

The Critical Phases of Effective Research Planning, Scientific Writing, and Communication

An interactive one-day workshop on “The Critical Phases of Effective Research Planning, Scientific Writing, and Communication” was conducted on November 26, 2021, at Sri Adichunchanagiri College of Pharmacy, Adichunchanagiri University, Karnataka, India. The target audience of this workshop was pharmaceutical and biomedical students, research scholars, and teaching faculty. Workshops and lectures on the above theme have been conducted by our team in collaboration with several learned speakers at various places in India at the behest of scientific societies, colleges, and universities since 2004.^[1-3] Such kind of regular training is essential for postgraduates/doctoral students and promising teacher-researchers as they are not exposed to all of these processes, especially developing a research protocol and writing a quality manuscript for publication. We emphasize that there is a need for broad-based training in the scientific methods of research and communication before an individual can take up a scientific and/or academic career.

In principle, scientific research follows standard processes and ethical norms. Understanding these processes is key in the scientific enterprise and essential to succeed in one's scientific career. The research includes the generation of a multitude of ideas (divergent to convergent), as a result of critical and creative thinking, critical observation, and experiments that lead to new findings. The research process has several components starting from the generation of ideas to writing a thesis/research paper. Consequently, the researchers should learn step-by-step developmental processes that are feasible to be completed (e.g.) thesis in a given time frame. The preliminary elements required for significant career growth in research over time include several factors such as motivation, intelligence, novel ideas and thinking (creative, analytical, and critical), skill, environment, diligence, perspiration, smart work, and learning strategies, among others. Taking these points into careful consideration, the goal of this workshop was to kindle attendees' interest in various areas of “basic concepts of scientific research and scientific communication.”

This workshop had six informative and interactive sessions and focused on mastering the skills of participants on effective research planning, the science of scientific writing, and successful scientific publishing. The opening lecture was presented by Dr. G. Jagadeesh (Rockville, Maryland, USA), who spoke on “Basic concepts of the research process and cornerstones of a research project.” He narrated various fundamental aspects involved in research planning which are summarized here. Before a postgraduate/doctoral student begins any kind of research, a well-organized “plan of the project” is needed. This is called “research proposal/protocol,” and this might comprise more than one study protocol. All research projects have four essential components such as (a) writing a study protocol, (b) carrying out experiments, (c) tabulating, analyzing, justifying, and construing the findings, and (d) finally, writing a thesis and the research paper for publication in an indexed journal. For academic research and scholastic achievements, intelligence and creative thinking should get together for creative output and idea generation. The idea is the product of creativity and critical thinking, and that should bear fruit. A brilliant, interesting, and novel idea should be turned into work. The basis for generating novel idea(s) arises from in-depth knowledge related to the research topic. A strength in “review of literature,” armed with imagining and brainstorming of ideas through a process of sequential interaction of divergent (multiple solutions to target problems) and convergent thinking, results in a unique, original,

and novel idea that is most feasible to study. The generated idea(s) should be novel and useful to society. Second-tier ideas are not original; they are a mere improvement of existing ideas. Most of these “cooked ideas” also produce a thesis, publication, degree, and a job but do not greatly benefit either science or society, except the individual.

The starting point for scientific research is a conceptualization of a “research topic” after the review of the literature and from a selection of ideas. A focused and thorough literature review should open a way to articulate the “research topic” that guides the research. It is the keystone of the study. It begins, drives, and ends the study. Furthermore, the well-researched topic has a great potential for the generation of research questions and objectives. The research question and the study design are the two most important components of a study protocol that drives the study to initiation. At the outset, the specific research question or researchable problem/topic should be clearly defined. This is formulated based on (a) critical or intelligent observations made on the ongoing study in the investigators'/guides' laboratory and (b) identification of a gap (niche) in the literature on a topic based on previous research reports and adding additional important (dependent or independent) variables. The formulated research question should be developed into a hypothesis (es). The hypothesis is tested using different designs. The study design follows a set of plans with primary, secondary, and exploratory objectives. The student should be prepared to address the relevance (need) of the study, *i.e.*, why is a particular research topic important? A clearly written purpose statement for the study should be included with the protocol. A statement on the specific goal of the study should be comprehended from the problem. The researcher should bear in mind that the research protocol/proposal [Box 1] is evaluated based on the potentials that it is interesting, novel, well designed, feasible, and impactful.

Taken together, without a well-designed plan, there can be no research project, no experiment, and no publication. Developing a research question, planning a study, writing an optimal study protocol, initiating and then bringing the study to completion, analyzing and interpreting the results in the form of discussion, and eventually ending up with specific testable conclusions are a complex chain of procedures in any scientific enterprise. A systematic and step-by-step approach is necessary for planning the details of a study.^[4]

The next lecture was delivered by Dr. P. Balakumar (Pannai College of Pharmacy, Dindigul, India; Consulting Editor, Pharmacological Research-Elsevier) on the topic “Constructing an efficient literature search employing versatile search engines and biomedical databases, literature reviewing, and referencing.” He critically discussed navigating the way through online search engines and biomedical databases for a skillful literature search and reviewing [Box 2]. The literature search, a primary and essential component of the research process, may be defined as the process of examining all peer-reviewed published sources for obtaining a piece of much-needed scientific information on the topic

Box 1: The key questions that should be answered in the research protocol

- (a) What do you intend to do?
- (b) What has already been done in general and what have other researchers done in the field? (essentially, “the review of the literature”)
- (c) Why is this worth doing, and how is it innovative?
- (d) What will this new work add to the field of science and knowledge?
- (e) How will the research be accomplished?

Box 2: The key purposes of the literature review

- (a) To understand the current status of a relevant topic of research
- (b) To postulate evidence for generating novel research hypotheses for evaluation
- (c) To justify and gain knowledge on different components of the research process (research questions, objectives, hypotheses, experimental methods, statistical analyses, so on) that are appropriate for the planned study
- (d) To strengthen the educational basis of one's research

of interest. Meticulousness in literature search is indeed important to keep the information updated on specific topics, digest the current state of knowledge, identify a research problem, and avoid the duplication of work. The foremost step to identify a research topic primarily involves a standard web-based literature search and review so that a researcher can identify potential gaps in the knowledge base of the published work in a way of meticulously meticulous.

A successful researcher, in addition to having proficiency in literature searching and reviewing, should know how to find the right kind of search engines and databases to extract from the wealth of information existing in the ocean of biomedical and health sciences. The presentation by Dr. Balakumar conferred about constructing successful literature searches using a variety of biomedical databases and search engines, including PubMed/Medline, Embase, Web of Science, SciFinder, CINAHL, The Cochrane Library, International Pharmaceutical Abstracts, Scopus, ScienceDirect, Quertle, BibliMed, Citeline, PharmaPendium, AHFS Drug Information, Facts and Comparisons' eAnswers, Micromedex, Drugs@FDA, and DSSTOX, among others (reviewed in^[5]).

Referencing is not only an important but also an inevitable aspect of scientific writing. Citations and references are some of the most complicated and important areas of manuscript/thesis preparation. It can also be the most time-consuming if authors are not vigilant while citing references. Submitting manuscripts with inaccurate or inconsistent references is often a problem to both reviewers and publishers and may also face rejection. Importantly, a manuscript if published with incorrect references can pose a problem to the readers as well. Hence, one should keep the references clear and accurate. The use of bibliography software could minimize most of the problems and optimize clarity and accuracy. However, one should remember that the use of reference management software does not mitigate the need to be scrupulous. Thus, the researchers should carefully examine the manuscript and the references for any possible errors, despite the use of bibliography software. In the hands-on part of the didactic lecture by Dr. B. N. Srikumar (Department of Neurophysiology, National Institute of Mental Health and Neuro Sciences, Bengaluru, India), the workshop participants learned the application of Mendeley, a freeware that helps organize the literature and also integrates with Microsoft Word for the generation of citations and bibliography. At the end of the lecture, the workshop participants had an opportunity to know (a) different styles of referencing such as Harvard and Vancouver, (b) the importance of sticking to a single referencing style in a document and conforming to the requirements of journals for scientific articles and universities for theses and dissertations, (c) the use of reference management software to manage literature storage and retrieval and subsequently citing and referencing in manuscripts and theses/dissertations.

In the postlunch presentation, Dr. Srikumar conducted a practical session on statistical analyses of data with an overview followed by a demonstration of statistical software, GraphPad Prism. Research involves experiments on a sample from a population and extrapolating (or attributing) to the population. It should be noted that the obtained results might be a chance factor. This can be ruled out with the application of proper statistical tests. Knowledge of statistics is required to design

experiments, evaluate and interpret data, and properly represent the data. During the lecture, the participants were introduced to the type of biological variables, a measure of central tendency and variation, basic concepts of hypothesis testing, and statistical tests such as Student's *t*-test and one-way ANOVA. The participants were instructed about different ways of data presentation.

The next lecture of Dr. Balakumar focused on the science of scientific writing and the competent ways of writing various components (Title [indicative vs. declarative], Abstract, Introduction, Results, Discussion, and Conclusion sections) of a research manuscript and a thesis. Writing a scientific paper is a tough task as it necessitates good planning, constructiveness, determination, and a considerable amount of time. Scientific writing might be a quite frustrating process; however, scientific writing is the most proficient way to communicate the key findings of the work to other professionals in the form of a publication. Writing quality is certainly an important factor in the impact of scientific research. An author should be simple in technical writing without becoming simplistic by thinking about the primary needs of readers. The use of technical jargon in manuscript writing should be avoided. Deficiency in language quality, clarity, and cohesiveness might delay the publication process or even might make a scientific paper unpublishable. Thus, it is a key responsibility of the author to present meaningful and clear information about the work in the manuscript. In addition, the manuscript should be free from typographical and syntax errors. It is recommended to use the present tense for well-known facts (for instance, metoprolol is a selective beta-1-adrenergic blocker used to treat high blood pressure), and the past tense for describing the results of experiments. It is better to use the active voice while constructing a sentence and to avoid unfamiliar abbreviations/acronyms and multiple statements in one sentence. The purpose of a Results section is to present the key findings of a research, which should be presented in an orderly sequence, while for every result presentation, there must be clear methodologies in the Methods section. It is often essential to express the results in a table or figure form. The Discussion section is largely considered as the core of a research paper that usually requires several writing and correction attempts. The Discussion section should also identify potential limitations of the study, and it should possibly provide recommendations for the necessity of further research. Finally, every published original article should carry testable conclusions. Scientific publications function as building blocks of knowledge.

The workshop ended with the presentation on the comprehensive topic "submission of a manuscript to an indexed journal: journal selection, indexing, impact factor, cover letter, and the peer review process" by Dr. Jagadeesh. He elaborately spoke on various aspects of the scientific publication such as (a) importance of publication, (b) why one should publish a scientific paper?, (c) benefits of publication for the student/researcher/teacher/clinician, (d) benefits of publication for an institution/university/society, (e) types of publication, (f) factors to consider in the selection of a journal, (g) the importance of a cover letter, (h) the peer-review process and getting past the gatekeepers, (i) editor's and author's role after the peer review, and (j) importance of citations after publication.

There was a belief that teaching students were the most important aspect of the job, and teachers devoted all their energy to teaching (excellence in teaching). Now, the bar is raised for entry into the teaching profession. Performing potential research and publishing papers are considered a key part of the job description at all levels of the academic career. The publication is the gateway to the successful selling of findings. Having a robust body of published work helps advance one's scientific career. Publishing helps establish an individual as an expert in their field of knowledge. The peer-reviewed publication provides evidence that supports the evaluation of the merit of research funding requests. Prior research experience and preliminary findings supported by

publication(s) open the door for grants. Good research starts long before papers get written. Recommended sources for further reading are listed with this workshop report.^[1-6]

In conclusion, the participants of the workshop were educated in different aspects of research that included a range of diverse topics such as (a) cornerstones of the research process, (b) constructing a successful literature search and review using different databases and search engines, (c) impact factor, CiteScore, h-index (author and institution), h_m -index, h5-index, citations, self-citations, field-weighted citation impact, and citation benchmarking, (d) practical session on basic statistical analysis, (e) art and science of scientific writing, and effectively writing different components of a research paper/thesis, (f) Harvard and Vancouver referencing styles, (g) Web of Science, Journal Citation Reports, Clarivate analytics impact factor, and selection of a scientific journal, (h) working with journals: cover letter, submission process, peer-reviewing, responding to reviewers, the publication process, *etc.*, and (i) ethics in publication. Overall, the participants suggested that the workshop was very useful for their research and dissertation work. In addition, the participants suggested conducting such a kind of workshop for 2–3 days so that sufficient time would be available to have hands-on and practical training for various sessions, especially the statistical part. A significant number of participants expressed their interest to attend similar kinds of workshops in the near future.

Acknowledgements

The authors express their gratitude to Dr. Vedamurthy Joshi, Dr. Mani Rupeshkumar, and Prof. D. R. Bharathi of Adichunchanagiri University, Karnataka, India, for their diverse roles in completing this workshop. The authors thank Dr. R. Lakshmi Raj Sulochana of Pannai College of Pharmacy, India, for the critical reading of this manuscript.

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Submitted: 05-Jan-2022 Revised: 29-Jan-2022
Accepted: 19-Feb-2022 Published: 28-Mar-2022

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Access this article online	
Quick Response Code: 	Website: www.phcog.com
	DOI: 10.4103/0973-1296.341084

Cite this article as: Balakumar P, Srikumar BN, Ramesh B, Jagadeesh G. The critical phases of effective research planning, scientific writing, and communication. *Phcog Mag* 2022;18:1-3.