

Indexed Literature as a Foundation for Inductive and Deductive Reasoning: The Triad of Research Methodology, Statistical Analysis, and Ethical Publishing in the AI Era

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ABSTRACT

It is imperative to address the complexities of conducting and disseminating high-quality research amidst a rapidly changing scientific environment in the era of Artificial Intelligence (AI). Despite the existence of extensive literature on idea generation, literature search, protocol writing, methods, experimental design, statistical analysis, research ethics and indexed publications, there remains a significant gap in integrating these areas with the expanding impact of AI in scholarly publishing. The symposium emphasized aligning basic concepts of research, literature search and review, protocol design, and methodological consistency with suitable statistical approaches, notably in the selection between parametric and nonparametric analyses, and in upholding ethical standards in research and publication practices using AI. Essential discussions centered on the prudent use of AI tools, underscoring their potential to enhance productivity alongside the hazards of bias, authorship integrity, and transparency. Through a blend of inductive reasoning informed by real-world studies, deductive reasoning grounded in established theoretical frameworks, and abductive reasoning described as inference to the best explanation, the symposium established a comprehensive platform to foster critical thought and evidence-based decision-making. It was posited that the combination of robust research methodology, sensible statistical techniques, rigorous adherence to ethical principles, and responsible AI use could markedly increase the quality, credibility, and reproducibility of scientific outputs. The principal objective was to bridge the gap between theoretical knowledge and practical application within contemporary research practices. Additionally, the symposium aimed to deepen participants' understanding of study design, statistical decision-making, ethical compliance, and AI-assisted publishing, ultimately fostering responsible and high-quality scientific contributions.

Keywords: Idea generation, Inductive and deductive reasoning, Research methodology, Statistical analysis, Ethical publishing, Artificial intelligence.

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INTRODUCTION

It is widely acknowledged that the primary role of academic faculty was traditionally centered on teaching, with full attention devoted to the teaching-learning process. However, this role has significantly evolved over the time, leading to more stringent

criteria for entering the teaching profession. Currently, faculty members are also expected to engage in research and publish their findings, making these activities essential responsibilities alongside teaching. Consequently, an academic's career progression is closely linked to the development of a substantial portfolio of published research outputs, reflecting a pivotal shift in the academic environment toward greater emphasis on research contributions. Furthermore, it is crucial to address the challenges of conducting and sharing high-quality research, especially in rapidly evolving scientific settings influenced by Artificial Intelligence (AI). The ethical use of AI and ensuring that research practices are globally acceptable are paramount considerations in this new era.



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There is a notable gap in systematic exposure for undergraduates and postgraduates, doctoral students, and aspiring teacher-researchers in research protocol development and the production of high-quality scientific papers, highlighting the need for comprehensive training in research methodology and communication prior to embarking on careers in research or academia. On 30 January 2026, the Office of Research and Development, in association with the Institution's Innovation Council and the Department of Electronics and Communication Engineering of Periyar Maniammai Institute of Science & Technology (Deemed to be University) (PMIST), Thanjavur, India, organized a one-day international symposium. The event, themed "Indexed literature to inductive and deductive reasoning: the triad of research methodology, statistical analysis and ethical publishing in the AI era," was conducted for teaching faculty, research scholars, and undergraduate and postgraduate students across various fields, including engineering, pharmacy, medical, biomedical, architecture, computing science, science, social science, and arts, underscoring the importance of routine training in scientific research. Over the past two decades, we have engaged knowledgeable speakers to host workshops, symposia, and lectures on these themes in India (Balakumar and Jagadeesh, 2012; Balakumar *et al.*, 2013; Balakumar *et al.*, 2024; Balakumar *et al.*, 2024).

Dr. Gowraganahalli Jagadeesh, retired Senior Expert Pharmacologist at the U.S. Food and Drug Administration, USA; Dr. Murugan Thangiah from Taylor's University, Malaysia; Dr. Saravanan Pandiaraj from King Saud University, Saudi Arabia; Dr. Shubhada Nagarkar from the Centre for Publication Ethics, Savitribai Phule Pune University, India; and internal resource experts, namely, Dr. Balakumar Pitchai, Dr. P. Ilangovan, Dr. P.K. Srividhya, Dr. R. Malliga, Dr. V. Ramachandran, and Dr. V. Anburaj from PMIST, India, addressed the symposium, covering comprehensive dimensions of scientific research, including its foundational concepts, the intricacies of scientific writing, publishing, and ethical considerations and the nuances of using AI. The event gathered approximately 350 participants from various institutions, demonstrating a wide-ranging interest in these critical topics within the scientific community. The structured nature of the symposium enabled a thorough exploration of each topic, fostering an environment conducive to knowledge sharing and professional development.

Scientific research is grounded in ethical standards and standard operating procedures, which are essential for both effective scientific practice and professional success. The research process encompasses various steps, from idea generation to publication, emphasizing the importance of creative and critical thinking. The objectives of the symposium were to explore diverse aspects of research aimed at enhancing participants' knowledge of foundational concepts such as scientific communication and research publications, as well as the ethical use of AI in research.

With eight engaging topics, the symposium sought to equip attendees with skills for efficient research planning, scientific writing, successful publishing, and effective use of AI in research. The special addresses at the symposium were delivered by Prof. V. Ramachandran, Vice-Chancellor, and Dr. R. Malliga, Pro-Vice-Chancellor of PMIST, India. In their discussions at the symposium, the vital importance of integrating AI into academic research and publication strategies was highlighted, particularly regarding its potential to enhance the global reputation of an institution. Throughout the presentations, they consistently reinforced this theme, illustrating that the ethical use of AI leads to marked improvements in research outcomes. The strategic aim behind this integration is to increase not only the quality of academic research but also the status of an institution within the international academic community. The central message emphasized the importance of adapting to contemporary technological advancements within scholarly activities. There was a strong advocacy for a progressive approach that seeks to refine academic research practices in the young, nimble minds of undergraduate and postgraduate levels, ensuring competitiveness in an ever-evolving academic environment.

Transformational Leadership as A Catalyst for Advancing Research Productivity in Higher Educational Settings

Following the above mind-blowing addresses, Dr. V. Anburaj, the Vice-President of PMIST, delivered a plenary lecture titled "Transformational leadership as a catalyst for advancing research productivity in higher educational settings." In his thought-leadership speech, Dr. Anburaj emphasized that transformational leadership plays an essential role in enhancing research productivity within higher education institutions by creating an inspiring vision that motivates faculty and students to engage in research activities. Transformational leadership fosters an environment conducive to innovation and collaboration among researchers, leading to increased output and improved quality of research work. Transformational leaders build strong relationships and trust within academic teams, which helps individuals feel valued and empowered in their research endeavors. Such empowerment enhances motivation, prompting faculty members and students to pursue more ambitious research projects. In addition, transformational leadership often establishes a supportive culture that underscores continuous professional development, encouraging researchers to improve their skills and competencies. Beyond motivation, transformational leaders strive to align research goals with the strengths and interests of faculty members. They facilitate open communication and promote idea sharing, which effectively connects faculty desires with administrative objectives, fostering a shared commitment to research excellence. Moreover, the strategic vision of transformational leaders can clarify pathways for securing funding and resources vital for conducting innovative

research. Together, transformational leadership acts as a catalyst for advancing research productivity in higher education through several modes of operation such as motivation, empowerment, alignment of institutional and personal goals, and strategic resource advocacy. By connecting these elements, educational leaders can cultivate an environment that promotes high-quality research outcomes.

Academic Research as A Foundation for Societal Growth and Transformation

In the next lecture, Prof. P.K. Sridividya opined that academic research plays a crucial role in the growth and transformation of society by generating knowledge that has significant impacts on policy-making, innovation, and the resolution of various societal challenges. It fosters critical thinking and promotes interdisciplinary collaboration, allowing different fields to unite in pursuit of comprehensive solutions to complex problems. The insights derived from research are grounded in solid evidence, which is vital for making informed decisions. Moreover, engaging communities in research initiatives enhances public understanding and creates strategies tailored to address society's specific needs. By widely disseminating research findings through diverse channels, the accessibility of this knowledge is improved, fostering dialogue between the academic community and the general public. Such a commitment to nurturing a culture of analysis not only contributes to the development of specific academic fields but also positions academic research as an essential factor in advancing social equity and sustainability. In summary, academic research is a driving force behind transformative change within society.

Strategic Thinking and Reasoning Frameworks for Developing Effective Research Protocols

In the next lecture, Dr. G. Jagadeesh (Retired Senior Expert Pharmacologist at the US Food and Drug Administration, Silver Spring, MD, USA) spoke on the topic: strategic thinking and reasoning frameworks for developing effective research protocols. Designing a high-quality research protocol is the most important intellectual challenge in the research process and requires more than just methodological knowledge. It demands sophisticated thinking and a systematic blend of advanced reasoning skills that turns an initial idea into a solid, fundable, and actionable scientific plan. This detailed presentation clarified key thinking strategies and reasoning processes, equipping researchers with the strategic intellectual tools needed to develop genuinely innovative, methodologically sound research proposals.

The speaker distinguished between two main modes of thinking that support successful inquiry. Creative thinking (often called divergent or lateral thinking) drives innovation. It is essential for developing new research methods, broadening the scope of current knowledge, and identifying potential gaps in the literature that others may have missed or overlooked. This mode allows

researchers to explore the 'problem space' openly, enabling them to generate truly original research questions and new theoretical connections. On the other hand, critical thinking (convergent or vertical thinking) serves as the necessary filter that narrows and refines creative ideas, ultimately selecting one for detailed study (i.e., project selection). It plays a crucial role in assessing feasibility, ethical issues, and practical limitations, choosing suitable methods, and ensuring logical consistency throughout. An effective process results from the dynamic interaction between these two modes: generating innovative ideas followed by careful evaluation.

Building on this cognitive foundation, the presentation thoroughly explored the three main reasoning processes that connect theory and practical protocol design. Deductive reasoning is essential for establishing the theoretical framework, allowing researchers to move logically from general laws or theories to specific, testable hypotheses. Inductive reasoning is vital for grounding research in reality, prompting researchers to observe particular empirical data or gaps and generalize them into broader tentative claims, thereby emphasizing the study's importance. Finally, abductive reasoning, often the starting point for new inquiries, involves inferring the 'best possible explanation' for observed phenomena and serves as an effective strategic tool for initially formulating nonobvious hypotheses and framing original research questions.

By strategically integrating these cognitive skills, including abductive and creative thinking to identify and frame a compelling research problem, deductive and critical thinking to develop a rigorous theoretical framework, and inductive and critical thinking to design a strong methodology, students, doctoral candidates, and researchers can systematically create research protocols that are both innovative and well-structured with clear logic (Figure 1). This session provided researchers with practical, actionable insights into using these powerful intellectual tools to improve protocol development and, ultimately, to achieve successful scientific contributions.

Best Practices in Literature Search and Data Collection Using AI/ML: Ensuring Quality and Integrity in Scientific Research

Dr. Murugan Thangiah (Faculty of Social Sciences & Leisure Management, Taylor's University, Malaysia) was the next resource person who discussed the topic of literature search with AI/Machine Learning (ML) tools. In his elegant talk, Dr. Thangiah provided a comprehensive guide for academicians seeking to navigate best practices in literature search and data collection. In the rapidly evolving domain of academic research, the application of AI tools has notably transformed the way scholars engage with literature, build reasoning, and produce ethically responsible publications. The essence of this transformation is the use of state-of-the-art AI platforms including Consensus, Bohrium, and SciSpace, among others. The speaker demonstrated the

ethical use of Bohrium AI, which serves as a powerful tool for identifying indexed literature, allowing researchers to retrieve high-quality, peer-reviewed articles via semantic search and extensive database integration. The optimal use of such AI tools significantly increases the efficiency and thoroughness of literature identification, establishing vital groundwork for evidence-based research. Expanding on this foundation, Consensus AI enhances the cognitive and analytical phases of research, converting collected literature into significant knowledge. By utilizing AI-powered summarization, citation-aware drafting, and idea development, Consensus AI aids in both inductive and deductive reasoning. This integration enables researchers to methodically advance from the literature review to hypothesis creation and experimental design. Furthermore, the collaboration of these tools improves the understanding of ethical publishing standards by ensuring accurate citations and promoting transparency in knowledge synthesis. Holistic AI-driven search engines not only increase research efficiency and quality but also reshape the cognitive processes that characterize modern research. Overall, the presentation provided important insights for researchers, educators, and institutions seeking to embrace intelligent, ethical, and methodologically rigorous AI-driven research practices.

From Classical Statistics to AI-Assisted Statistical Analysis in Research

Scientific research encompasses a multifaceted set of procedures that include several critical stages. These stages begin with the identification of a problem that needs investigation, followed by a thorough literature search and review to contextualize the research. Identifying a research gap is essential, as it helps to formulate relevant and significant research questions. Researchers then generate hypotheses, distinguishing between null and alternative hypotheses, and outline the aim and objectives of the research. Organizing the study is another important step, which involves crafting an ideal research procedure tailored to address the identified questions effectively. The actual execution of the study requires methodical planning and meticulous attention to detail. A well-defined methodology is crucial, as the success of a research project, experiment, and publication depends strongly on how thoroughly the methodology is constructed and implemented. After conducting the research, it is necessary to carefully evaluate and interpret the collected data.

The next speaker, Prof. Balakumar Pitchai (Director at the R&D Office-Research Training & Publications, PMIST, India; Consulting Editor, Pharmacological Research-Elsevier; Adjunct

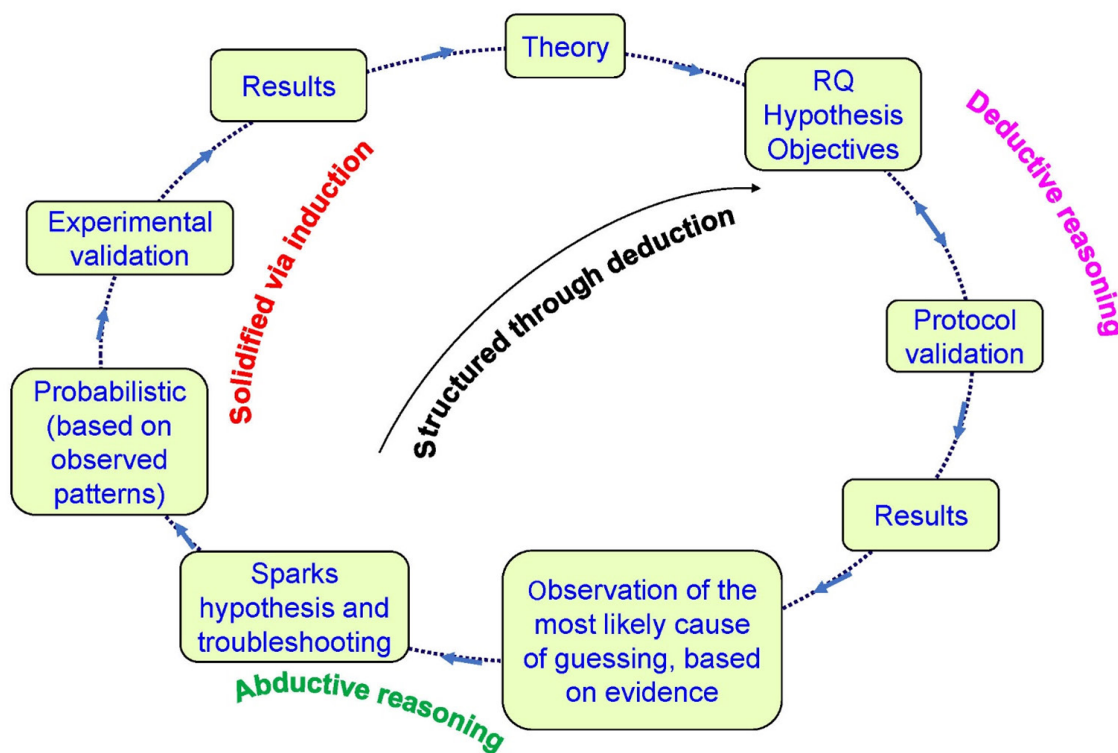


Figure 1: The triad of reasoning in research. Beyond broad thinking styles (creative, critical, and analytical), the architecture of a research study rests on specific methods of logical inference: deductive, inductive, and abductive reasoning. While researchers often default to one, the most effective research programs use a triadic approach, integrating all three to navigate the complexities of data. Transitions among these stages guide the planning of scientific studies. They act as the “gears” of the scientific research. A series of deductive arguments shows how the final conclusion is reached from a set of hypotheses, objectives, observations, data analysis, and discussion. The study leads to a conclusion with certainty. However, deduction is limited by its inability to generate new knowledge beyond what is already contained in the premises; it validates existing theories rather than discovering new phenomena. Inductive reasoning works the other way, the “bottom-up.” It deals with probability rather than absolute certainty. The conclusion is based on a series of observations or measurements. No hypothesis or theory is present at the outset. Generalization is based on observations. Abduction is the process of formulating the most likely explanation from an incomplete set of observations. It is a form of logical inference that draws a conclusion from the best explanation of the available evidence.

Professor of Pharmacology, School of Pharmacy, Taylor's University, Malaysia), stated that the setting of data analysis is undergoing a significant transformation moving from conventional, manually driven software solutions to automated, AI-powered tools. Although traditional tools such as GraphPad Prism and SPSS continue to serve as cornerstones of rigorous scientific analysis, newer AI tools such as Julius AI and Powerdrill AI are emerging. These AI tools are characterized by their ability to provide rapid analysis, offering enhanced speed and efficiency in data analysis and statistical interpretation. The speaker insisted that researchers, whether they use traditional methods or AI tools, must grasp the fundamental principles of statistical analysis, as shown below. It is crucial for them to apply the appropriate statistical tests for their specific research context.

Qualitative (categorical) and quantitative (numerical) variables represent two key types of data used in statistical analysis. Qualitative variables, which include nominal and ordinal data, do not follow a normal distribution and are analysed using nonparametric statistical tests. In contrast, numerical data, such as interval and ratio data, that are normally distributed are analysed using parametric tests; when the data do not meet this criterion, non-parametric tests are employed instead. Shapiro-Wilk test, Kolmogorov-Smirnov test, Anderson-Darling test, and D'Agostino-Pearson omnibus tests are commonly used to determine the normal distribution of data. Student's *t*-test is used to compare the means of two normally distributed groups, which may be either paired or unpaired. On the other hand, the Wilcoxon signed-rank test is used to compare two dependent (paired) groups, whereas the Mann-Whitney U test is used to compare two independent (unpaired) groups that are not normally distributed. To compare means across three or more independent groups, one-way Analysis of Variance (ANOVA) is applied, which is specifically designed for unmatched groups with a normal distribution. Repeated applications of the *t*-test for multiple pairwise comparisons increase the risk of type I error, which is the chance of falsely concluding that a significant difference exists (false positive). Repeated measures ANOVA is used to analyse the means of matched groups with more than two observations from the same subjects over time. Statistically significant differences between group means are indicated by a *p* value less than 0.05, prompting the use of *post hoc* tests for pairwise comparisons of group means. Among the common *post hoc* tests are Tukey's multiple comparisons test and the Bonferroni correction test, which are employed following significant differences in either one-way or repeated measures ANOVA. Analyses such as two-way or three-way ANOVA can be conducted to account for two or three independent variables, respectively.

For data that do not follow a normal distribution or are ordinal, the Kruskal-Wallis test is a nonparametric alternative to one-way ANOVA for comparing three or more independent groups. The

Friedman test, likewise, is a nonparametric method used to detect differences among multiple matched groups or repeated-measures data, functioning as a substitute for repeated-measures ANOVA and is suited for ordinal or nonnormally distributed data across three or more matched groups. Finally, to determine specific differences between pairs following significant results from the Kruskal-Wallis or Friedman tests, Dunn's *post hoc* test is typically applied. Categorical nominal unmatched variables, typically represented by counts or frequencies, are analysed through the Chi-square test. Readers are advised to consult a recent publication by our team on statistical data analysis, which discusses several experimental situations and conditions (Balakumar *et al.*, 2026).

Finally, the session concluded by emphasizing that the findings must be shared with the academic community through publication in an indexed journal, ensuring that the contributions to the field are recognized and widely disseminated. Each of these steps underscores the importance of a structured approach to research, highlighting that methodical planning is crucial for successful scientific investigation.

Ethical Use of AI in Scientific Publishing: What You Need to Know

In the post-lunch presentation, Prof. Shubhada Nagarkar (Department of Library and Information Science, Centre for Publication Ethics, Savitribai Phule Pune University, Pune, India) addressed another important topic: publication ethics and the ethical use of AI in scientific publishing. Recent reports from Retraction Watch, including the article "Research integrity conference hit with AI-generated abstracts," highlight growing concerns about the overuse and misuse of AI in scholarly research (<https://retractionwatch.com/2025/11/18/research-integrity-conference-hit-with-ai-generated-abstracts/>). An increasing number of publications have been retracted because of hallucinated citations, plagiarism, paper-mill-generated manuscripts, and authorship misconduct, many of which are now linked to inappropriate or undisclosed use of AI tools.

Prof. Nagarkar's attentive presentation provided an overview of AI use across different stages of the research life cycle, with a particular focus on unethical practices during both the conduct of research and the preparation of research manuscripts. Using selected examples of retracted papers, the talk illustrated how the misuse of AI tools can compromise research integrity. It also discussed practical do's and don'ts for responsible AI use, informed by journal, publisher, and institutional AI usage policies, emphasizing transparency, disclosure, and researcher accountability.

In addition, commonly used protocols and indicators for identifying AI-generated text are discussed, highlighting their relevance for researchers, reviewers, and editors at different stages of the research life cycle. According to the Retraction Watch database, more than 64,000 papers have been retracted globally

(<https://retractionwatch.com/>). Although retractions explicitly attributed to AI-related issues remain relatively small in number, they represent the fastest-growing category since 2022. To provide a structured understanding of integrity risks, the session presented a stage-wise framework (Table 1) that maps unethical uses of AI across the research life cycle, enabling participants to identify critical points of intervention.

Thus, extensive use of AI at different stages of research leads to (i) hallucinated contents and fabricated citations; (ii) manipulation of data, images, or experimental outputs; (iii) fake peer reviewers or superficial review reports; (iv) inappropriate authorship claims and misrepresentation of intellectual contribution; and (v) dissemination of misinformation.

Another key component of Dr. Nagarkar's presentation is a framework for identifying AI-generated content. The first dimension, textual integrity, focuses on linguistic and stylistic indicators such as repetitive phrasing, overly generic or polished language, semantic inconsistencies, and "tortured phrases." The second, bibliographic integrity, involves verifying references, including checks for non-existent phantom references, incorrect DOIs, and inconsistent citation patterns. Third, scientific validity, examines the credibility of the research itself, including the availability of raw data, reproducibility of results, statistical soundness, and alignment between methodology and conclusions. The speaker emphasized that existing AI detection tools are probabilistic and should not be relied upon completely. Effective identification of AI-related misconduct requires expert judgment, domain knowledge, and systematic verification practices. The presentation also addressed emerging regulatory and ethical frameworks, including guidelines from the International Committee of Medical Journal Editors (ICMJE) and the Committee on Publication Ethics, which emphasize transparency, the disclosure of AI use, and human accountability in scholarly publishing. These frameworks reinforce that AI tools cannot be recognized as authors and that responsibility for

the integrity of research outputs remains entirely with human researchers. Overall, the session presented a comprehensive approach to identifying and mitigating AI-related integrity risks in research. It underscored the importance of adhering to ethical standards in research and publications, emphasizing those responsibilities lie with individual researchers.

Research that Matters in the AI Era: Moving from Degree-Oriented Research to Problem-Oriented Research

The next session was delivered by Dr. Saravanan Pandiaraj (King Saud University, Saudi Arabia) on the above topic. In his presentation, Dr. Pandiaraj suggested that academic research today operates within a structured framework of degrees, deadlines, and publication metrics. While this framework ensures standardization and scholarly consistency, it often unintentionally promotes degree-oriented research practices, in which topic selection, methodology, and outcomes are driven by academic completion rather than by solving meaningful real-world problems. The presentation advocated a paradigm shift toward problem-oriented research, positioning research as a tool for innovation, societal impact, and long-term knowledge creation.

The session critically analysed how conventional research workflows, characterized by convenience-based methodology selection, descriptive literature reviews, and publication-centric goals, can limit originality and real-world relevance. In contrast, problem-oriented research begins with real-world challenges and transforms them into well-defined research questions, supported by robust methodological design and analytical consistency. For undergraduate, postgraduate, and doctoral researchers, the presentation emphasized the early development of problem-identification skills, the critical reading of literature to identify unresolved questions, and the alignment of objectives, data, and outcomes. For advanced researchers, the discussion extended to methodological depth, interdisciplinary integration,

Table 1: Unethical use of AI across the research life cycle.

Stage of the Research Life Cycle	Examples of Unethical Use of AI
Idea generation and hypothesis development	AI-generated research ideas or hypotheses presented without intellectual ownership or critical evaluation through literature.
Literature review	Fabricated or hallucinated references, phantom references, grey references, or incorrect or misleading references generated by AI.
Study design and data generation	AI-generated or manipulated data, images, or experimental outputs presented as real.
Data analysis and interpretation	AI-produced statistical analyses or interpretations used without validation, transparency, or reproducibility.
Manuscript writing	Undisclosed AI-generated text, fully AI-written manuscripts, and automated paraphrasing to evade plagiarism.
Peer review process	AI-generated fake reviewer identities, and AI-written peer-review reports.
Publication, and post-publication activities	AI-enabled paper mills are producing large volumes of fabricated or low-quality manuscripts.

ethical research design, and contributions beyond incremental novelty. Across all academic levels, the importance of research integrity, transparency, and responsible authorship was underscored during the presentation.

The speaker further emphasized that literature should serve as an analytical framework rather than a repository of summaries and that methodology must be selected based on problem complexity rather than availability or convenience. Participants were introduced to practical strategies for reframing research questions, strengthening methodological justification, and evaluating research success through impact, applicability, and knowledge advancement alongside traditional publication outcomes. By fostering a problem-oriented mindset, this session inspired students, researchers, and faculty supervisors to move beyond research as a formal academic requirement and toward research as a purposeful intellectual pursuit. The presentation ultimately positioned impactful research as the intersection of methodological consistency, ethical responsibility, and societal relevance, encouraging participants at all academic levels to contribute knowledge that extends beyond degrees and journals into meaningful real-world application.

Integrated ICT Tools for Scholarly Research: From Literature Mapping to Data Visualization and Publishing

The last presentation was delivered by Dr. P. Ilangovan (Deputy Director-IQAC, PMIST, India) on the aforementioned topic of contemporary interest. The growth of AI and its ability to integrate with Information and Communication Technology (ICT) tools have crucially changed the background of scholarly research. Traditional research tools from literature review to data visualization are being transformed and replaced by AI. The presentation offered a comprehensive approach to how AI and integrated ICT tools support scholarly research, from literature search and data visualization to indexed publishing for researchers, scholars, and undergraduate and postgraduate students. The key phases of the academic research life cycle are shown in Figure 2.

The speaker presented commonly used top-performing AI tools based on their utilization. The initial phases of research start with problem identification, literature search and review, identification of research gaps, and framing of research questions. These tasks can be facilitated using AI tools such as Consensus, Elicit, Research Rabbit, Connected Papers, and Semantic Scholar, which help to explore the areas and interdisciplinary research opportunities. The next phase is experiment, data collection and handling, using AI-assisted platforms such as Google Forms, REDCap, RapidMiner, and NotebookLM. AI-driven tools will perform data preprocessing removing noisy and null data and making the data ready to identify insights and patterns. The pre-processed data are ready for analysis and visualization using tools such as Copilot for Power BI, Tableau AI, and KNIME. These tools enhance the data and find the insightful information hidden in the data and create communicating dashboards for visualization and generate reports in easy understanding formats. The next step is the documentation phase, in which AI assistants such as Grammarly and Writefull, among others, help draft the manuscript and check its grammar and academic refinement. The similarity index and plagiarism in the document are checked using AI-enabled plagiarism-checking tools such as Turnitin and iThenticate. This helps researchers prepare quality manuscripts for moving toward quality-indexed publications.

Taken together, publishing papers is vital for academic careers as it facilitates the dissemination of research findings and significantly contributes to career advancement, academic recognition, and research funding. A strong portfolio of publications establishes expertise in a field, supports funding applications, and enables access to research grants. Furthermore, the societal impact of research papers and advancements through patents are critical for the global ranking of institutions.

CONCLUSION

Institutions play a crucial role in creating an environment conducive to research, which is fundamental to distinguishing themselves in the competitive academic arena. Such an atmosphere not only attracts top talent but also improves the

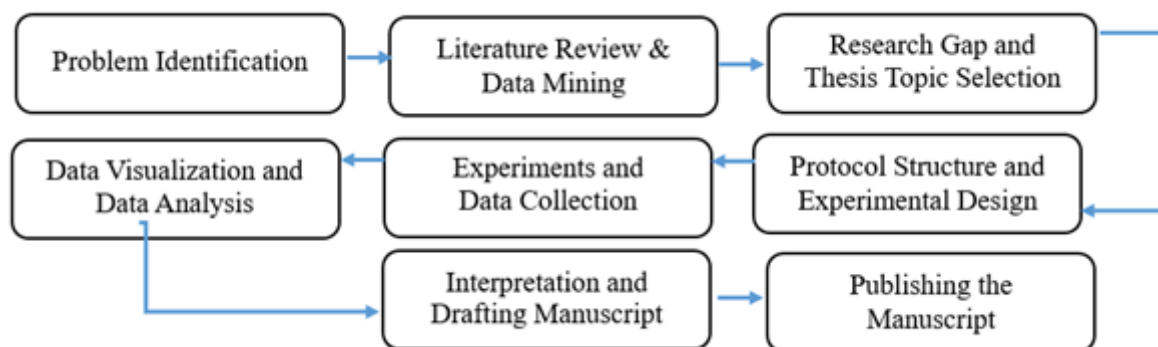


Figure 2: Key phases of the research life cycle.

quality and impact of innovative research outputs. The synergy between researchers and their institutions yields mutual benefits: researchers benefit from access to resources, support and recognition as experts, while institutions enhance their national and global reputations and contribute to the advancement of knowledge. Therefore, cultivating a research environment is crucial for on-going growth and institutional excellence. The participants suggested that such events should be held more frequently and last two days to provide ample time for practical, hands-on training across various sessions. A significant number of attendees expressed interest in attending similar symposia in the future. Recommended sources for further reading and understanding are listed in this symposium report, providing valuable resources for those seeking to deepen their knowledge of the topics discussed (Balakumar and Jagadeesh, 2012; Balakumar *et al.*, 2013; Balakumar *et al.*, 2024; Balakumar *et al.*, 2024; Balakumar *et al.*, 2026; Saunders *et al.*, 2009; Jagadeesh *et al.*, 2023).

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CONFLICT OF INTEREST

The authors declare that there is no Conflict of interest.

ABBREVIATIONS:

AI: Artificial Intelligence; **ML:** Machine Learning; **FDA:** Food and Drug Administration; **ICT:** Information and Communication Technology; **ANOVA:** Analysis of Variance; **SPSS:** Statistical Package for the Social Sciences; **ICMJE:** International Committee of Medical Journal Editors.

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