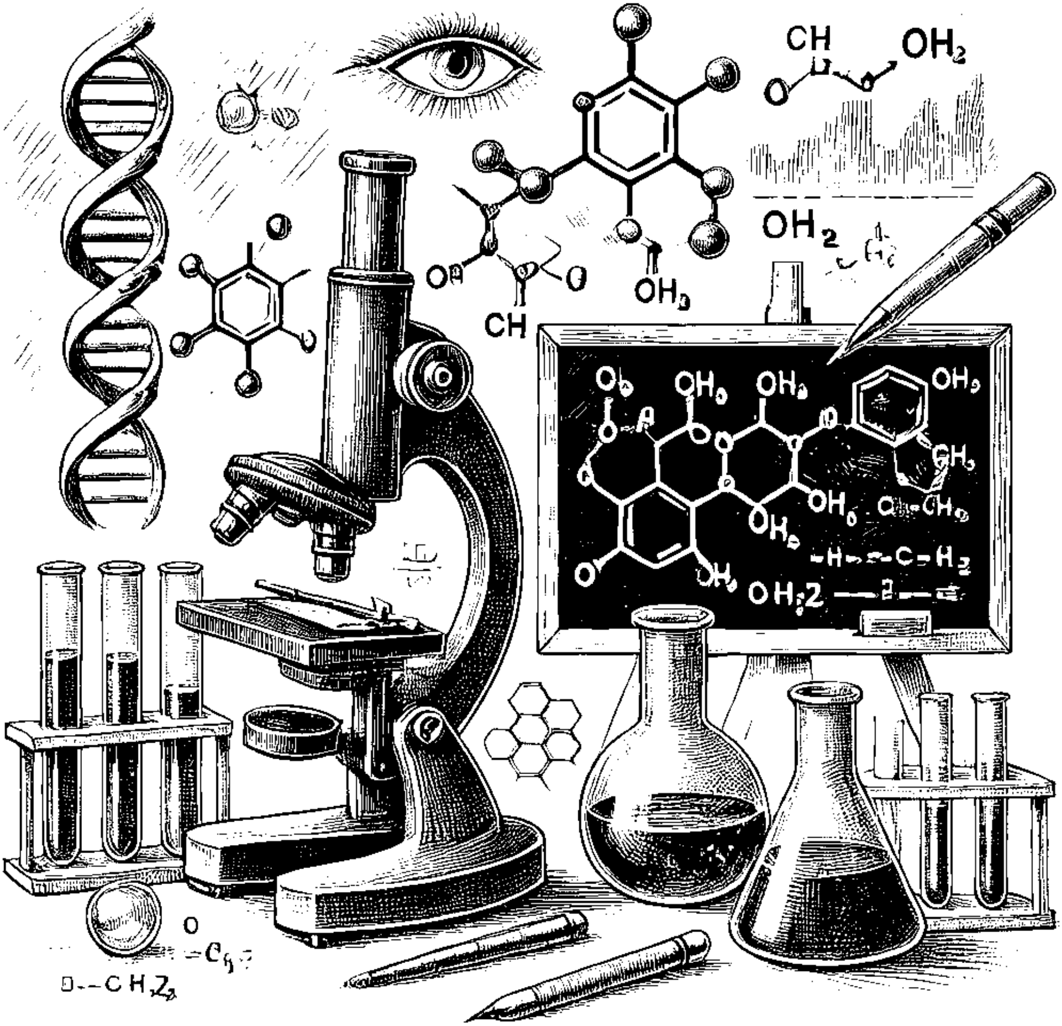
A QUICK GUIDE TO INTRODUCTION TO THE SCIENTIFIC WORK



CZECH AID

David Herák

A QUICK GUIDE TO INTRODUCTION TO THE SCIENTIFIC WORK

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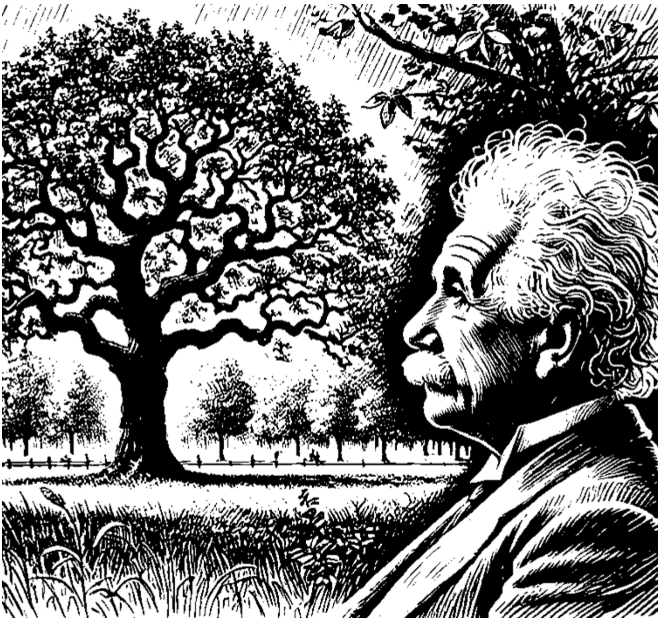
This handbook provides a concise overview of the fundamental principles of scientific work, serving as a supplementary resource to the accompanying lectures. It is a key output of the project "Enhancement of NUBB Teachers' Competencies in Using and Teaching Skills in the Field of Smart Agriculture," generously supported by the Ministry of Foreign Affairs of the Czech Republic in 2024.



„*Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid*" – Albert Einstein

SCIENCE AND SCIENTIST

SCIENTIST

Each PhD student should be a scientist.

A scientist creates new knowledge.

Scientists possess a clear understanding of what information is needed, why it is necessary, where it can be found, how it should be processed, and when it is required. This comprehensive approach highlights that information is the foundation of the knowledge process. Without the requisite knowledge, evaluating the value or significance of information becomes impossible, let alone using it purposefully and effectively.

SCIENCE

- Science is what scientists in a given field consider as science.
- Scientists form their own concepts (scientific language) by which they know the world and communicate their knowledge.
- Scientists set out the assumptions (hypotheses) on which science must be based and which are the basis of their cognitive abilities.
- Scientists determine the method and rules according to which knowledge is acquired.
- Science is a human activity.
- Science is based on generally accepted assumptions.

- Methods and concepts in science evolve as the scientific community evolves and grows.
- The core of the "standard model" of science (common to all scientists and all sciences) are hypotheses, experiments, theories and laws.

SCIENCE AND PARADIGM

After a certain maturation, each scientific field creates certain procedures, so-called paradigms (examples, patterns, models). The development in science then occurs through a gradual or sudden change of old patterns and ways of cognition; then, we talk about a paradigm shift.

RESEARCH

DEFINITION

Research is a systematic, structured process of inquiry aimed at discovering, interpreting, or revising facts, theories, or applications. It involves collecting, analysing, and interpreting data to answer specific questions or address problems, guided by established methodologies and ethical principles. The ultimate goal of research is to expand knowledge, deepen the understanding of phenomena, and generate insights that inform decisions, foster innovation, and drive progress across various fields.

Research is commonly categorised into two primary types (Tab. 1):

Basic (Pure or Fundamental) Research: A systematic investigation focused on expanding knowledge and understanding the fundamental aspects of phenomena and observable facts, without an immediate emphasis on practical applications or specific outcomes. Its primary objective is to enrich theoretical frameworks and foundational understanding.

Applied (Targeted) Research: A solution-oriented inquiry to address specific, practical problems or challenges. It aims to develop actionable insights, processes, or products by employing empirical methodologies and focusing on real-world applications in a particular field of study or research.

Tab. 1 Basic versus Applied Research

Basis for Comparison	Basic Research	Applied Research
Meaning	Basic Research refers to the study that is aimed at expanding the existing base of scientific knowledge.	Applied Research is the research that is designed to solve specific practical problems or answer certain questions.
Nature	Theoretical	Practical
Utility	Universal	Limited
Concerned with	Developing scientific knowledge and predictions	Development of technology and technique
Goal	To add some knowledge to the existing one.	To find out a solution for the problem at hand.

Over the past century, scientists have increasingly recognized the interconnectedness of basic and applied research, understanding that fundamental discoveries often pave the way for practical innovations, while real-world challenges frequently inspire new theoretical directions. This synergy is exemplified by the groundbreaking contributions of renowned Czech scientists such as Prof. Jaroslav Heyrovský (1890–1967), who revolutionized electrochemistry with the invention of polarography; Prof. Otto Wichterle (1913–1998), the pioneer behind soft contact lenses; and Prof. Antonín Holý (1936–2012), whose work on antiviral compounds laid the foundation for life-saving medications. These examples highlight the seamless integration of theory and application in advancing science and improving lives.

HYPOTHESIS

A hypothesis is an idea or proposition about the natural world that observations or experiments can test. In order to be considered scientific, hypotheses are subject to scientific evaluation and must be falsifiable, which means that they are worded in such a way that they can be proven incorrect.

We should follow certain principles when formulating hypotheses

- it should be worded concisely, unambiguously, logically and simply,
- it should be formulated in the form of a notification sentence, most often an implication,
- it should be verifiable, all variables must be defined operationally,
- we should avoid words that express personal and cultural judgments or preferences,
- a vague statement should not be issued as a hypothesis.

DATA AND INFORMATION

DATA

Data refers to a collection of facts, figures, or information, often in digital form, that can be analysed, interpreted, and utilised to inform decisions or generate insights. It is typically categorised into two main types:

Primary Data: Data specifically collected or generated to address a particular scientific problem, offering unique and firsthand information relevant to the study.

Secondary Data: Pre-existing data that has been gathered and processed for purposes other than the current problem being addressed, often repurposed for new analyses.

DATA VERSUS INFORMATION

- Data is a collection of facts. Information is how you understand those facts in context.
- Data is unorganised, while information is structured or organised.
- Information is an uncountable noun, while data is a mass noun.
- The word information is used with a singular verb, while data is used with a plural verb.
- Data is not typically useful on its own, but information is.
- Data generally includes the raw forms of numbers, statements, and characters. Information doesn't have to.

- Information depends on data.

PRIMARY DATA

- Direct or indirect (via some indicators) observation, which is focused on the planned perception of selected phenomena, which are then systematically recorded.
- Structured interview, in which the required information is obtained directly with the respondent.
- Questionnaire in which the respondent answers the questions in written or electronic form.
- An experiment in which we exhibit the investigated system of the action of specific, predetermined conditions (input quantities) and evaluate their influence on the outputs and behaviour of the system
- Document analysis is the analysis of any documents that were not created for the purpose of your research

SECONDARY DATA

- Scientific Databases: Comprehensive repositories like Web of Science (WoS), Scopus, or others provide peer-reviewed articles, conference papers, and scientific studies that can be analysed for trends, citations, and evidence-based insights.
- Intellectual Property Sources: Patents, utility models, trademarks, and design registrations offer valuable information about innovations, technological trends, and competitive landscapes in various industries.

- Statistical Yearbooks: Annual data compilations from governmental or international agencies (e.g., UN, WHO, or national statistical offices) provide critical statistics on demographics, economy, health, and agriculture.
- Legislation: Laws, regulations, directives, and legal codes available through official government websites or legal databases help understand the regulatory framework and its implications for specific fields of study.
- Internet Resources: A vast array of online content, including blogs, forums, websites, and online reports, can be utilised for secondary research, though the credibility and accuracy of sources must be critically evaluated.
- Newspapers and Periodicals: Print and online publications offer real-time information on events, market trends, and public opinions, which can be essential for socio-economic or market-based research.
- Libraries: Physical and digital libraries provide access to a wealth of historical documents, research papers, theses, and archival materials that serve as crucial secondary data sources.
- Tax Records: Governmental and institutional tax data can offer insights into financial trends, income distributions, or economic activity, particularly in economic or policy-based research.

MANUSCRIPT STRUCTURE

INTRODUCTION

This section clearly presents the aim of the contribution. It summarises the essence of the research and gives only strictly limited references that support the state of the present knowledge. Quotations published in the text should coincide with the data in the list of references. Each contribution must contain this section. The chapter should be finished with a sentence describing the aim of the study.

- To briefly describe the current state of solved problems and to determine the question: Why?
    - For example, if your article is focused on vanilla drying, don't describe vanilla (use citations) and be targeted to the drying of vanilla
    - Citations of references must support this chapter and summarise relevant literature
- The chapter should be finished with *„the aim of this study is………….."*
- The reader has to understand why you were interested in the question you asked

MATERIALS AND METHODS

This section describes the subject of the research, observations and operating procedures sufficiently detailed to make them reproducible. The material used is defined accurately (species, varieties, breeds, machines, used chemicals, experimental sites, groups of animals, housing, procedures for measurements and evaluation, number of replications, used statistical methods and programmes. They also include characteristics of the experimental site and the weather pattern. There are also references to the methods used, including statistical methods. The type and manufacturer of devices should be given.

- There should be enough information here to allow another scientist to repeat your experiment.
- If you had a complicated protocol, including a diagram, table or flowchart to explain the methods you used may be helpful.
- Do not put results in this section. You may, however, include preliminary results that were used to design the main experiment that you are reporting on.
- Mention relevant ethical considerations. If you used human subjects, did they consent to participate? If you used animals, what measures did you take to minimise pain?

RESULTS AND DISCUSSION

This section contains results in a logical sequence, as far as possible in tables, graphs, or illustrations, if required. Identical results cannot be presented in tables as well as in graphs. Only important observations should be emphasised or summarised. The results of the statistical evaluation should be denoted clearly. Discussion should unambiguously express a comparison of the achieved results with the previous knowledge of the topic. It must clarify what is completely new in the presented results where these results differ from the findings of other authors, and what they coincide with the published opinions. Discussion should emphasise the significance of the results and draw attention to the newly opened issues and the need for their solution.

- To present the results you've gotten. Use graphs and tables if appropriate, but also summarize your main findings in the text.
- To use appropriate methods of showing data. Don't try to manipulate the data to make it look like you did more than you actually did.
- Highlight the most significant results. How do these results relate to the original question? Do the data support your hypothesis? Are your results consistent with what other investigators have reported?
- If your results were unexpected, try to explain why. Is there another way to interpret your results? What further research would be necessary to answer the questions raised by your results?
- All claims and hypotheses should be supported by statistical evaluation (for example ANOVA)
- The used curve for data fitting should have a physical nature or they were already published in previous studies
- If they don't have any background it is better to use a line curve for fitting
- Relationship between measured data and the fitted curve should be verified at least by a coefficient of determination
- The conducted experiment as well as results, should be background for further research and studies

CONCLUSION

This section should comprise a brief statement of the major findings and implications of the study. It is not the function of this section to summarise the study; this is the purpose of the abstract

ACKNOWLEDGEMENTS

All important contributors should be acknowledged, for example, persons who provided statistical or technical advice and assistance, the subjects, those who helped with recruitment and personnel who helped with the preparation of the manuscript. If a grant supported the research, then the name of the funding body must be included.

TITLE

Make your title specific enough to describe the contents of the paper, but not so technical that only specialists will understand. The title should be appropriate for the intended audience

Be concise but descriptive, although you do not want to be vague or incorrect. This is your first chance to grab the reader’s attention

ABSTRACT

An abstract is a brief summary of the content of the manuscript. It should provide the highlights from the introduction, methods, results, discussion and conclusions

HIGHLIGHTS

Highlights are a short collection of bullet points that convey the core findings and provide readers with a quick textual overview of the article. These three to five bullet points describe the essence of the research and highlight what is distinctive about it.

KEYWORDS

Most journals require the author to identify three or four keywords representing the paper's major concept. These are used for indexing purposes

REFERENCES

A bibliographic citation refers to a book, article, web page, or other published item. Citations should supply details to identify the item uniquely. Different citation systems and styles are used in scientific citation, legal citation, prior art, and the arts and the humanities (Tab. 2).

There are two general types of citations in the text

- It was published by Blahovec (1996)
- It was already published in the previous study (Blahovec, 1996)

Tab. 2 Comparison table for **APA**, **MLA**, and **ISO** citation styles

Aspect	APA (7th Edition)	MLA (9th Edition)	ISO 690
Primary Use	Social sciences, education, psychology	Humanities, literature, arts	Broad, especially technical and scientific writing
Author Format	Last name, Initial(s) (e.g., Smith, J.)	Full name (e.g., John Smith)	Last name, Initial(s) or full name, depending on context

Title Format	Italicized for books; sentence case for articles and books	Italicized for books; title case for articles and books	Italicized for books; sentence case recommended for articles
In-text Citation	(Author, Year, Page)	(Author Page)	(Author Year) or [Number] depending on numeric system
Reference List Format	Alphabetical by author's last name	Alphabetical by author's last name	Alphabetical or numeric order, based on citation order
Publication Date	Included immediately after the author's name	Placed at the end of the citation	Included immediately after the author's name
Page Numbers	p. or pp. for page range (e.g., p. 12, pp. 12–14)	No "p." or "pp." (e.g., 12, 12–14)	Full range explicitly (e.g., 12–14)
URL/DOI Format	DOI as URL (https://doi.org/...) or full URL for websites	Full URL without http:// (shortened version if possible)	DOI preferred; URLs must be complete (http:// or https://)
Example - Book	Smith, J. (2020). *Title of the Book*. Publisher.	Smith, John. *Title of the Book*. Publisher, 2020.	Smith, J., 2020. *Title of the Book*. Publisher.
Example - Article	Smith, J. (2020). Title of the article. *Journal Name*, 10(3), 15–30. https://doi.org/...	Smith, John. "Title of the Article." *Journal Name*, vol. 10, no. 3, 2020, pp. 15–30.	Smith, J., 2020. Title of the article. *Journal Name*, 10(3), pp. 15–30.
Example - Website	Smith, J. (2020, March 1). Title of the	Smith, John. "Title of the	Smith, J., 2020. Title of the webpage.

	webpage. *Website Name.* https://www.example.com	Webpage." *Website Name*, 1 Mar. 2020, www.example.com.	*Website Name.* [online] Available at: https://www.example.com

SCIENTOMETRICS

Dr. Eugene Garfield (1925 – 2017), one of the pioneers of bibliometrics and scientometrics, founded the Institute for Scientific Information (ISI) in Philadelphia, Pennsylvania, in 1960. He revolutionised the field of scientific literature by developing an indexing system based on the analysis of citations within academic works. This system introduced the concept of the "impact factor," a metric that measures the frequency of citations to articles in science journals, serving as an indicator of their significance within the field. Dr. Garfield's contributions include various innovative bibliographic tools, such as Current Contents, the Science Citation Index (SCI), Journal Citation Reports, Index Chemicus, and other citation databases, all of which have profoundly influenced research evaluation and scholarly communication.

Scientometrics is the field of study concerned with measuring and analysing scientific literature. Scientometrics is a sub-field of bibliometrics. Major research issues include the measurement of the impact of research papers and academic journals, the understanding of scientific citations, and the use of such measurements in policy and management contexts

SCIENTOMETRICS OUTCOMES

Scientometrics is the study of measuring and analysing scientific literature and research outcomes, offering insights into the productivity, influence, and impact of various entities in the research ecosystem. Key outcomes include:

Higher Education Institutes: Scientometric analyses often evaluate the research output and quality of universities and institutions, helping to benchmark their performance in terms of publications, citations, and global impact.

- Shanghai Ranking: Also known as the Academic Ranking of World Universities (ARWU), this evaluates institutions globally based on research performance, alumni achievements, and faculty excellence, often using scientometric data.
- THE Ranking: The Times Higher Education (THE) ranking measures universities' research, teaching, international outlook, and citations, emphasising their role in global research output and collaboration.

Journals: Scientometric studies assess journals based on metrics like citation counts, impact factors, and their contribution to specific fields, aiding researchers in choosing appropriate venues for publishing.

- Impact Factor (IF): A key metric indicating the average number of citations received by articles published in a journal over a specific period, reflecting the journal's influence and prestige in the scientific community.
- Science Citation Index (SCI): A comprehensive database that tracks citations of scientific articles across disciplines,

enabling detailed analysis of research trends, authorship patterns, and collaboration networks.

- Acknowledgment Index: Measures recognition given to contributors, funders, or facilities in the acknowledgement sections of publications, highlighting the broader ecosystem supporting research.

Articles: The primary units of scientific communication are analysed for their content, citation patterns, and contribution to knowledge within specific domains.

- Citation Impacts: A key scientometric outcome assessing how often a publication or researcher is cited by others, indicating the influence and reach of their work in advancing science.

Researchers: Individual scientists are evaluated based on their publication output, h-index (a measure of productivity and citation impact), and collaboration patterns.

- Hirsch Index (h-index): A widely used metric quantifying an individual researcher's productivity and citation impact.

WEB OF SCIENCE

The Web of Science (WoS) is a comprehensive research platform and citation database maintained by Clarivate, providing access to a vast collection of academic and scholarly content across multiple disciplines. It serves as a trusted resource for researchers, academics, and institutions to discover, analyse, and evaluate scientific information. WoS indexes millions of research articles, conference proceedings, and patents from reputable journals and publishers worldwide, ensuring high-quality and peer-reviewed content. One of its key features is citation tracking, which allows users to trace the influence of research articles by showing how often other works have cited them. This capability makes WoS an essential tool for understanding the impact and reach of research. The platform also includes tools like Journal Citation Reports (JCR), which provide essential journal performance metrics such as the Journal Impact Factor (JIF) to evaluate the quality and influence of academic journals. Web of Science covers various disciplines, including sciences, social sciences, arts, and humanities, making it valuable for researchers from diverse fields. Its curated content ensures reliability, as only high-quality publications are indexed. The platform also offers advanced tools for searching, analysing, and visualising research trends, collaborations, and networks, helping researchers identify influential papers, journals, and potential collaborators.

Universities and funding agencies often rely on Web of Science metrics to assess research impact and institutional performance, underlining its importance in the academic and research ecosystem. Web of Science is particularly renowned for its rigorous indexing criteria and historical depth of citation data, making it a cornerstone for scholarly research and evaluation.

Journal Citation Reports

Journal Citation Reports are a database owned by Clarivate and is a resource for journal evaluation, providing a systematic means of determining the relative importance of science journals within their subject categories. Impact factors are drawn from over 22.000 journals worldwide from the Science Citation Index and the Social Sciences Citation Index. Journal citation Reports consist of the following databases:

- **Science Citation Index Expanded (1964)**

SCIE (1988-present) former (SCI 1964) offers bibliographical access to a curated collection of over 9,200 journals across 178 scientific disciplines.

- **Social Sciences Citation Index (1988)**

SSCI (1988-present) offers bibliographical access to a curated collection of over 3,400 journals across 58 social sciences disciplines, as well as selected items from 3,500 of the world's leading scientific and technical journals.

- **Arts & Humanities Citation Index (1988)**

AHCI is a multidisciplinary index and fully indexes over 1,700 arts and humanities journals, as well as selected items from over 250 scientific and social sciences journals

- **The Conference Proceedings Citation Indexes (1990-present) – Science (CPCI-S) and Social Science & Humanities (CPCI-SSH)**

CPCI offer bibliographical access to a curated collection of over 205,900 conference proceedings in the sciences, social sciences and the arts & humanities.

- **The Emerging Sources Citation Index (2015)**

ESCI aims to extend the scope of publications in the Web of Science to include high-quality, peer-reviewed publications. It ensures important research is visible in the Web of Science Core Collection even if it is not yet internationally recognised.

Master List

The Master Journal List includes all journals indexed in Web of Science, including the complete list of journals in the Web of Science Core Collection (including Science Citation Index Expanded, Social Sciences Citation Index, Arts & Humanities Citation Index, and Emerging Sources Citation Index), Biological Abstracts, BIOSIS Previews, Zoological Record, and Current Contents Connect, as well as the Chemical Information products. The list of journals is updated on a monthly basis.

Not all journals included in The Master Journal List have assigned Impact Factors.

Impact Factor

Impact Factor of an academic journal is a measure reflecting the average number of citations to recent articles published in the journal. It is frequently used as a proxy for the relative importance of a journal within its scientific category (journals with higher IF deemed to be more important). Impact factors are calculated annually starting from 1975 for those journals that are indexed in the Journal Citation Reports (JCR).

In a given year, the impact factor of a journal is the average number of citations received per paper published in that journal during the two preceding years.

$$\boldsymbol{IF = \frac{A}{B}}$$

A is the number of times that articles published in that journal, for example, in 2011 and 2012, were cited by articles in indexed journals during 2013.

B is the total number of "citable items" published by that journal in 2011 and 2012.

The impact factor compares different journals within a certain field. ISI Web of Knowledge indexes more than 12,000 science and social science journals.

The impact factor is useful in clarifying the significance of absolute (or total) citation frequencies. It eliminates some of the bias of such counts, favouring large journals over small ones, or frequently d issued journals over less frequently issued ones and older journals over newer ones. Particularly in the latter case, such journals have a larger, more citable body of literature than smaller or younger journals. All things being equal, the larger the number of previously published articles, the more often a journal will be cited.

IF itself is just a single tool for measuring the journal's importance. But it is a relatively easy-calculated and internationally recognised one.

Revised Impact Factor

The revised Impact Factor is IF regarding self-citations.

$$\boldsymbol{IF = \frac{A}{B - C}}$$

A is the number of times that articles published in that journal, for example, in 2011 and 2012, were cited by articles in indexed journals during 2013.

B is the total number of "citable items" published by that journal in 2011 and 2012.

C is the number of times that articles published in that journal, for example, in 2011 and 2012, were self cited during 2013.

Five Years Impact Factor

The five-year impact Factor is an alternative five-year impact that can be calculated based on adding citations to articles published in the same five-year period. And yet another is possible by selecting one or two earlier years as factor “B” above.

Eigenfactor Score

The Eigenfactor Score (EFS) calculation is based on the number of times articles from the journal published in the past five years have been cited in the JCR year. Still, it also considers which journals have contributed these citations so that highly cited journals will influence the network more than lesser cited journals. References from one article in a journal to another article from the same journal are removed, so that Eigenfactor Scores are not influenced by journal self-citation.

The *Eigenfactor*® Algorithm - 2008 was developed by the Metrics Eigenfactor Project, a bibliometric research project conducted by Professor Carl Bergstrom and his laboratory at the University of Washington.

Article Influence Score

AIS determines the average influence of a journal's articles over the first five years after publication. It is calculated by multiplying the Eigenfactor Score (EFS) by 0.01 and dividing by the number of articles in the journal, normalised as a fraction of all articles in all publications.

This measure is roughly analogous to the *5-Year Journal Impact Factor* in that it is a ratio of a journal's citation influence to the size of the journal's article contribution over a period of five years.

The equation is as follows:

$$\boldsymbol{AIS = \frac{0.01 \cdot EFS}{X}}$$

where X is 5-year Journal Article Count divided by the 5-year Article Count from All Journals.

The mean AIS for each article is 1.00. A score greater than 1.00 indicates that each article in the journal has above-average influence. A score less than 1.00 indicates that each article in the journal has below-average influence.

SCOPUS

Scopus is a multidisciplinary abstract and citation database maintained by Elsevier, providing comprehensive access to peer-reviewed literature across various academic disciplines. Researchers, academics, and institutions widely use it for discovering, analysing, and evaluating scientific content. Scopus indexes a vast collection of scholarly works, including journal articles, conference proceedings, book chapters, and patents from thousands of publishers globally. Its multidisciplinary coverage spans life sciences, physical sciences, social sciences, and humanities, making it a valuable tool for researchers from diverse fields. One of Scopus's standout features is its robust citation analysis, enabling users to track citations, measure the impact of publications, and identify influential works. Metrics such as the h-index, citation count, and journal-level indicators like the CiteScore provide valuable insights into research performance and journal quality. Scopus also plays a crucial role in the calculation of the SCImago Journal Rank (SJR), a journal metric that reflects the scientific prestige of journals by considering both the number of citations received and the importance of the citing sources. The SCImago Journal & Country Rank database utilizes Scopus data to calculate the SJR indicator, which is widely used to evaluate journal performance. Scopus offers tools for analyzing author profiles, research affiliations, and collaboration networks, helping users uncover research trends and potential partnerships. Its user-friendly interface and advanced search capabilities make it easy for researchers to efficiently filter and navigate through extensive datasets. Additionally, Scopus integrates with other Elsevier tools, such as ScienceDirect, to provide seamless access to full-text articles where available. Known for its broad and global scope, Scopus indexes content from both well-established and emerging regions. Its rigorous content selection criteria ensure that only high-quality academic materials are included. Universities, funding agencies, and researchers often rely on Scopus metrics and SJR values for benchmarking, academic evaluations, and grant applications. While Scopus competes with other databases like Web of Science, Google Scholar, and PubMed, it is distinguished by its breadth of content, intuitive analytics tools, and its role in supporting metrics like SJR, which are critical in the academic research landscape.

SCImagio Journal Rank

The SJR (SCImago Journal Rank) indicator measures the scientific influence of scholarly journals by considering both the number of citations a journal receives and the importance or prestige of the journals from which those citations originate. It assigns a numeric value representing the average number of weighted citations received during a specific year for documents published in the preceding three years. Higher SJR values indicate greater journal prestige and influence within the scientific community. Derived from the eigenvector centrality measure used in network theory, the SJR indicator emphasizes the quality of citations over mere quantity. It serves as a vital metric for assessing scientometric outcomes within the Scopus database, providing an alternative to the Impact Factor used in the Web of Science.

HIRSCH INDEX – H INDEX

The index is based on the distribution of citations received by a given researcher's publications. A scientist has index h if h of his/her Np papers have at least h citations each, and the other (Np − h) papers have no more than h citations each. In other words, a scholar with an index of h has published h papers, each of which has been cited in other papers at least h times. Thus, the h-index reflects both the number of publications and the number of citations per publication. The index is designed to improve upon simpler measures, such as the total number of citations or publications. The index works properly only for comparing scientists working in the same field; citation conventions differ widely among different fields.

ALTMETRICS

Altmetrics (alternative metrics) are an alternative to or complement to traditional citation impact metrics. Altmetrics especially capture online attention - how has research been shared, discussed and reused online.

Examples of Altmetrics include:

- mentions on Facebook, Twitter, or online news sites
- exports to citation management systems like Mendeley or Zotero
- downloads (of full text articles, software, etc.)
- comments in blogs or other online forums

ACKNOWLEDGEMENT INDEX

The acknowledgement index is a scientometric index that analyses scientific literature acknowledgements and attempts to quantify their impact. Like a citation index, an acknowledgement index measures influences on scientific work, but in a different sense; it measures institutional and economic influences as well as informal influences of individual people, ideas, and artefacts.

OPEN SCIENCE

OPEN ACCESS

Open access is a publishing model for scholarly communication that makes research information available to readers at no cost. Open access is a publication model, an alternative to disseminating scientific knowledge through toll-access scientific journals. Its principle is unlimited online access to scientific information from self-archiving articles in open repositories or in open journals.

Golden Route

Full Open Access journals: publication via publisher platforms, in full open access journals. This route may involve a charge. The publication costs, known as 'article processing charges' (APCs), are covered by authors or by their institutions. Hybrid Journals: publication via 'hybrid' journals. These subscription journals allow open-access publication of individual articles on payment of an Article Processing Charge (APC).

Green Route

The full text of academic publications is deposited in a trusted repository, a publicly accessible database managed by a research organisation.

Diamond Route

Publication via diamond journals/platforms that do not charge author-facing publication fees (APCs). Diamond open-access journals are usually funded via library subsidy models, institutions, or societies.

THE BENEFITS OF OPEN ACCESS

Open Access (OA) publishing provides unrestricted, free access to scholarly research, offering numerous benefits that significantly enhance the dissemination and impact of scientific information. One of its primary advantages is the acceleration of scientific information interchange. By eliminating paywalls and subscription barriers, Open Access ensures that research findings are shared more quickly and widely, allowing scientists, practitioners, and policymakers to access and utilize new knowledge without unnecessary delays. This model also extends the availability of scientific information to a broader audience, including researchers from low-resource institutions, independent scholars, and even members of the general public who might otherwise be excluded from accessing subscription-based content.

Furthermore, Open Access increases the visibility of scientific information, as publications in OA platforms are more widely disseminated and easily discoverable through search engines and databases. This heightened visibility not only benefits researchers by showcasing their work to a global audience but also ensures that critical findings reach those who can apply them effectively. The removal of access barriers also leads to an increase in the number of readers, as Open Access attracts a diverse audience that includes not only academics but also industry professionals, educators, and policymakers.

Another significant benefit of Open Access is its positive impact on citation rates. Studies have shown that articles published in Open Access journals often receive more citations than their paywalled counterparts, as their accessibility fosters greater engagement and usage by the global research community. By promoting inclusivity and collaboration, Open Access is transforming the way knowledge is shared, democratising access to information, and driving progress across disciplines and sectors.

Open Access Principles Statements

- Budapest Open Access Initiative (February 2002)
- Bethesda Statement on Open Access Publishing (June 2003)
- Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (October 2003)
- LERU Statement (October 2015)

GRATIS VERSUS LIBRE

The distinction between "gratis" and "libre" is fundamental in discussions about access and freedom, particularly in the context of Open Access, software, and intellectual property. "Gratis" refers to something that is free of charge, meaning it can be accessed without any cost to the user. In contrast, "libre" goes beyond the concept of cost-free access to emphasise freedom and independence. It implies that users have the liberty to use, modify, share, or build upon the material without significant restrictions.

Richard Stallman, the founder of the GNU Project and a pioneer of the free software movement, famously captured this distinction with the phrase: "Think free as in free speech, not free beer." This highlights the difference between merely providing something without monetary cost ("gratis") and ensuring it embodies the principles of freedom and autonomy ("libre"). For instance, an article available for free download (gratis) may still have restrictions on how it can be reused or shared, whereas a libre resource would allow users to freely engage with and repurpose the material under open licenses. Understanding the distinction between gratis and libre is essential in contexts such as Open Access publishing and free software development, where the ultimate goal is not just to provide access but to empower users with freedom and flexibility in how they interact with the content or tools

Gratis

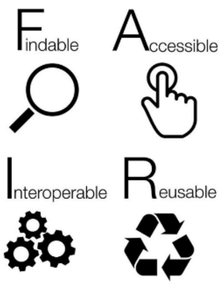
In contrast to publishing strategies (the golden and green paths), the terms "gratis" and "libre" refer to works as attributes of an open approach. The "gratis" attribute means that the work (article) is accessible free of charge. Thus, it removes financial barriers to access to information and, in principle, gives the reader the right to read, download, and print.

Libre
In contrast, the "libre" attribute also provides free access, but the publication is available free of charge and without further barriers for other uses and re-uses. "Libre open access" is thus extended to the right to make copies, distribute them, search, link, use, and extract. Re-use rights are determined by the applicable Creative Commons license, which usually requires authorship of the original authors (CC-BY license).

OPEN DATA

Open data is information and data published on the Internet that is complete, easily accessible, machine-readable, using standards with freely available specifications, made available under clearly defined conditions of use with minimum restrictions, and accessible to users at the minimum possible cost. These include, for example, timetables, government revenues, budgets, databases, a list of social service providers, the Minister's calendar, or clean air measurements. They come from universities, NGOs, private companies, or public administrations.

FAIR DATA



The FAIR principles prioritise machine-actionability, which refers to the ability of computational systems to autonomously find, access, interoperate, and reuse data with little to no human intervention. This focus on machine-actionable data is increasingly vital as the volume, complexity, and creation speed of data continue to grow, necessitating robust computational support to manage and analyse vast and intricate datasets efficiently.

SUMMARY

The handbook "A Quick Guide to Introduction to Scientific Work" concisely overviews essential scientific research principles and practices. Published under a project supported by the Ministry of Foreign Affairs of the Czech Republic in 2024, it aims to enhance teacher competencies at Cambodia's National University of Battambang. It emphasises the interconnectedness of basic and applied research, highlighting their role in driving innovation. The guide defines science as a human activity based on hypotheses, experiments, and theories, explaining paradigm shifts and formulating clear, verifiable hypotheses. It distinguishes between primary and secondary data, detailing sources like databases and statistical yearbooks. Practical sections guide researchers in structuring scientific manuscripts, covering introductions, methodologies, results, and conclusions, emphasising ethical considerations. It also introduces scientometrics, including impact factors and h-index, and advocates for Open Access and FAIR Data to enhance accessibility and collaboration. This guide is a practical resource for bridging theoretical knowledge with real-world applications, fostering innovation and global problem-solving.

This handbook was published by the Faculty of Engineering at the Czech University of Life Sciences Prague in collaboration with the Faculty of Agriculture and Food Processing at the National University of Battambang in Cambodia. It serves as a key outcome of the project titled "Enhancement of NUBB Teachers' Competencies in Using and Teaching Skills in the Field of Smart Agriculture," generously supported by the Ministry of Foreign Affairs of the Czech Republic in 2024.

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