Cómo se escribe un artículo científico

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Basics of research paper writing and publishing

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Abstract: Publishing research results is an integral part of a researcher's professional life. However, writing is not every researcher's favorite activity, and getting a paper published can be a very tedious and time-consuming process. Unfortunately, many of the obstacles along the writing and publishing path can be avoided by following some simple guidelines and practices. This paper presents a synthesis of guidelines found in literature about structuring and writing scientific papers. The paper outlines the process of publishing research papers in journals and conference proceedings, aiming to provide early-stage researchers with a handy introduction to essential issues. The paper takes an interdisciplinary stance by giving examples from technology-enhanced learning, research and learning from literature in social, natural, and computing sciences.

Keywords: paper writing, publication process, paper structure, journal publications, conference publications, writing tips, scientific practice.

References to this paper should be made as follows: Demtl, M. (2014) 'Basics of research paper writing and publishing', Int. J. Technology Enhanced Learning, Vol. 6, No. 2, pp. 105-123.

Biographical notes: Michael Demtl is a Senior Researcher at the Information Systems chair at RWTH Aachen University, Germany. He has conducted and managed R&D in several publicly funded projects in the area of technology-enhanced learning at University of Vienna and RWTH Aachen University. He holds a PhD in Information Systems from University of Vienna. He has given seminars and workshops on scientific writing and publishing at the University of Vienna and the Joint European Summer School on Technology Enhanced Learning, respectively.

1 Introduction

The dissemination of research results and findings is an integral part of the research process and the career in academia. Researchers write to keep records of their work for themselves, but more important for readers and peers who are expecting a standard form, language and style when reading research papers. Writing in a scientific style may be hard in the beginning for novices, but clear communication and concise writing for a scientific audience can be trained (Davis, 1997).
RULES OF THUMB FOR WRITING RESEARCH ARTICLES1

Tomaž Hengl2, Michael Gould3

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Abstract

The paper provides 'rules of thumb' for writing research articles (RA) and getting them published. These were discussed during the "Scientific Writing" course organized for ITC PhD students by Cressie Communication Services. Important aspects of macro and micro-structure of a paper were selected through group discussions. The substructures and functions of different sections of RAs are described. Results of previous investigations and interviews among journal editors were used to summarize what makes a good RA. It was concluded that clear, logical, coherent, focused, good argument and well-structured writing gets the paper published and read. Some important rules of the thumb selected were: "Adjust your writing to the audience and purpose", "Avoid redundancy and unnecessary explanations" and "Write like you speak and then revise".

Keywords: Research article, rules of thumb, structure, publishing.

1. INTRODUCTION

A scientific or research article is a technical (or expository) document that describes a significant experimental, theoretical or observational extension of current knowledge, or advances in the practical application of known principles (O'Connor and Woodford, 1976). It is important to emphasize that a research article (further referred as RA) should report on research findings that are not only sound (valid) and previously unpublished (original), but also add some new understanding, observation, proof, i.e. potentially important information (Gordon, 1983). Unlike a novel, newspaper article or an essay, a RA has a required structure and style, which is by international consensus known as "Introduction Methods Results and Discussion" or IMRD. However, a RA is not only a technically rigid document, but also a subjective intellectual product that invariably reflects personal opinions and beliefs. Therefore, it requires good skills in both structuring and phrasing the discoveries and thoughts. These skills are acquired through experience, but can also be taught.

1 You are free to distribute this document, or use it in classes, as long as you give credit to the source and you do not use it for any commercial purposes. It is licenced under the Creative Commons Attribution License (by).
• El artículo científico es un informe escrito y publicado que describe resultados originales de investigación

• Es el método principal para comunicar los resultados científicos
IMRAD
IMRaD

• Introducción
  – ¿Por qué hiciste la investigación?
• Materiales y método
  – ¿Qué usaste y cómo lo usaste?
• Resultados:
  – ¿Qué encontraste?
• And
• Discusión:
  – ¿Qué significa, qué implica lo que encontraste?
Green open access
Authors can share their research in a variety of different ways and Elsevier has a number of green open access options available. We recommend authors see our green open access page for further information (http://elsevier.com/greenopenaccess). Authors can also self-archive their manuscripts immediately and enable public access from their institution's repository after an embargo period. This is the version that has been accepted for publication and which typically includes author-incorporated changes suggested during submission, peer review and in editor-author communications. Embargo period: For subscription articles, an appropriate amount of time is needed for journals to deliver value to subscribing customers before an article becomes freely available to the public. This is the embargo period and it begins from the date the article is formally published online in its final and fully citable form.

This journal has an embargo period of 24 months.

Language (usage and editing services)
Please write your text in good English (American or British usage is accepted, but not a mixture of these). Authors who feel their English language manuscript may require editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the English Language Editing service available from Elsevier's WebShop (http://webshop.elsevier.com/languageediting/) or visit our customer support site (http://support.elsevier.com) for more information.

Submission
Our online submission system guides you stepwise through the process of entering your article details and uploading your files. The system converts your article files to a single PDF file used in the peer-review process. Editable files (e.g., Word, LaTeX) are required to typeset your article for final publication. All correspondence, including notification of the Editor's decision and requests for revision, is sent by e-mail.
<table>
<thead>
<tr>
<th>Generic paper structure</th>
<th>Example I</th>
<th>Example II</th>
<th>Example III</th>
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<tbody>
<tr>
<td>1. Introduction</td>
<td>1. Introduction</td>
<td>1. Introduction</td>
<td>1. Introduction</td>
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<tr>
<td>2. Theoretical</td>
<td>2. Theory</td>
<td>2. Background and research models</td>
<td>2. Background</td>
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<td>background/literature</td>
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<td>(where appropriate)</td>
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<td></td>
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<tr>
<td>approach/methodology/</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>research design</td>
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<td></td>
<td>5. Operationalisation and validation</td>
</tr>
<tr>
<td>5. Results</td>
<td>5. Scale validation</td>
<td>5. Data analysis and results</td>
<td>6. Data analysis and results</td>
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<tr>
<td>6. Discussion of</td>
<td>6. Results</td>
<td>7. Discussion (including limitations and implications)</td>
<td>7. Discussion</td>
</tr>
<tr>
<td>results</td>
<td>7. Discussion (including limitations and implications)</td>
<td>6. Conclusions (including contributions, limitations and implications)</td>
<td></td>
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<td>7. Implications – for</td>
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<td>research and practice</td>
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<td></td>
<td></td>
<td>10. Conclusions</td>
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<td>RAS Title</td>
<td>Main functions</td>
<td>Preferred style</td>
<td>Rules of thumb</td>
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</tr>
<tr>
<td></td>
<td>- indicates content and main discoveries;</td>
<td>- short and simple (7-10 words);</td>
<td>- avoid complex grammar;</td>
</tr>
<tr>
<td></td>
<td>- attracts the reader's attention;</td>
<td>- purposive (aims at specific audience);</td>
<td>- make it catchy!</td>
</tr>
</tbody>
</table>

**Make it catchy!** (que sea pegadizo):
- Atractivo
- Debe destacar entre miles de títulos

**Accurate**

**Include some keywords**
• Define un título provisional desde el principio:
  – Lista de palabras clave
  – Lista de varios posibles títulos
• La ironía, los juegos de palabras y el humor son peligrosos
• Se deben evitar los acrónimos desconocidos y los neologismos (nuevos términos)
• Utiliza el mínimo posible de palabras que describan correctamente el contenido
• ¿Quiénes son los autores de un artículo?
• ¿Cuántos autores puede tener un artículo?
• ¿En qué orden se escriben los nombres de los autores?
Multiauthor Papers: Onward and Upward
BY CHRISTOPHER KING

When ScienceWatch last visited the topic of multiauthor papers back in 2007, the signs were unclear as to whether the trend of reports listing untold hundreds of authors was perhaps showing signs of leveling off in the middle of the last decade.

With this latest update, we can now answer with a resounding “No”! In fact, recent years have seen a steep increase in the number of papers with authors in excess of 50, and a particularly notable spike in reports whose author counts exceed 1,000 and more. To borrow a term credited to Indiana University information scientist Blaise Cronin, “hyperauthorship” would seem to be flourishing—driven in particular, as we’ll see, by an international undertaking in high-energy physics that recently made world headlines.

Graph 1 tracks papers indexed by Thomson Reuters for each year between 1968 and 2011, showing the number of papers with more than 50, 100, 200, 500, and—a final benchmark not even required for the ’07 survey—1,000 authors. (The numbers are cumulative, in that papers in the respective groupings above 100 authors are included in the statistics for papers with 50 or more.)
Maximum number of authors on a single paper, by year, 1992 to 2011
Precision electroweak measurements on the Z resonance

A. Abbiendi, T. Acciarri, G. Achard, R. Ackenheil...

Abstract

We report on the final electroweak measurements performed with data taken at the Z resonance by the experiments operating at the electron–positron colliders SLC and LEP. The data consist of 17 million Z decays accumulated by the ALEPH, DELPHI, L3 and OPAL experiments at LEP, and 600 thousand Z decays by the SLD experiment using a polarised beam at SLC. The measurements include cross-sections, forward–backward asymmetries and polarised asymmetries. The mass and width of the Z boson, $m_Z$, and $\Gamma_Z$, and its couplings to fermions, for example the $p$ parameter and the effective electroweak mixing angle for leptons, are precisely measured:

$m_Z = 91.1875 \pm 0.0021 \text{ GeV}$.
Precision Electroweak Measurements on the Z Resonance

The ALEPH, DELPHI, L3, OPAL, SLD Collaborations,¹
the LEP Electroweak Working Group,²
the SLD Electroweak and Heavy Flavour Groups

Accepted for publication in Physics Reports
Appendix A

Author Lists

The ALEPH, DELPHI, L3, OPAL and SLD Collaborations have provided the inputs for the combined results presented in this Report. The LEP Electroweak Working Group and the SLD Heavy Flavour and Electroweak Groups have performed the combinations. The Working Groups consist of members of the five Collaborations. The lists of authors from the Collaborations follow.
A.1 The ALEPH Collaboration

A.5 The SLD Collaboration

• Consejos:
  – Establecer un criterio de autoría desde el primer momento, desde que se inicia la investigación ➔ Se debe negociar
  – ¿En qué orden se escriben los nombres de los autores?
• Revisión doble ciega ➔ Sin autores
Blinding Your Manuscript

Our apologies. We haven’t quite gotten around to writing comprehensive blinding instructions for this page.

In general, make sure the names of the authors and/or their affiliations do not appear on the title page.

Do not refer to “my previous research” or “our previous research” and then give a reference to your own work. You may use your own work, but the sentence should be written “In previous research, Jones et al. (2011) discovered....”

You want to include all relevant references, but not make it obvious that you are self-citing. Identifying the reference as “Author (2011), for instance, is not acceptable. In the world of Google, this means I can find out who you are and it is no longer a blind submission.”
This paper presents a _________ method for _________
(synonym for new) (sciencey verb)
the __________. Using __________, the
(noun few people have heard of) (something you didn’t invent)
__________ was measured to be ______ +/- ________
(property) (number) (number)
(units) (sexy adjective). Results show _________ agreement with
theoretical predictions and significant improvement over
previous efforts by __________, et al. The work presented
(Loser) here has profound implications for future studies of
(buzzword) and may one day help solve the problem of
(buzzword)
(supreme sociological concern).

Keywords: __________, __________, __________
• Que quede claro:
  – No es fácil escribir un buen abstract
  – Pero es muy importante escribir un buen abstract, porque es lo primero (y quizás lo único, si no logra convencer) que va a leer cualquiera que se interese por el artículo
• Junto con el título, es lo último que se escribe
• No se debe repetir:
  – El título exactamente con las mismas palabras
  – Frases exactas que aparezcan luego en la introducción
• Evita detalles demasiado concretos
<table>
<thead>
<tr>
<th>Función principal</th>
<th>Estilo preferido</th>
<th>Consejo</th>
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<tbody>
<tr>
<td>- reflects the main 'story' of the RA;</td>
<td>- past (perfect) tense and passive voice(!)</td>
<td>- avoid introducing the topic;</td>
</tr>
<tr>
<td>- calls attention but avoids extra explanations;</td>
<td>- short and concise sentences;</td>
<td>- explain: what was done, what was found and what are the main conclusions;</td>
</tr>
<tr>
<td></td>
<td>- no citations, tables, equations, graphs etc.</td>
<td>- bring summary 'numbers';</td>
</tr>
</tbody>
</table>

- De 100 a 300 palabras
- Puede reproducir la estructura IMRaD → **Structured abstract**
Secuencia de preguntas (en este orden) que ayudan a escribir el resumen:

1. ¿Cuál es el problema?
2. ¿Por qué el problema es importante?
3. ¿Qué hicieron otros que no funcionó?
4. ¿Cuál es la solución propuesta?
5. ¿Cuáles son los principales resultados?
6. ¿Qué consecuencias o implicaciones conlleva la solución?
ABSTRACT
This paper provides a sample of a LaTeX document which conforms, somewhat loosely, to the formatting guidelines for ACM SIG Proceedings. It is an alternate style which produces a tighter-looking paper and was designed in response to concerns expressed by authors, over page-budgets. It complements the document Author’s (Alternate) Guide to Preparing ACM SIG Proceedings Using \LaTeX Xe and BibTeX. This source file has been written with the intention of being compiled under \LaTeX Xe and BibTeX.

The developers have tried to include every imaginable sort of “bells and whistles”, such as a subtitle, footnotes on title, subtitle and authors, as well as in the text, and every optional component (e.g. Acknowledgments, Additional Authors, Appendices), not to mention examples of equations, theorems, tables and figures.

To make best use of this sample document, run it through \LaTeX Xe and BibTeX, and compare this source code with the printed output produced by the dvi file. A compiled PDF version is available on the web page to help you with the `look and feel'.

CCS Concepts
• Computer systems organization → Embedded systems; Redundancy; Robotics; • Networks → Network reliability

Keywords
ACM proceedings, \LaTeX X, text tagging

1. INTRODUCTION
The proceedings are the records of a conference. ACM seeks to give these conference by-products a uniform, high-quality appearance. To do this, ACM has some rigid requirements for the format of the proceedings documents: there is a specified format (balanced double columns), a specified set of fonts (Arial or Helvetica and Times Roman) in certain specified sizes (for instance, 9 point for body copy), a specified live area (18 × 23.5 cm [7” × 9.25”]) centered on the page, specified size of margins (1.9 cm [0.75”]) top, (2.54 cm [1”]) bottom and (1.9 cm [0.75”]) left and right; specified column width (8.45 cm [3.33”]) and gutter size (.83 cm [.33”]).

The good news is, with only a handful of manual settings1. 
INTRODUCTION
• Junto con el abstract, la parte más difícil de escribir, pero lo más importante, la lectura de todo el artículo depende de esta parte
• Igual que el abstract, se debe escribir lo último
<table>
<thead>
<tr>
<th>Función principal</th>
<th>Estilo preferido</th>
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<tbody>
<tr>
<td>- introduces the topic and defines the terminology;</td>
<td>- simple tense for referring to established knowledge or past tense for literature review;</td>
<td>- use the state-of-the-art references;</td>
</tr>
<tr>
<td>- relates to the existing research;</td>
<td></td>
<td>- follow the logical moves;</td>
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<tr>
<td></td>
<td></td>
<td>- define your terminology to avoid confusion;</td>
</tr>
<tr>
<td>- indicated the focus of the paper and research objectives;</td>
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<tr>
<td>Función principal</td>
<td>Estilo preferido</td>
<td>Consejo</td>
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<tr>
<td>Introduction</td>
<td>- introduces the topic and defines the terminology; - relates to the existing research; - indicated the focus of the paper and research objectives;</td>
<td>- simple tense for referring to established knowledge or past tense for literature review;</td>
</tr>
</tbody>
</table>

Si el trabajo relacionado es muy extenso, se puede crear una sección individual:
- Literature review → Revisión bibliográfica, Revisión de la literatura
- State of the art → Estado de la cuestión
- Related work → Trabajos relacionados
- Theoretical background → Marco teórico
2. **estado del arte.** Calco censurable del inglés state of the art. «Se tendrá la inestimable ocasión de ver allí [...] los desarrollos más avanzados, el estado del arte de nuestras variadas tecnologías» (Abe [Esp.] 12.7.96). En español, se recomienda sustituirlo por las expresiones estado o situación actual, últimos avances o estado de la cuestión, según los casos.
While prior work based on Wand and Weber’s (1990; 1993) theory of ontological expressiveness has attempted to examine characteristics of modeling grammars, or characteristics of models created with such grammars, our research is interested in examining how the theory of ontological expressiveness informs an understanding of the usage of conceptual modeling grammars.

We use a theory of ontological expressiveness (Wand and Weber 1993) to facilitate an understanding of four key properties of conceptual modeling grammars in terms of their levels of ontological completeness and ontological clarity. [...] We then examine empirically whether the ontological deficiencies of BPMN (as predicted through the selected theoretical base) manifest in the perceptions of the users of the grammar. Subsequently, we examine whether the perceptions of these deficiencies inform user perceptions about the usefulness and ease of use of the grammar.

We proceed as follows. The next section provides a background to the process modeling domain, and describes the selected theoretical models. Next, we describe the research method employed in our empirical study. We then discuss operationalization and validation of measurements used, before the next section presents our data analysis and an examination of the results. The final section presents the implications of our research and discusses the limitations of our work.
1. INTRODUCTION
Blah, blah, blah.

Blah, blah, blah.

Related work.

Blah, blah, blah.

Organization of the paper.

2. METHOD

3. METHOD
1. INTRODUCTION
Blah, blah, blah.
Blah, blah, blah.
Related work.
Blah, blah, blah. ¿Qué es lo nuevo que se presenta en este artículo?
Organization of the paper.

2. METHOD

1. INTRODUCTION
Blah, blah, blah.
Blah, blah, blah.

2. RELATED WORK
Organization of the paper.
Blah, blah, blah.

3. METHOD
METHODOLOGY
(MATERIALS & METHOD)
• Es lo más fácil de escribir → Empezar un artículo por esta parte
<table>
<thead>
<tr>
<th>Función principal</th>
<th>Estilo preferido</th>
<th>Consejo</th>
</tr>
</thead>
<tbody>
<tr>
<td>- provides enough detail for competent researchers to repeat the experiment;</td>
<td>- past tense but active voice(!);</td>
<td>- mention everything you did that can make importance to the results;</td>
</tr>
<tr>
<td>- who, what, when, where, how and why?</td>
<td>- correct and internationally recognised style and format (units, variables, materials etc.);</td>
<td>- don't cover your traces (&quot;some data was ignored&quot;), establish an authors voice (&quot;we decided to ignored this data&quot;);</td>
</tr>
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</table>

- if a technique is familiar, only use its name (don't re-explain);  
- use simple(st) example to explain complex methodology;
RESULTS
<table>
<thead>
<tr>
<th>Función principal</th>
<th>Estilo preferido</th>
<th>Consejo</th>
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<tbody>
<tr>
<td>- gives summary results in graphics and numbers;</td>
<td>- past tense;</td>
<td>- present summary data related to the RA objectives and not all research results;</td>
</tr>
<tr>
<td>- compares different 'treatments';</td>
<td>- use tables and graphs and other illustrations;</td>
<td>- give more emphasise on what should be emphasised - call attention to the most significant findings;</td>
</tr>
<tr>
<td>- gives quantified proofs (statistical tests);</td>
<td></td>
<td>- make clear separation between yours and others work;</td>
</tr>
</tbody>
</table>
• Hay que destacar las resultados esperados... y los no esperados
• Hay que ser objetivos: no esconder los resultados que nos perjudiquen
• Utiliza tablas o gráficos para mostrar los datos:
  – Todo artículo debería tener un par de tablas y de gráficos
  – Elige el más apropiado según el caso
  – No repitas, no muestres los mismos datos como tabla y como figura
  – Todas las tablas, gráficos e imágenes se deben referenciar y explicar en el texto
CONCLUSIONS AND DISCUSSION
<table>
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<th>Función principal</th>
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<th>Consejo</th>
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<tbody>
<tr>
<td>Conclusions and Discussion</td>
<td>- answers research questions/objectives; - explains discrepancies and unexpected findings; - states importance of discoveries and future implications;</td>
<td>- simple or present tense (past tense if it is related to results); - allows scientific speculations (if necessary);</td>
</tr>
</tbody>
</table>
FUTURE WORK
• Los siguientes pasos en la investigación
• Experimentos futuros
• Extensiones
• Imaginar (especular) casi cualquier cosa
ACKNOWLEDGMENT
• Se pueden añadir cuando el artículo es aceptado
• Quién ha colaborado, quién ha proporcionado financiación, quién ha proporcionado datos para el análisis
<table>
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<tr>
<th>References</th>
<th>Función principal</th>
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<th>Consejo</th>
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<tr>
<td></td>
<td>- gives list of related literature and information sources;</td>
<td>- depends on journal but authors/editors, year and title must be included;</td>
<td>- always cite the most accessible references; - cite primary source rather than review papers;</td>
</tr>
</tbody>
</table>

Cite up-to-date references
Las referencias ayudan a:
– Poner el trabajo en contexto (estado de la cuestión)
– Comparar resultados
– Proporcionar información adicional para evitar repetir explicaciones, ecuaciones, resultados, etc.

Mejor las referencias más modernas con resultados más recientes
– Pero se puede utilizar una referencia muy antigua si es un trabajo fundamental
• Consejo importante:
  – Incluir algunas referencias del propio congreso o revista
    • Esto ayuda a mostrar que el tema del artículo encaja en el congreso o revista
    • Ayuda a aumentar el número de citas de la publicación