Guide to Appropriate Literature Survey and Scientific Writing

M. Aminur Rahman*, and M. Ruhul Amin

***Abstract*—**Literature survey/review is an evaluation of what accredited scholars and researchers have written on a selected topic. In writing the literature review, author's purpose is to convey to his/her reader what knowledge and ideas have been established on a subject, and what their strengths and weaknesses are. As a section of writing, the literature review must be defined by a guiding concept. It is not just a descriptive list of the material available, or a set of summaries. A literature review must do these things: (i) be organized around and related directly to the thesis or research question; (ii) synthesize results into a summary of what is and is not known; (iii) identify areas of controversy in the literature; (iv) formulate questions that need further research. Researchers conduct reviews of the literature to justify proposed studies, to uncover patterns of findings in the field, to enter into scientific debate, and to discover gaps in knowledge that lead to future research questions. Research reviews are often the first step toward making discoveries and social interventions in our society. A scientific paper has been defined as "a written and published report describing original research results". The watchwords of scientific writing are clarity, brevity, and organization, which are essential because researchers usually read scientific literature for information and not entertainment. Scientific research articles provide a method for scientists to communicate with other scientists about the results of their research. Thus, researcher's assignment as an author is to convey information quickly, yet clearly, understandably, and concisely. In order to write a good scientific paper, author generally should use the format and style described below. However, although formats and styles vary from time to time and place to place, the clear, concise, and organized style does not. Before writing a first draft, it is important to establish that the topic of the manuscript is likely to be consistent with the focus of the journal. This may be clearly stated within the journal or may be determined by examining several recent issues. Having selected a journal, it is essential to carefully read and follow the "guidelines for authors" published within the journal or obtained directly from the editor or publisher. These guidelines are usually very specific and include rules about word limit, organization of the manuscript, margins, line spacing, preparation of tables and figures and the method used to cite references. Failure to comply with the guidelines may result in rejection or return of the manuscript for correction, thereby delaying the process of review and publication. An accurate, terse, and lucid presentation of the information at hand is a work of beauty and excitement in its ability to convey maximum information in minimum space and reader time. Having finished the first draft, immediately revise it and be prepared to do this several times until the author feels it is not possible to improve it further. Acceptance of a manuscript is invariably conditional on changes being made, so the author must has to be prepared to rewrite and revise the manuscript extensively. In many instances, a manuscript has more than one author and thus the writing may be shared. However, the style needs to be consistent throughout, so even if sections of the early drafts are written by different authors, the first author must go through the entire manuscript before submitting, and make any necessary editorial changes if required.

*Corresponding author: Dr. M. Aminur Rahman, Laboratory of Marine Biotechnology, Institute of Bioscience, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia; E-mail: aminur1963@gmail.com.

M. Ruhul Amin, Department of Mechanical Engineering, Kuliyyah of Engineering, International Islamic University Malaysia, Jalan Gombak, 53100 Kuala Lumpur, Malaysia; E-mail: aminbpy@gmail.com.

***Index Terms*—** Literature review, Scientific paper, Journal, Format, Proofreading, Publication.

I. Literature Survey

A Literature survey (also known as literature review) is a document of the comprehensive review of published and unpublished work from different data sources in the areas of specific interests leading to development of a strong basis for research. It is an overview of what has been studied, argued, and established about a topic, and it is usually organized chronologically or thematically. Literature reviews use secondary sources, and do not report new or original experimental work [1]. It is not just a summary of the sources; rather it evaluates critically previous and current research in relation to how relevant and for useful it is and relates to one's own research. Literature reviews are a staple for research in nearly every academic field [2]. It usually has an organizational pattern and combines both summary and synthesis to given a new interpretation of old material or combine new with old interpretation. A systematic review is a literature survey focused on a research question, trying to identify, appraise, select and synthesize all high quality research evidence and arguments relevant to that question. A meta-analysis is typically a systematic review using statistical methods to effectively combine the data used on all selected studies to produce a more reliable result. Shields and Rangarjan [3] distinguished between the process of reviewing the literature and a finished work or product known as a literature review. The process of reviewing the literature is often ongoing and informs many aspects of the empirical research project. All of the latest literature should inform a research project. Scholars need to be scanning the literature long after a formal literature review product appears to be completed.

Literature reviews are in great demand in most scientific fields. Their need stems from the ever-increasing output of scientific publications [4]. For example, compared to 1991, three, eight, and forty times more papers were indexed by Web of Science in 2008 on malaria, obesity, and biodiversity, respectively [5]. Given such mountains of papers, scientists cannot be expected to examine in detail every single new paper relevant to their interests [6]. Thus, it is both advantageous and necessary to rely on regular summaries of the recent literature. Although recognition for scientists mainly comes from primary research, timely literature reviews can lead to new synthetic insights and are often widely read [7]. For such summaries to be useful, however, they need to be compiled in a professional way [8]. When starting from scratch, reviewing the literature can require a titanic amount of work. That is why researchers who have

spent their career working on a certain research issue are in a perfect position to review that literature. Some graduate schools are now offering courses in reviewing the literature, given that most research students start their project by producing an overview of what has already been done on their research issue [9]. However, it is likely that most scientists have not thought in detail about how to approach and carry out a literature review. Reviewing the literature requires the ability to juggle multiple tasks, from finding and evaluating relevant material to synthesizing information from various sources, from critical thinking to paraphrasing, evaluating, and citation skills [10].

II. Scientific Writing

A scientific paper is a written report describing original research results. However, writing an effective scientific paper is not so easy. A good rule of thumb is to write as if the author's paper will be read by a person who knows about the field in general but does not already know what he did. The structure of a research article usually depends on the journal to which the article is being submitted. The format of a scientific paper has been defined by centuries of developing tradition, editorial practice, scientific ethics and the interplay with printing and publishing services. A scientific paper should have, in proper order, a Title, Author, Abstract, Introduction, Materials and Methods, Results, and Discussion. Many journals have page limits, figure limits, or specific article divisions to which authors must adhere. These are the basic structure guidelines that the scientific journal will follow:

Title: A title should be the fewest possible words that accurately describe the content of the paper. Omit all waste words such as "A study of ...", "Investigations of ...", "Observations on ...", etc. Indexing and abstracting services depend on the accuracy of the title, extracting from it, keywords useful in cross-referencing and computer searching. An improperly titled paper may never reach the audience for which it was intended, so be specific. If the study is of a particular species, name it in the title. If the inferences made in the paper are limited to a particular region, then name the region in the title.

Author: Authorship of a scientific or scholarly paper should be limited to those individuals who have contributed in a meaningful and substantive way to its intellectual content. All authors are responsible for fairly evaluating their roles in the project as well as the roles of their co-authors to ensure that authorship is attributed according to these standards in all publications for which they will be listed as an author. Each author should have participated sufficiently in the work to take public responsibility for its content. All co-authors should have been directly involved in all three of the following: (i) planning and contribution to some component (conception, design, conduct, analysis, or interpretation) of the work which led to the paper or interpreting at least a portion of the results; (ii) writing a draft of the article or revising it for intellectual content; and (iii) final approval of the version to be published. All authors should review and approve the manuscript before it is submitted for publication, at least as it pertains to their roles in the project. The first author is usually the person who has performed the central experiments of the project. Often, this individual is also the person who has prepared the first draft of the manuscript. The lead author is ultimately responsible for ensuring that all other authors meet the requirements for authorship as well as ensuring the integrity of the work itself. The lead author will usually serve as the corresponding author. Each co-author is responsible for considering his or her role in the project and whether that role merits attribution of authorship. Co-authors should review and approve the manuscript, at least as it pertains to their roles in the project.

Abstract: An abstract is a single paragraph, usually comprising of about 200-300 words. A well prepared abstract should enable the reader to identify the basic content of a document quickly and accurately, to determine its relevance to the reader's interests, and thus to decide whether to read the document in its entirety. The abstract should succinctly state the principal objectives and scope of the investigation where these are not obvious from the title. More importantly, the abstract should concisely summarize the results and principal conclusions. The abstract should not include details of the methods employed unless the study is methodological, i.e. primarily concerned with methods. It is no need to repeat information contained in the title. The abstract, together with the title, must be self-contained as it is often published separately from the paper in abstracting services. Omit all references to the literature and to tables or figures, and omit obscure abbreviations and acronyms even though they may be defined in main body of the paper. References are typically not cited in the Abstract, since the reader expects a more full discussion in the body of the article. It should be possible to determine the major points of a paper by reading the abstract. Although it is located at the beginning of the paper, it is easiest to write the abstract after the paper is completed.

Introduction: Every scientific paper/report needs an introduction, though it is sometimes broken down into different components. The length of an introduction depends on the journal and the paper; however, the structure and content should be similar. The Introduction should (i) describe the question tested by the experiments described in the paper, (ii) explain why this is an interesting or important question, (iii) describe the approach used in sufficient detail that a reader who is not familiar with the technique will understand what was done and why, and (iv) very briefly mention the conclusion of the paper. The author must clearly state his or her hypothesis, and quickly summarize the methods used to investigate that hypothesis. The author should address relevant studies by other researchers; however, a full history of the topic is not needed. The introduction should contain all the background information a reader needs to understand the rest of the author's paper. This means that all important concepts should be explained and all important terms defined. The author needs to know who will be reading this paper, and make sure that all the concepts in the paper are accessible to them. There must have very explicit objectives of the study. Normal length of introduction should be 2-3 paragraphs.

Materials and Methods: The Materials and Methods section should succinctly describe what was actually done. In this section, several key points should need to be addressed. Often in field-based studies, there is a need to describe the study area in greater detail than is possible in the Introduction. Usually authors will describe the study region in general terms in the Introduction and then describe the study site and climate in detail in the Materials and Methods section. The

sub-headings "Study Site", "General Methods" and "Analysis" may be useful, in that order. Equipment available off the shelf should be described exactly and sources of materials should be given (e.g., YSI, model 58; Yellow Springs Instruments, Yellow Springs, OH, USA). Modifications to equipment or equipment constructed specifically for the study should be carefully described in detail. The method used to prepare reagents, fixatives, and stains should be stated exactly, though often reference to standard recipes in other works will suffice. Any materials used should be documented, and any computer programs used should be discussed. This section should address the experiments, models, or theories devised. It should contain little to no background information, since this information should be placed in the introduction. Also, the Methods section should contain no results, conclusions, or interpretations. It should include description of the techniques used so someone could figure out what experiments were actually done. The details of a published protocol do not need to be reproduced in the text but an appropriate reference should be cited – e.g., simply indicate "were done as described by Rahman et al. [11]". Any changes from the published protocol should be described.

Results: In this section, the author should thoroughly detail the results of the experiments, models, or theories developed in the body of the article by presenting the data, digested and condensed, with important trends extracted and described. Because the results comprise the new knowledge that the authors are contributing to the world, it is important that their findings be clearly and simply stated. The Results should be clear, short and sweetened, without excessive verbiage. However, need not to be too concise as the readers cannot be expected to extract important trends from the data unaided. The results should be supplemented by figures and tables, and the figures and tables should be briefly explained. No interpretations or conclusions should be drawn. All interpretation and discussion of the results should be saved for the Discussion and Conclusions section. Any results which include multiple data points that are critical for the reader to evaluate the experiment should be shown in tables or figures. However, the results should be summarized in accompanying text. When referring to a particular table or figure, they should be capitalized (e.g., Table 1, Figure 6, etc.) The text of the Results section should be succinct but should provide the reader with a summary of the results of each table or figure. Not all results deserve a separate table or figure. As a rule of thumb, if there are only a few numerical results or a simple conclusion, the results should be described in the text instead of in a table or figure.

Tables and Figures: All tables and figures should be put into a contextual framework in the corresponding text. A table of strains/varieties should be mentioned in the Materials and Methods section, a table of results should be summarized in the Results section and a figure displaying a biosynthetic pathway should be described in the Discussion section. Tables and figures should present information in a format that is easily evaluated by the reader. A good rule of thumb is that it should be possible to figure out the meaning of a Table or Figure without referring to the text. Tables and figures should typically summarize results, not present large amounts of raw data. When possible, the results should provide some way of evaluating the reproducibility or statistical significance of any numbers presented.

Tables should be sequentially numbered. Each table should have a title (shown above the table) that describes the point of the table. For example, "Table 1. Growth performances, survival, feed utilization and production of mahseer (*Tor putitora*) fingerlings after 8 weeks of rearing; mean ±S.D. with ranges in parentheses." If necessary to interpret the table, specific descriptions about what a result represents or how the results were obtained can be described in a legend below the table (e.g., "Production was calculated as the total number of fingerlings that survived and then harvested after a rearing period of 8 weeks in nursery ponds").

Figures should be sequentially numbered. Each figure should have a title (shown below the figure) that describes the point of the figure. For example, "Figure 1. Mean percentage of eggs fertilized in conspecific and heterospecific crosses of *Echinometra* sp. A (Ea) and *Echinometra* sp. C (Ec); maternal species named first." If necessary to interpret the figure, specific descriptions about what a result represents or how the results were obtained can be described immediately following the title (e.g., "Fertilization rate of Ea x Ec was significantly different from those of Ea x Ea, Ec x Ec, and Ec x Ea at $P < 0.05$").

Tables and figures may be printed on separate pages that follow the Reference section. Alternatively, the tables and figures may be integrated into the paper, if the authors are using a page layout program. However, if they are integrated into the paper, make sure that there is not a page break in the middle of a table or figure. No need to wrap text around the outside of tables and figures – if the results are important enough to show as a table or figure they should stand out on the page, not be buried in text.

Discussion and Conclusions: In the Discussion section, authors should discuss the results. In some cases, when the author has many points to discuss, he or she may split this into two sections; however, one section is usually sufficient. In this section, the author should restate the problem he or she was attempting to address, and summarize how the results have addressed it. When the authors address these questions, it is crucial that their discussion rests firmly on the evidence presented in the Results section. Continually refer to the results (but not to repeat them). Most importantly, authors should not extend their conclusions beyond those, which are directly supported by their results. Speculation has its place, but should not form the bulk of the Discussion section. Authors must have to be sure to address the objectives of the study in the Discussion section and to discuss the importance of the results. Don't leave the reader thinking "So what?". The authors should discuss the significance of all the results, and interpret their meaning. Potential sources of error should be discussed, and anomalies analyzed. Finally, the author should tie his or her conclusions into the "big picture" by suggesting the impact and applications this research might have. This can be accomplished by discussing how the results of this paper will affect the author's field, what future experiments could be carried out based on this research, or what affect the conclusions could have on industry.

Acknowledgments: An acknowledgements section is not usually required; however, most scientific papers include a paragraph of acknowledgements and thanks for help (editorial, technical, financial assistances etc.) received on the research or the paper. For example, "The authors are much indebted to the Department of Chemistry, Biology and Marine Science, University of the Ryukyus, Okinawa, Japan,

for providing the laboratory facility and space for conducting the experiment and rearing the urchins. Grateful thanks are also due to Professor Dr. John S. Pearse, University of California, Santa Cruz, CA, USA, for thoughtful comments and scholastic suggestions towards the overall improvement of the paper. The Project was supported by the Japan Society for the Promotion of Science (JSPS) and the Research University Grant Scheme (RUGS) of Universiti Putra Malaysia (UPM) Vide Project (No. 05-03-10-1034RU)". In journals where the reviewer's names are revealed, it is considered polite for the author to acknowledge the help of the reviewers.

Citations: It is essential to credit published papers for work mentioned in the manuscript. There are a variety of ways of citing references in the text – the style used depends upon the policy of the journal. In the text, citations should refer to reference list. There will be no need to rewrite title of references in text.

Reference lists: Similar to the citations, a variety of formats for references are used by different journals. For an example of a commonly used example, authors can see "Instructions to authors" on American Society for Microbiology (ASM) web site at http://jb.asm.org/misc/ifora .shtml) or examples from published manuscripts from relevant journals.

Genetic nomenclature: Authors should use correct genetic nomenclature for both genotype and phenotype. In order to review the rules for example, the bacterial genetic nomenclature, authors should go through the Microbial Genetics topics link.

Format: Certain general rules are commonly followed during scientific paper writing. These are as follows:

Flow: Readers interpret prose more easily when it flows smoothly, from background to rationale to conclusion. Authors should not force the readers to figure out their logic – clearly need to state the rational. In addition, it is much easier on the readers if the authors explicitly state the logic behind any transitions from one idea to another.

Abbreviations: Authors should use standard abbreviations (hr, min, sec, etc) instead of writing complete words. Some common abbreviations that do not require definition are shown in the "Instruction to Authors" of the journal's website. All other abbreviations should have to be defined the first time they are used, and then subsequently use the abbreviation [e.g. Ampicillin resistant (AmpR)]. As a general rule, no need to use an abbreviation unless a term is used at least three times in the manuscript. With two exceptions (the degree symbol and percent symbol), a space should be left between numbers and the accompanying unit. In general, abbreviations should not be written in the plural form (e.g. 1 ml or 5 ml, not mls).

Past, present, and future tense: Results shown in the paper should be described in past tense. Results from published papers should be described in the present tense (based upon the assumption that published results are "facts"). Only experiments that the authors have plan to do in the future should be described in the future tense.

Third vs first person: It is OK to use first person in scientific writing, but it should be used sparingly – reserve the use of first person for things that the authors want to emphasize that "they" uniquely did (i.e. not things that many others have done as well). Most text should be written in the third person to avoid sounding like an autobiographical account penned by a narcissistic author. However, it is better to say "It is possible to.." than to say "One could ...". Writing that use the impersonal pronoun "one" often seems noncommittal and dry. In addition, inanimate objects (like genes, proteins, etc.) should be described in third person, not with anthropomorphic or possessive terms (e.g., instead of saying "its *att* site", say "the chromosomal *att* site").

Empty phrases: Authors should have to avoid the using of phrases that do not contribute to understanding. For example, the following phrases could be shortened (or completely deleted) without altering the meaning of a sentence: "the fact that ..." (delete); "In order to ..." (shorten to simply "To ..."). Likewise, the title of a table of results does not benefit from the preface "Results of ...". In short, authors should not use more words than he/she need to make their points.

Specify: If several expressions modify the same word, they should be arranged so that it is explicit which word they modify. It is common to use a pronoun such as "it" or "they" to refer to a concept from the previous sentence. This is OK as long as there is only one concept that "it" or "they" means. However, if there is more than one concept, it is easy for the reader to get confused about what the pronoun is meant to specify (even if author knows which one he means). It is better to error on the side of redundancy by repeating the concept in subsequent sentences, than to take the chance of confusing the reader. Author should not make the reader guess what he means.

Parentheses: Authors should have to avoid double parentheses. For example, "Three gene products catalyze reactions in the pathway for proline biosynthesis (Figure 1) (3)" could be reworded to say "Figure 1 shows the three reactions of the pathway for proline biosynthesis (3)."

Proofreading: Authors must have to always spellcheck their manuscript and carefully proofread the paper before final submission to the specified journal. In addition to checking for errors and typos, authors should have to read their paper by themselves as if they were reading it out loud to ensure that the wording and sentence construction is not clumsy.

REFERENCES

[1] Baglione, L. 2012. Writing a Research Paper in Political Science. CQ Press, Thousand Oaks, CA, USA.

[2] David, L. 2013. The Uses of Analysis: Rhetorical Analysis, Article Analysis, and the Literature Review. Academic Writing Tutor. Retrieved 10 September 2013.

[3] Shields, P. and Rangarjan, N. 2013. A Playbook for Research Methods: Integrating Conceptual Frameworks and Project Management. New Forums Press, Stillwater, OK, pp. 193-229.

[4] Rapple, C. 2011. The role of the critical review article in alleviating information overload. Annual Reviews White Paper. Available: http://www.annualreviews.org/userimages/ContentEditor/1300384004941/Annual_Reviews_WhitePaper_Web_2011.pdf.

[5] Pautasso, M. 2010. Worsening file-drawer problem in the abstracts of natural, medical and social science databases. Scientometrics, 85: 193–202. doi:10.1007/s11192-010-0233-5.

[6] Erren, T.C., Cullen, P. and Erren, M. 2009. How to surf today's information tsunami: on the craft of effective reading. Medical Hypotheses, 73: 278–279. doi:10.1016/j.mehy.2009.05.002.

[7] Hampton, S.E. and Parker, J.N. 2011. Collaboration and productivity in scientific synthesis. Bioscience, 61: 900–910. doi:10.1525/bio.2011.61.11.9.

[8] Ketcham, C.M. and Crawford, J.M. 2007. The impact of review articles. Laboratory Investigation, 87: 1174–1185. doi:10.1038/labinvest.3700688.

[9] Boote, D.N. and Beile, P. 2005. Scholars before researchers: on the centrality of the dissertation literature review in research preparation. Educational Researcher, 34(6), 3–15. doi: 10.3102/0013189x034006003.

[10] Budgen, D. and Brereton, P. 2006. Performing systematic literature reviews in software engineering. Proceedings of the 28th International Conference on Software Engineering, ACM New York, NY, USA, pp. 1051–1052. doi:10.1145/1134285.1134500.

[11] Rahman, M.A., Yusoff, F.M., Arshad, A., Shamsudin, M.N. and Amin, S.M.N. 2012. Embryonic, larval, and early juvenile development of the tropical sea urchin, *Salmacis sphaeroides* (Echinodermata: Echinoidea). The Scientific World Journal, 2012: 1–9. http://dx.doi.org/10.1100/2012/938482.