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Editorial

Demystifying the Intricacies of Research Methodology, Scientific Publishing and Patenting

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It was generally believed that the most significant part of academic faculties' work was teaching students, thus they devoted their all-time to the teaching-learning process. The basic requirements to become a faculty are more stringent now. At every stage of the academic profession, conducting prospective research and writing publications are regarded as essential tasks for a teaching faculty. One's scientific career can progress with a substantial body of research that is published. On 18 December 2023, the Office of Research and Development along with the Institution's Innovation Council of Periyar Maniammai Institute of Science and Technology (Deemed to be University), Thanjavur, India hosted an interactive one-day international symposium with the theme "Demystifying the intricacies of research methodology, scientific publishing and patenting." This symposium was intended for research scholars, teaching faculty, and students studying engineering, pharmacy, computer science, biomedicine, science, social science, and arts. Since 2004, our team has collaborated with several knowledgeable speakers to offer workshops, symposia and lectures on the aforementioned theme in various locations in India, at the request of scientific societies, colleges, and universities.[1-5] Since postgraduates, doctoral students, and aspiring teacher-researchers are not systematically exposed to all of these practices, particularly in creating a research protocol and producing a high-caliber scientific paper for publication, this kind of routine training is crucial. We emphasize that before pursuing a career in research or academia, a person must have comprehensive training in scientific research methodology and communication procedures.

Dr. Gowraganahalli Jagadeesh, former Senior Expert Pharmacologist from the US Food and Drug Administration, USA; Dr. Renukha Sellappans and Dr. Murugan Thangiah from Taylor's University, Malaysia; Prof. P.K. Srividhya, Prof. Balakumar Pitchai, and Prof. Kumaran Shanmugam from Periyar Maniammai Institute of Science and Technology (Deemed to be University), India have spoken at this international symposium, covering methodically the multifaceted aspects of the basic concepts of scientific research, scientific writing and publishing, ethics and patenting. There were around 200 participants from different institutions in and around attended this systematically conducted international symposium.

Scientific research, in general, adheres to ethical standards and standard operating procedures. Comprehending these procedures is crucial for scientific endeavour and indispensable for achieving the feat in a scientific profession. Research involves generating a wide range of ideas moving from divergent to convergent, thinking creatively and critically, and conducting research that yields novel insights to solve a problem. There are various steps in the research process, from coming up with ideas to publication. Essentially, the researchers ought to ascertain developmental processes in detail that may persuasively be completed within a specified time range. Taking these points into account, the symposium's objectives were to explore different facets of research, and to support prospective participants in gaining an in-depth understanding of the fundamental concepts of scientific research, scientific communication and research protection (patenting). This symposium had seven thought-provoking and engaging topics, which aimed to provide attendees with efficient research planning, scientific writing, successful scientific publishing, and patenting abilities. After the inaugural addresses delivered by

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Prof. S. Velusami, Vice-Chancellor, and special address by Mr. V. Anburaj (Member-Board of Management, Periyar Maniammai Institute of Science and Technology-Deemed to be University, India) insisting the importance of academic research and publication for institutions' global recognition and benefits, the registrar of the same institution, Prof. P.K. Srividhya delivered the first lecture.

Prof. P.K. Srividhya urged the participants to concentrate on integrating research to solve societal problems by securing grants from various funding agencies. An academic's career advancement depends on his/her ability to publish research findings because these publications offer a platform for knowledge creation, recognition, and a variety of career-growth and advancement options. Academic staff members can gain greatly from research papers, especially when it comes to career progression and promotion. Research publications are an important aspect of the academic environment. The contribution to knowledge, professional recognition, advancement, grant opportunities, international collaboration, the efficacy of mentoring and teaching, institutional reputation, networking opportunities, employment opportunities, and personal and professional development are just a few of the most significant benefits of undertaking valid research and publishing scientific papers. Dr. Srividhya also underlined the importance of high-quality publications in indexed journals and the value of creativity and research, as well as the necessity of filing a patent to protect research.

In the next lecture, Dr. G. Jagadeesh (Formerly, US Food and Drug Administration, Silver Spring, MD, USA; Distinguished Visiting Professor at the College of Pharmaceutical Sciences, Dayananda Sagar University, Bengaluru, India) spoke on "The roadmap to successful research: embarking on research and principles of research process." When beginning their research journey, postgraduate students and early-career researchers need to have a well-organized "plan of study." In the first stage, a review of existing literature is conducted, and then new scientific concepts and research topics are generated through creativity and critical thinking. The unique ideas are related to creativity (Figure 1). Creative thinking is the force behind problem identification (and problem solving), often as an extrapolating exercise from antecedent knowledge base. It is one of the bases of choosing a research topic that involves moving between divergent (considering many possibilities) and convergent (closing in on a few possibilities and those most feasible to study) thinking to settle upon an idea from a selection of ideas. In order to select ideas for investigation, we should focus on first-tier concepts, or original ideas. Ideas that fall into the second tier or secondary are only improvements on those that fall into the first tier, they are not new ideas. The two main elements of a research protocol are the research question and the study design. The research topic should evolve into a hypothesis, while the relationship described in the hypothesis should be tested by experiments, followed by statistical analysis. A well-structured plan with primary, secondary, and exploratory objectives guides the study design. The researcher must be prepared to justify the study's relevance. The study's purpose and research questions should be clearly stated in the proposal or protocol (BOX 1).

BOX 1: Principal questions to be addressed in the research protocol.

How are you going to proceed with the study?

Has this area already been extensively researched?

What other studies have been conducted? (using "the literature review")

Is it worthwhile to pursue research on the suggested topic?

What makes it novel?

What new perspectives will this work bring to the field?

Does this research not amount to a "me too" study?

What is the process for conducting the research?

Taken together, scientific research involves a complex series of processes, including formulating a research question, organizing the study, creating an ideal procedure, beginning and executing the investigation, evaluating and interpreting the data, and publishing. A methodical, step-by-step planning process must be undertaken for any study. A research project, experiment, and publication are unlikely to happen without a meticulously planned methodology.

Dr. Renukha Sellappans (Head, School of Pharmacy, Faculty of Health and Medical Sciences, Taylor's University, Malaysia) was the next resource person who spoke on the topic "Basics of scientific publishing: what does an academician need to know?" In the ever-evolving landscape of academia, effective scientific publishing is a cornerstone of scholarly success. In her talk, Dr. Renukha provided the comprehensive guide for academicians seeking to navigate the intricate process of sharing their research with the global scientific community. The session was geared up by delving into the fundamental question of why to publish. Beyond the conventional expectations, by facilitating research publications, we can explore the multifaceted benefits of dissemination, including knowledge contribution, academic recognition, and fostering collaboration. Understanding the varied types of articles is pivotal in crafting a publication strategy. It is essential to understand what types of articles are available for publication before creating a strategy. The lecture critically elucidated distinctions between research articles, reviews, and commentaries, among others, empowering academicians to strategically choose the most suitable format for their research findings. Navigating the complexities of manuscript preparation can be daunting, but the presentation demystified the process by offering insights into the structure and length of an article. From composing compelling abstracts to specific journal requirements, participants received practical advice on optimizing their manuscripts for publication. Choosing the right journal is also

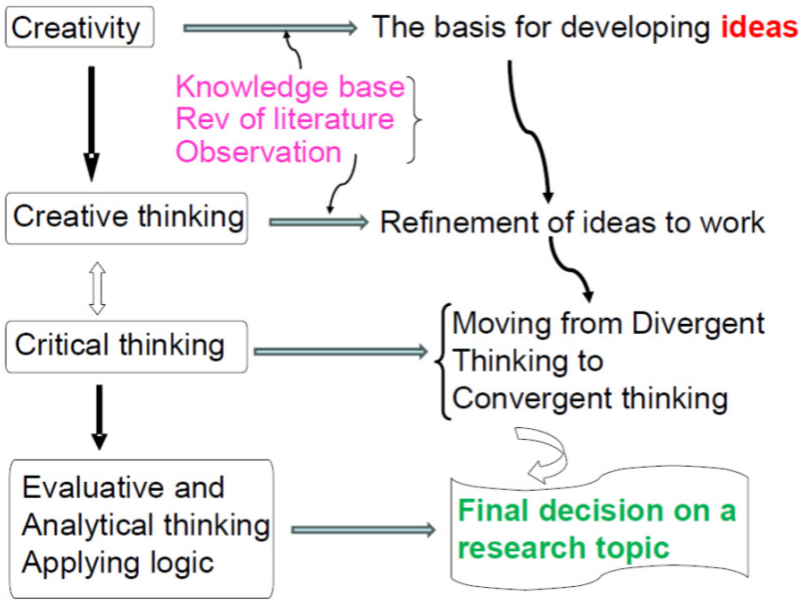

Figure 1: Thinking process in research.

Several modes of thinking are required for successful research: creative thinking, critical thinking, divergent thinking, and convergent thinking. Creative thinking in choosing a research topic involves moving between divergent (considering many possibilities) and convergent (closes on a few and most feasible to study) thinking to settle upon an idea from a selection of ideas. Critical thinking is a refinement of the creative process that allows the individual to identify gaps in the literature and recognize what is missing or wrong with ideas, solutions, or conclusions. It is the creative aspect of problem identification and molding it into a tangible set of concepts from which hypotheses and objectives are generated.

a crucial decision that influences the visibility and impact of a publication. Participants learned strategies for identifying suitable journals, considering factors such as scope, audience, and impact factor. The journey from manuscript preparation to publication would be incomplete without navigating the peer review process. Participants gained a deeper understanding of the nuances of peer review, learning how to respond to reviewer comments and improve the quality of their work through constructive feedback. By the end of this session, participants were armed with the essential knowledge needed to confidently navigate the scientific publishing process, ensuring that their research not only reaches the right audience but also makes a meaningful contribution to the advancement of knowledge in their field.

The subsequent talk was presented by Dr. Murugan Thangiah (School of Liberal Arts and Sciences, Faculty of Social Sciences and Leisure Management, Taylor's University, Malaysia) on the topic 'Ethics in scientific research and publications.' His presentation provided a comprehensive overview of the fundamental aspects of ethical considerations in scientific research and the dissemination of research findings. In the scientific landscape, ethical standards are crucial for guaranteeing the reliability, validity, and social impact of research endeavors. Dr. Murugan described several aspects of research ethics, including data handling and processing, the research framework, transparency, and adherence to ethical norms in experimental design and implementation. In addition, the lecture examined the ethical challenges arising from the publication process. Preserving the authenticity and originality of scientific contributions requires an examination of issues related to authorship attribution, intellectual property rights, plagiarism, and the ethical responsibilities of researchers and publishers. The importance of peer review mechanisms in maintaining publication integrity was also discussed, with a particular focus on ensuring fair evaluation and constructive criticism. Through the presentation, Dr. Murugan aimed to instill the participants an understanding of the ethical complexities inherent in scientific research and scholarly publishing by synthesizing insights from current literature, ethical guidelines, and real-world case studies. Various unethical practices in scientific publishing such as falsification, fabrication, plagiarism, salami slicing, guest authorship, and ghost authorship, among others, were highlighted to caution the participants against engaging in such egregious transgressions.

In the post-lunch presentation, Prof. Balakumar Pitchai (Director, Research Training and Publications-The Office of Research and Development, Periyar Maniammai Institute of Science and Technology-Deemed to be University, India; Consulting Editor, Pharmacological Research-Elsevier; Adjunct Professor of Pharmacology, School of Pharmacy, Faculty of Health and Medical Sciences, Taylor's University, Malaysia) delivered a lecture on the topic "Structuring a world-class manuscript for publication in a SCIE/SSCI/AHCI/PubMed-Medline/Scopus indexed journal." A critical step in identifying a research problem is to conduct a conventional web-based literature search and review in a methodical manner. This allows the researcher to systematically identify any potential gaps in the existing knowledge base of published work. During his presentation, Dr.

Balakumar provided a concise analysis of how to effectively find and review the literature using biomedical databases and online search engines. The process of looking through all peer-reviewed published sources to find crucial scientific information on the subject of interest is known as literature search, and it is a fundamental step in the research process. The audiences were informed about the snowballing procedure to perform an efficient literature search, which involves backward reference tracking and forward citation tracking. Scientists must not only 'do' science but must also 'write' science. Research outcomes are measured through quality publication. Dr. Balakumar's lecture emphasized three major aspects: (i) The significance of publishing in indexed journals (SCIE/SSCI/AHCI/PubMed-Medline/Scopus) (ii) The art and science of scientific writing, and the structuring of a world-class manuscript; and (iii) Successfully publishing the manuscript. The participants were informed of the key steps involved in conducting research from initiation to completion (BOX 2).

BOX 2: Key steps to start research.

(a) Literature search and review to identify the research problem based on the research gap.

(b) Idea generation: creative and critical thinking.

(c) Choose a research topic that involves moving between divergent and convergent thinking.

(d) Formulating research questions from the research topic.

(e) Hypothesis generation based on the existing literature.

(f) Research questions and hypotheses are articulated into more precise objectives (formulating aims and objectives of the study).

(g) Study design and protocol writing.

(h) Performing experiments and data analysis.

(i) Writing a manuscript for publication in an indexed journal.

The participants were taught about the essential elements of developing an effective title (indicative vs. declarative), abstract (structured vs. unstructured), keywords, graphical abstract, and introduction, as well as how to create a methodology section, effective results section that includes a display of tables and figures, and finally the discussion section of the research paper. BOX 3 describes issues in publishing.

BOX 3: Four categories of issues in scientific publishing.

(a) Typographical and grammatical errors: Spelling and grammar mistakes that obstruct clarity are the major issues. By far the most common issue with submissions is shoddy writing with syntax errors.

(b) Structural inconsistency: The clarity/tone is the second most frequent problem, where the author's comprehension of the subject topic is lacking in the manuscript.

(c) Scope: Picking the appropriate journal is important. Several papers are rejected because of not being within the scope of the journal.

(d) Predatory and cloned/hijacked journals: Predatory and cloned/hijacked journals produce pseudoscience/junk science where researchers should not submit their findings. These journals are polluting the science.

Scientific writing is a challenging yet essential task for consolidating ideas and communicating key findings to the research community. It requires good planning, constructiveness, determination, and time. The quality of scientific research is significantly impacted by the quality of writing. Authors should be simple in technical writing without becoming simplistic, taking into consideration of the readers' needs. They should avoid using technical jargon and poor English quality, as the latter can delay publication or even make a paper unpublishable. The author's responsibility is to present clear and meaningful information in the manuscript, free from grammatical, typographical, and syntax errors.

While organizing the manuscript, it is important to briefly mention the research problem statement at the start of the abstract. The abstract should contain adequate information about how the work advances the field (Figure 2). Readers frequently stop reading the abstract if it is not fascinating and clear.

The introduction should provide a brief overview of the topic, highlighting previous research findings and should clearly state the research question to be addressed. The justification should rationalize the urgent need for attention, highlighting issues with previous hypotheses or research gaps in the field. The objectives should be stated at the end of the introduction, and the chosen structure should briefly review the upcoming parts. BOX 4 reveals the key components of an introduction section.

BOX 4: Key components of an introduction section.

(a) A brief overview of the subject: Start with an overview of a topic (*e.g.* prevalence data).

(b) Prior research: Reviewing previous findings on your subject deserves in the introduction. For those who might not be familiar with it, it also presents previous findings. State the research question to be addressed in the study.

(c) A justification for your research: Justify your topic's urgent demand for attention. Provide links to current occurrences, if appropriate. You must also highlight an issue with previous hypotheses or point out a research gap in the field.

(d) Objectives: A statement should be included at the end of introduction. It is important to briefly review what you plan to cover in the next parts of the structure you choose.

The introduction section should cite the most recent references. Depending on the goals of the study, research methodologies can be developed using a framework called the "research onion" as given by Saunders et al.[6] in their book "Research Methods for Business Students." The model consists of multiple layers that are arranged in an onion-like configuration. The introduction section should use the present tense, while the methodology and experiment results should use the past tense. Avoid unfamiliar abbreviations and multiple statements in one sentence. The "results section" of a research paper should present key findings in an orderly sequence, while the "methods section" should contain clear methodologies for each result presentation. The

active voice should be used and unfamiliar abbreviations should be avoided. The "discussion section" of a research article is crucial for summarizing results, identifying potential drawbacks, and making suggestions for additional study (BOX 5). Scientific writing requires careful attention to citations and references, as errors or inconsistencies in referencing can cause problems for publishers, reviewers, and potentially lead to rejection.

BOX 5: Organizing the discussion section.

(a) Begin the discussion by summarizing the main findings of the study, and answering research questions.

(b) Draw attention to the acceptance or rejection of the null hypothesis.

(c) Cite as many specific references as possible when discussing the findings in relation to the earlier body of literature.

(d) The earlier research that supports or contradicts the findings of the present investigation must be discussed.

(e) Coherently state how the study is unique.

(f) A succinct explanation of the idea and excellence of the study's methodology may be taken into consideration.

(g) It is strictly advised to avoid making general, vague, or sweeping statements.

(h) Discuss the key limitations of the study findings.

(i) Discuss the relevance of the results to the current practice.

(j) Conclude the section by outlining the study's major findings.

(k) At the conclusion, the necessity for more research and potential directions can be emphasized.

(l) When writing the discussion part, often use the present tense/present perfect tense and the active voice.

Prof. Kumaran Shanmugam (Department of Biotechnology, Periyar Maniammai Institute of Science and Technology-Deemed to be University, India) delivered the next lecture on "Emerging trends in intellectual property rights (IPR) and principles of patenting." Of note, IPR may be classified broadly into eight types: (i) patents, (ii) copyrights, (iii) industrial designs, (iv) geographical indications, (v) trade mark, (vi) semiconductor integrated circuit layout design, (vii) trade secret, and (viii) plant varieties (https://cipam.gov.in/). Understanding the fundamentals of IPR directs researchers to protect their innovation in required countries, and it can be monetized. World Intellectual Property Organization (WIPO) offers online distance learning courses, most of which are free. Participants were trained to register and complete courses like the Patent Cooperation Treaty (PCT), introduction to IPR, and others. In India, the National Programme on Technology Enhanced Learning (NPTEL) also offers a few courses online, where free academic materials and certificates are provided at a nominal charge.

To systematically foster the culture of innovation and start-up ecosystem in Higher Educational Institutions (HEIs) in India, the Ministry of Education (MoE) launched the Institution's Innovation Council (IIC) program in 2018 through the MoE's Innovation Cell (MIC) in partnership with AICTE. For the innovation and entrepreneurship ecosystem to become established and stabilized in HEIs, the IICs' main task is to involve a large number of faculty, students, and staff in various innovation and entrepreneurship-related activities, such as ideation, problem-solving, proof of concept development, design thinking, IPR, project handling and management at pre-incubation/incubation stage, among others. (https://iic.mic.gov.in/). In this presentation, the participants gained information concerning traditional knowledge and IPR. Discussion on technical and legal disputes of IPR will demystify the intricacies and ability to solve the problems for the future. Understanding and interpreting each country's IPR law helps to avoid technical complications. Finally, an innovative brain will uphold the dignity of the human being in day-to-day life. The presentation enlightened the participants to solve research problems innovatively, with unique and out-of-the-box thinking.

The symposium ended with the presentation on the topic "The power of publication: enhancing institutions' world ranking and researchers' influence" by Dr. Jagadeesh (Formerly, US Food and Drug Administration, Silver Spring, MD, USA; Distinguished Visiting Professor at the College of Pharmaceutical Sciences, Dayananda Sagar University, Bengaluru, India). Publishing papers is a crucial aspect of academic careers at all levels. It serves as a means to effectively disseminate research findings and plays a significant role in career advancement, academic recognition, and securing research funding. Having a strong portfolio of published works is essential for establishing oneself as an expert in a particular field. Additionally, peer-reviewed publications provide the necessary evidence to support research funding requests and open doors for grants. Ultimately, the impact of published research papers on society and the advancements made through patents are key factors in ranking institutions at both national and international levels.

Institutions must foster a research-friendly environment to stand out and attract top talent. Conducting innovative research is mutually beneficial for both the researchers and the institution.

Institutions at both national and international levels are ranked based on the number of grants they receive, the number of publications they produce, and the impact of their research on society. This includes how their research solves problems and provides guidance, as well as the number of patents they acquire. To stand out among other universities, a university needs to encourage research and provide an environment where researchers can thrive. Supporting faculty in obtaining grants is one way that the university can support them in making discoveries, and in integrating, disseminating, and applying those discoveries. To promote innovation and patenting, it would be beneficial for

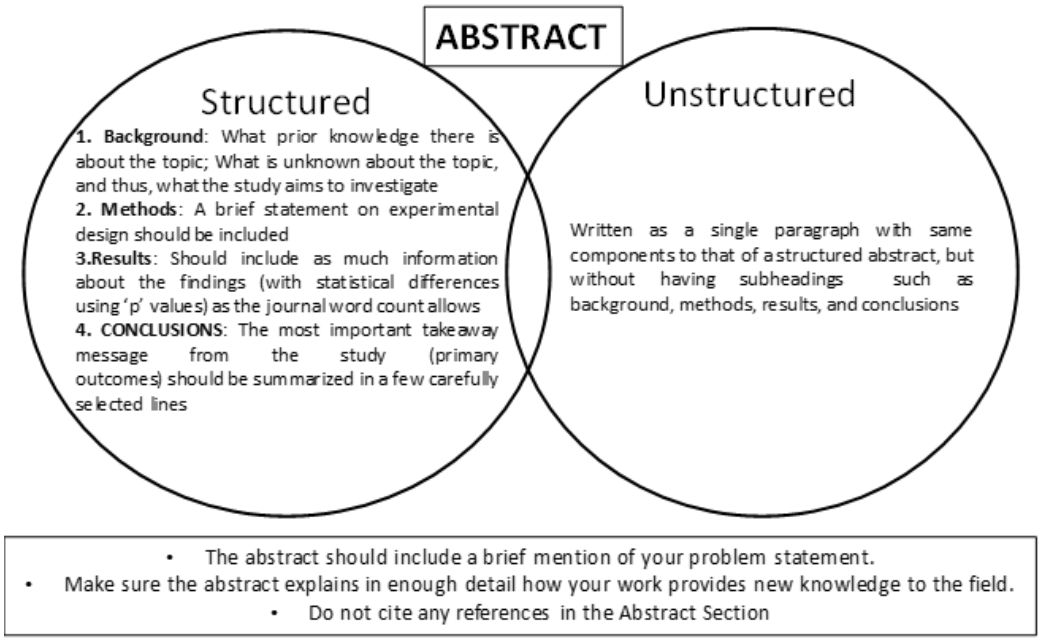

Figure 2: An overview of structured and unstructured abstract.

the university to establish a research and development cell. This would create a win-win situation for both the researchers and the university.

Taken together, the process of writing and selecting a suitable journal for submission is crucial for the successful publication of research findings. Manuscripts should be carefully categorized based on their type, novelty, significance, and target audience. Additionally, factors such as the impact factor of the journal, abstracting/indexing service, publishing frequency, and target audience should be taken into consideration. It is important to avoid publishing in predatory or non-indexed journals. Predatory journals are polluting the research.[7] A well-prepared manuscript that adheres to the journal's author guidelines should be accompanied by an effective cover letter to make a positive impression on journal editors. Subsequently, the manuscript undergoes peer review, an essential process for ensuring the credibility and quality of the research. The editor then assesses the referee responses to decide on accepting, revising, or rejecting the manuscript. Rejection and revision are integral parts of the publication process, and every paper contributes to the continuity of research. The final step is to persist in pursuing and publishing research if you are passionate about it. Recommended sources for further reading and understanding are listed in this symposium report.[1-9]

In conclusion, the participants of the symposium were educated in different aspects of research that included a range of diverse topics such as (a) Research methodology: exploring the latest advancements in research methodologies across various disciplines; (b) Scientific writing: enhancing the writing skills and learning effective strategies for communicating research findings; (c) Publication ethics: learning ethical considerations in research and publication, addressing issues such as authorship, plagiarism, and peer review; (d) Patenting: acquiring the recent developments in IPR. In general, the attendees expressed that the symposium was quite beneficial for their research and dissertation assignments. Furthermore, the participants recommended holding this kind of event frequently and for two days to allow enough time for practical, hands-on training for a variety of sessions. Many attendees said that they would like to attend symposiums of this nature in the future.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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