheses, and conceptual relationships theoretically justified?
Research design	Are the design, unit of analysis, population, sample, and sampling procedures clearly explained?
Sample adequacy	Is sample size justified using appropriate statistical or methodological considerations?
Measurement	Are constructs, indicators, scales, and reflective/formative specifications justified?
Analytical methods	Are the statistical techniques appropriate for the research questions and data characteristics?
Statistical reporting	Are estimates, uncertainty, effect sizes, diagnostics, and non-significant findings transparently reported?
Discussion and conclusions	Are interpretations theoretically grounded and consistent with the evidence?
Implications and limitations	Are contributions, limitations, and future research recommendations clearly differentiated?
Presentation and references	Are tables, figures, citations, references, and DOI information accurate and consistent?
Ethics and integrity	Are consent, privacy, funding, conflicts of interest, and AI use addressed where applicable?

Dimension	Main evaluation questions
Journal readiness	Does the manuscript comply with the target journal's scope, format, and submission requirements?

Source: secondary data.

The framework also allows adaptation to other research traditions. Qualitative studies require emphasis on interpretive credibility, reflexivity, and analytical transparency rather than statistical hypothesis testing. Systematic reviews require transparent search strategies, eligibility criteria, study selection, and synthesis procedures, with PRISMA 2020 serving as an appropriate reporting guideline where applicable. Mixed-methods studies must explicitly justify the integration of qualitative and quantitative components (Creswell & Inoue, 2025). Consequently, the framework provides shared principles while allowing discipline-specific methodological requirements to determine the appropriate procedures and reporting standards.

Extending IMRAD through an integrated research reasoning framework

The proposed framework extends the conventional understanding of scientific article preparation by distinguishing manuscript organisation from the intellectual processes required to produce a coherent research contribution. IMRAD provides a recognisable structure for communicating research. However, its organisational function does not necessarily explain how researchers should make decisions connecting theoretical arguments, research designs, statistical procedures, and empirical interpretations. This distinction aligns with the American Psychological Association's (2020) reporting philosophy, which emphasises transparency and completeness in communicating research procedures and findings. However, reporting standards primarily establish expectations regarding what information should be communicated (Jayawardhana & Ekanayake, 2026). In contrast, the proposed framework additionally emphasises how the underlying research decisions should be logically connected before and during manuscript preparation (Schindler et al., 2026).

This distinction also relates to the conceptual perspectives of MacInnis (2011) and Jaakkola (2020), who emphasise the importance of developing meaningful theoretical arguments and establishing a coherent conceptual contribution. Their perspectives suggest that scholarly quality depends not only on presenting research components but also on the logic connecting them. The proposed framework extends this understanding into methodological and statistical practice by positioning research questions as the central reference point for theoretical development, methodological selection, empirical analysis, and interpretation. Thus, it does not replace IMRAD or existing reporting standards, but complements them with an integrated decision-making perspective. This extension is particularly relevant for researchers who understand an article's technical structure but struggle to translate a research problem into an appropriate analytical strategy and defensible scientific conclusions.

Methodological alignment and the integration of statistical decision-making

An important methodological implication of the framework is that statistical analysis should be treated as a consequence of research objectives and design rather than as an independent technical activity. In practice, researchers may select regression, mediation, moderation, or structural equation modelling because these techniques are familiar or supported by available software. However, methodological appropriateness requires consideration of the research question, measurement characteristics, data

structure, model assumptions, and intended inferences. Hair et al. (2019) emphasise that applying and reporting PLS-SEM must be justified by the analytical objectives and accompanied by appropriate evaluations of measurement and structural models. Similarly, Hayes (2018) and Igartua & Hayes (2021) show that mediation and moderation are distinct analytical concepts that require different theoretical explanations and interpretive procedures.

The proposed framework connects these methodological perspectives through the principle of aligning research questions with methods. This connection matters because using a sophisticated analytical technique does not automatically improve a study's explanatory or predictive value. For example, mediation analysis requires a theoretically defensible explanation of the mechanism through which a predictor may relate to an outcome. In contrast, moderation analysis requires justification for why the relationship changes under particular conditions. Hayes et al. (2017) further explain the differences between regression-based conditional process analysis and structural equation modelling, indicating that analytical choices should consider the objectives and specifications of the research model. Consequently, the framework encourages researchers to distinguish between statistical evidence of an indirect or conditional relationship and stronger claims regarding causal mechanisms. This distinction matters especially in cross-sectional research, where temporal ordering and alternative explanations may remain insufficiently established.

The framework also strengthens the connection between measurement quality and the credibility of structural interpretations. Assessing measurement models should not be reduced to mechanically applying numerical thresholds, because the conceptual meaning of constructs and the nature of their indicators remain fundamental. Fornell & Larcker (1981) established an influential approach to evaluating discriminant validity, while subsequent research by Henseler et al. (2016); Franke & Sarstedt (2019); and Rönkkö & Cho (2022) demonstrates the importance of more rigorous discriminant validity assessment, including HTMT-based approaches. Cheung et al. (2024) also recommend reporting reliability, convergent validity, and discriminant validity in structural equation modelling. Taken together, these studies reinforce the argument that measurement assessment should be theoretically informed and transparently reported. The proposed framework integrates these recommendations by linking construct definition, indicator selection, measurement specification, and structural interpretation within a single methodological workflow.

Another important implication concerns the distinction between explanatory performance, predictive capability, statistical significance, and practical relevance. Researchers sometimes interpret statistically significant path coefficients or high R^2 values as sufficient evidence of a strong or useful model. However, these indicators represent different aspects of analytical performance. Cohen (1988) provides a foundation for understanding effect sizes, while Shmueli et al. (2019) emphasise the importance of evaluating predictive performance through procedures such as PLSpredict rather than relying exclusively on in-sample explanatory measures. Wasserstein et al. (2019) similarly caution against reducing scientific conclusions to binary decisions based on statistical significance thresholds. The proposed framework brings these perspectives together by encouraging researchers to interpret estimates in relation to their magnitude, uncertainty, theoretical meaning, and intended application. Accordingly, the quality of statistical reporting should be judged by the completeness and appropriateness of the interpretation rather than by the number of significant findings.

Implications for scientific writing and research methodology education

Beyond its methodological contribution, the framework also has implications for teaching and learning scientific research. Statistics and research methodology are often taught as separate subjects, which may lead students to see statistical analysis as a technical requirement that begins only after data collection. This separation can make it difficult for learners to understand why particular analytical techniques are appropriate and how the resulting evidence should influence theoretical interpretation and manuscript development. By connecting research questions, theory, design, analysis, and reporting, the proposed framework offers an alternative instructional perspective in which statistical techniques are introduced as tools for answering clearly formulated scientific questions.

Integrating statistics II and research methods is particularly relevant because students need to understand both the technical implementation and the intellectual justification of analytical procedures. For example, learning regression analysis should involve not only interpreting coefficients and significance values but also evaluating model specification, assumptions, effect magnitude, and the limitations of the research design. Similarly, learning mediation and moderation should include theoretical reasoning concerning indirect mechanisms and conditional relationships rather than focusing exclusively on software procedures. This instructional perspective aligns with the broader emphasis on methodological transparency and theoretical coherence in Hayes (2018); Hair et al. (2019), and the American Psychological Association reporting standards (2020).

Nevertheless, the proposed educational value should be interpreted as a potential application rather than an empirically demonstrated outcome. The framework has not yet been evaluated through controlled teaching interventions, comparative assessments of student performance, or independent examinations of manuscript quality. Therefore, future research should examine whether its implementation improves students' methodological reasoning, ability to select analytical techniques, accuracy of statistical interpretation, and competence in preparing scholarly manuscripts. Such investigations could provide evidence regarding the educational effectiveness and practical usability of the proposed framework.

Conceptual originality and interdisciplinary relevance

This article's conceptual originality lies in integrating principles commonly addressed in separate methodological and scholarly writing domains. Existing publications provide substantial guidance on conceptual article development, statistical analysis, measurement assessment, and research reporting. For example, Jaakkola (2020) discusses approaches to conceptual article design, MacInnis (2011) explains how to develop conceptual contributions, and Torraco (2005) addresses synthesising literature to generate new perspectives. Similarly, Hair et al. (2019) provide methodological recommendations for PLS-SEM, while Hayes (2018) provides detailed guidance on mediation, moderation, and conditional process analysis. These contributions establish important foundations, but they address different dimensions of the research process.

The proposed framework brings these dimensions together by emphasising their interdependence. Its added value lies in the systematic connection between identifying a research gap, theoretical justification, methodological selection, measurement quality, statistical analysis, empirical interpretation, and manuscript readiness. Rather than introducing new statistical procedures, it provides an overarching structure through

which established methodological knowledge can be translated into practical research decisions. This integration is especially relevant for interdisciplinary researchers who must navigate different analytical traditions and reporting expectations. However, interdisciplinary applicability should not be interpreted as methodological uniformity. Each discipline retains its own theoretical assumptions, ethical requirements, measurement conventions, and standards for evaluating research quality. The framework therefore provides common principles while allowing the operational procedures to be adapted to the characteristics of individual research traditions.

Limitations and future research directions

Despite its conceptual and practical contributions, the proposed framework has several limitations. First, its development relies on a select body of methodological literature and preliminary educational materials rather than an exhaustive systematic literature review. Consequently, the framework may not capture all relevant methodological debates, disciplinary differences, or emerging analytical developments. Second, its technical coverage emphasises quantitative research, particularly regression, mediation, moderation, and PLS-SEM. Although the underlying principles may be adapted to qualitative research, mixed-methods studies, systematic reviews, and other analytical approaches, these applications require more specialised methodological elaboration. Third, the framework has undergone conceptual consistency assessment but has not been subjected to independent expert validation, usability testing, or empirical effectiveness evaluation.

These limitations provide several opportunities for future research. First, expert assessment involving researchers from different methodological and disciplinary backgrounds could evaluate the framework's conceptual completeness, clarity, and practical relevance. Second, educational implementation studies could investigate its usefulness in improving students' research methodology competence and scientific writing skills. Third, comparative research could examine manuscript quality before and after implementing the framework using predefined assessment criteria, including theoretical coherence, methodological appropriateness, statistical reporting accuracy, and transparency. Finally, future work could develop specialised versions for qualitative research, mixed-methods research, systematic reviews, and advanced quantitative techniques. Such extensions would help establish whether the proposed framework can be adapted consistently across different academic contexts and provide a stronger foundation for its future refinement.

Conclusions

This article develops an integrated conceptual-methodological framework that positions scientific writing as a coherent and interconnected process rather than a mechanical arrangement of manuscript sections based on the introduction, methods, results, and discussion (IMRAD) structure. The proposed framework highlights the alignment of research problems, research gaps, theoretical foundations, research questions, methodological designs, statistical analyses, interpretation, and research reporting as the fundamental elements of scholarly quality. Its central finding is that a scientific article's quality depends not only on the sophistication of the analytical techniques used, but also on the consistency of research decisions, methodological appropriateness, transparency of evidence, proportionality of interpretation, and adherence to academic integrity. By integrating guidance on regression, mediation and moderation analysis, and partial least squares structural equation modelling (PLS-SEM),

the framework provides a structured workflow for connecting conceptual reasoning with statistical procedures and scientific reporting.

The proposed framework offers conceptual, methodological, and practical contributions to research methodology education and scholarly publishing. Conceptually, it extends existing guidance by organising previously fragmented principles of scientific writing, methodological decision-making, statistical analysis, and research reporting into a unified framework. Methodologically, it emphasises selecting analytical techniques based on research questions, data characteristics, measurement quality, and inferential objectives, while discouraging the mechanical application of statistical thresholds and software outputs. Practically, it provides operational guidelines and a manuscript-readiness checklist that can support students, lecturers, supervisors, early-career researchers, and academic authors in preparing more coherent and transparent scientific articles. Nevertheless, this study is limited by its conceptual-methodological nature, the absence of empirical validation, and its primary emphasis on quantitative research, particularly regression-based analysis and PLS-SEM. Therefore, the proposed framework should be regarded as an initial guiding model rather than an empirically established instrument for improving manuscript quality or publication outcomes.

Future research should empirically evaluate the framework's applicability, usability, and effectiveness through expert assessments, classroom implementation, comparative studies, and pre and post implementation evaluations of manuscript quality. Further studies could also investigate whether applying the framework improves researchers' methodological understanding, analytical decision-making, reporting accuracy, and ability to develop theoretically meaningful contributions. In addition, the framework should be expanded and adapted to accommodate qualitative research, mixed-methods studies, systematic literature reviews, meta-analysis, CB-SEM, and other discipline-specific analytical approaches. Longitudinal evaluations and cross-disciplinary applications would provide further evidence regarding its robustness, adaptability, and educational value. Through these developments, the proposed framework could evolve into a more comprehensive, empirically supported reference for strengthening the quality, transparency, and credibility of scientific research and scholarly publications.

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