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quality higher education for all

Guidance Document

GOOD ACADEMIC RESEARCH PRACTICES

September 2020



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Guidance Document
**GOOD ACADEMIC
RESEARCH PRACTICES**

September 2020

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Message from the Chairman

I am delighted to present the Guidance Document on Good Academic Research Practices (GARP). This document gives information on good practices across the research lifecycle for quality, impactful, and ethical research.

It is important to conduct quality research with integrity and focus on publishing the outcomes in high-quality journals. This will help in raising the benchmarks of research performance and enhancing the reputation of individuals, institutions, and the country. The University Grants Commission (UGC) is committed to raising the standards of research at institutions of higher education in India. This document reiterates the values underlying research integrity to help create a culture of responsible and quality research in the academic and research community. It offers practical checklists at each step of the

research, which will act as good ready references for the audience. This compilation also covers guidance from several internationally and nationally recognized model documents on best practices and frameworks of research. The guidance will help prepare the Indian academic research community to be at par with international benchmarks for research quality, integrity, and excellence.

I congratulate the Vice Chairman, UGC, the knowledge partner Clarivate, and the expert group committee members who have worked tirelessly to conceptualize and compile this document.

I hope the academic and research community will find the GARP document helpful to guide them towards quality and ethical research.

Prof. D. P. Singh
Chairman, UGC



Knowledge Partner



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organizations across the world, rely on the Web of Science to inform and guide research support, execution, evaluation, and planning decisions at a global, national, institutional, and individual level.

Clarivate has contributed to this report by supporting the literature review and compilation activities of the existing guidelines, and providing other inputs arising from Clarivate's experience and expertise as a trusted publisher-neutral provider of research solutions to the academic and research community worldwide.

It is hereby disclosed that Clarivate Analytics is a provider of scholarly research solutions including Web of Science, EndNote, Journal Citation Report, and InCites, among others.

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Prof. Rajnish Jain

Secretary

University Grants Commission.

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Summary

Public trust in research and its output is essential for a healthy modern society. Although the research enterprise is self-correcting, this self-regulation occasionally needs help. Over the years, research institutions, professional societies, and govern-

ments have established several protocols, codes of conduct, norms, and principles to enhance that trust in research institutions, funders, producers, publishers, and products.

Values

Although the principal player in the research enterprise remains the researcher, the research enterprise is a dynamic global ecosystem with multiple stakeholders with diverse incentives and interests, which are not always aligned. In spite of the diversity of interests, they have a common stake in research integrity, based on a set of shared values that include ethics, rigour, relevance, transparency, respect, impartiality, and accountability (Edwards and Roy, 2017).

It is incumbent upon the stakeholders and the

institutions to establish and maintain a culture of research integrity. This culture must be supported by robust policies, procedures, and processes together with a governance structure to promote these values and address any transgressions in a timely, fair, and transparent fashion. Research culture is not static; it varies across time and space. It is informed by local traditions and norms, so although this document is based on a set of shared values, these must be interpreted and implemented in accordance with the local context.

Good Research Practice

This document provides a general framework for enhancing research integrity by focusing on potential threats and good practice at each stage in the research cycle. Typically, research misconduct is defined in terms of fabrication, falsification, or plagiarism. However, malfeasance manifests itself in multiple forms and can occur at any stage of the research cycle from the initial selection of the research problem, through to the dissemination of the research outputs, to fellow researchers, decision-makers, and the public at large.

Research Design:

Good research practice begins with problem selection and research design. The proposed research should address questions, the answers to which will contribute new knowledge, solve challenges, correct errors in the existing literature, or develop new methods for conducting such research. A good research design involves having a well-documented plan outlining the objectives, roles, and responsibilities. Research builds upon the work of others, who must be

properly identified, and their contributions appropriately acknowledged. A good literature review helps do that. It locates the proposed research in the broader research landscape, provides insights into identifying data sources and research methods, and lays out a rigorous and systematic approach to analysing and synthesizing the evidence to support the research claims.

Conducting Research:

Good documentation in the form of laboratory notes, research journals, or field notes is valuable for keeping track of one's research progress. This record of the processes and procedures, including information on data sources, their quality, storage, and retrieval is not only necessary to document proper research practice but also to address questions should concerns be expressed about potential misconduct or veracity of results. It is the researchers' responsibility to avoid plagiarism, falsification, fabrication, or misrepresentation, and to report such misdemeanours if they are observed or suspected. Research integrity is also enhanced by conducting the research in a systematic and methodologically rigorous fashion and carefully drawing conclusions that can be traced to the research.

To minimize the potential for any conflicts, agreements regarding roles and responsibilities, authorship, ownership of intellectual property and other arrangements, especially in collaborative research, must be clarified at the outset.

Dissemination:

It is the researchers' responsibility to disseminate the research in full. It should be peer-

reviewed and published in high-quality forums, especially in the current scenario, with the proliferation of predatory journals. Contributions of all collaborators, funders, reviewers, and others who have directly or indirectly supported the research must be appropriately acknowledged.

Research Management and Training:

An Office of Research Integrity (ORI) can provide institutional support and structure for creating and sustaining a culture of honesty and ethical research practice. Although, research integrity and ethical practice are based on universal values, the context matters. Each ORI should develop guidelines, processes, and procedures for dealing with suspected and actual research misconduct. Penalties for misconduct must be clear and well-advertised; misconduct should be addressed promptly and transparently with tact and fairness. Institution-wide research management systems can effectively manage, track, and report on research activities and outcomes.

Supervising research and mentoring junior scholars and students is an important role for senior researchers. The ORI has the responsibility of raising awareness about the conduct of research and providing training for research supervisors and their students.

Research integrity is vital for science to thrive. The values articulated here can form a sound foundation for a research culture that emphasizes integrity in the daily practice of every researcher.



1

Introduction

The integrity of the research enterprise rests on honesty and trust (OECD, 2015). According to the US National Institutes of Health, (Grants.nih.gov., 2018), "Research integrity includes:

- ▶ Use of honest and verifiable methods in proposing, performing, and evaluating research.
- ▶ Reporting research results with particular attention to adherence to rules, regulations, and guidelines.
- ▶ Following commonly accepted professional codes or norms."

Research is, by and large, a self-regulating and self-policing process wherein researchers conduct and present their research without falsification and fabrication, giving credit to other scholars for their ideas when and where such credit is due. However, research also has aspects of competition, including an emphasis on priority claims. Prestige has become associated with research excellence and high achievement; it has become a high-value undertaking in which intellectual success frequently leads to commercial success (Stephan, 2012).

It is critical for the advance of scientific research that the research community pursues novel, influential, and relevant research. Research quality, benefits, and integrity are highly interdependent. Therefore, while maintaining high research quality is vital, it is equally important that research is conducted in a culture that supports honesty and integrity to ensure the highest standards of ethical practice and behaviour.

There is ever-increasing pressure to demonstrate societal or economic impact of science coupled with the potential for monetary gain. To seek even the smallest advantage, the temptation to come close to, and perhaps cross, ethical boundaries is very strong. Given the high stakes, there is concern about the stability of the ethical foundations and integrity of the research enterprise. Wellcome conducted a voluntary survey of respondents from all over the world, but mainly from the UK. The findings (Wellcome Trust Research Culture Report, 2020) indicated that researchers felt intense pressure to publish, with scant value placed on how the results were achieved.

This problem of scholarly wrongdoing is



compounded by the recent rapid increase in the number of research publications in journals of dubious quality. Research publications across the world have grown at a compounded annual growth rate of approximately three percent over the past two centuries (Johnson, et al., 2018:5). This growth in research output has also been accompanied by a rise in poor-quality and predatory journals, and lapses in ethical research practice (Eykens, et al., 2019). Two percent of the scientists who were surveyed admitted to having falsified, fabricated, or modified data (Fanelli, 2009). Retraction Watch, along with other similar organizations (Oransky, 2020; WAME, 2020), aim to, "Promote transparency and integrity in science and scientific publishing, and to disseminate best practices and increase efficiency in science." They maintain, "A database of retractions, expressions of concern and related publishing events" from all over the world, identifying well-placed and highly-regarded researchers who have falsified or fabricated data, journals that have retracted publications because of bad peer review practices, and funders that have stripped researchers of their current funding or barred them from seeking future research support (Fang, et al., 2012). It is important to note however, that retractions are often acts of "genuine self-correction and transparency", which serve a valuable purpose in maintaining the integrity of the scholarly record (Quan-Hoang, 2020).

Research misconduct is not uncommon (Brainard and You, 2018). On the one hand, the ability to electronically scan documents and with the advances in machine learning and text analysis, some aspects of research misconduct such as plagiarism are becoming easier to identify and potentially curtail. But

on the other hand, misconduct such as data fabrication, falsification of results, mishandling of research subjects, and conflicts of interest remain much more difficult to detect and police.

Researchers, funders, publishers, research administrators, and other stakeholders in the research ecosystem have to play a prominent role in this context. It is incumbent upon them to have clear and unambiguous policies and procedures for ensuring good research practices. It is equally important to have a governance structure to ensure that violations of good practice are addressed in a fair, timely, consistent, and transparent fashion.

Recently, several efforts have been made to explicitly define the various components of research integrity and ethical practice (See Appendix 1). Research organizations, including universities, have developed their own guidelines for the ethical conduct of research. Good research practice is not a mystery, what is lacking is a culture supported by a sound governance structure to ensure that research misconduct is rare. However, procedures and processes to address the violations fairly, promptly, and effectively, if and when such misconduct occurs, are lacking.

To address such concerns and to promote academic integrity and publication ethics in Indian universities, the University Grants Commission (UGC) created the Consortium for Research Ethics (CARE) on November 28, 2018. (UGC Public Notice, 2019). Further, UGC constituted an Expert Group on Good Academic Research Practices chaired by Professor Rakesh Bhatnagar, Vice Chancellor, Banaras Hindu University to study this topic and to offer recommendations about policies

and procedures regarding integrity in the conduct, production, and dissemination of academic research. This document reflects recommendations from such experts and from similar efforts across the globe.

The focus of this document is on developing and sustaining research integrity within an ethical research culture. While this framework must be operationalized locally, this document offers recommendations for institutions to consider for successfully enhancing a culture of research integrity. In particular, institutions can:

- ▶ Create an ORI as the organizational entity responsible for the implementation of these guidelines at each institution.

- ▶ Develop materials for training on research integrity, ethical behaviour, and good research practices. This training will provide the substantive knowledge, skills, and competencies for a researcher with regard to research integrity and ethics. The core content of the such training should be mandatory with additional training materials reflecting the local context being designed simultaneously and delivered at the discretion of each ORI.

2

Values Underlying Research Integrity

The Office of Research Integrity, ORI, must promote the following values in the conduct and management of research:

- ▶ **Ethics:** Research is conducted in an ethical manner ensuring dignity, rights, safety, and privacy within the researcher ecosystem.
 - ▶ **Rigour:** Research ensures high quality design, reliable data, the appropriate use of methods, rigorous and careful analysis, and transparent reporting and interpretation of the results.
 - ▶ **Relevance:** In the endeavour of expanding the knowledge-base and understanding the environment and ecosystem, research advances the short-and long-term goals of science and society.
 - ▶ **Transparency:** Honesty is promoted through transparency in developing, undertaking, reviewing, reporting, and communicating research in a fair, comprehensive, and unbiased fashion (All European Academies, 2017).
 - ▶ **Respect:** The process of research is aligned with the norms and traditions of society and its cultural heritage, with respect for colleagues, research participants, and the environment.
 - ▶ **Impartiality:** Objectivity and lack of bias are the core principles of research.
- Researchers should avoid conflicts of interest in setting research priorities, establishing research collaborations, choosing research questions, and interpreting and assessing the implications of the research results.
- ▶ **Independence:** Research functions must be insulated from both the appearance and the reality of undue influence of funders or other non-researchers with a stake in the outcome of the research. To promote objectivity, researchers should be allowed independence in the design, conduct, analysis, interpretation, and dissemination of the research and research findings.
 - ▶ **Accountability:** Research will comply with both the spirit and the letter of relevant rules and procedures such as regulations governing professional standards. The ORI will publish and make readily accessible such rules, roles, and procedures that will ensure that instances of alleged misconduct or malfeasance are rare. If and when they occur, they are effectively and promptly addressed in a fair and timely fashion with sensitivity towards the rights of all concerned.

Integrity in research implies that these values permeate every aspect and are upheld by all involved in the research enterprise.

3

Framework for Good Academic Research Practices

To operationalize the above values, this document develops a multi-part framework, built around the research cycle, to guide researchers and institutions in achieving research integrity and ethical behaviour.

The purpose of this framework is to encourage discussion and debate about ethical research practice and not merely to provide a set of rules that must be adhered to without

reflection. This framework is meant to be the beginning of a living document that must be interpreted and applied within the specific context of each research institution. The framework focuses on three stages of the research life cycle:

- 1. Research Design**
- 2. Conduct of Research**
- 3. Research Dissemination**

3.1 Research Design

3.1.1 Planning

Responsible conduct of research begins at the planning stage. The choice of research questions and rationale is a critical starting point. The creation of new knowledge and translation are important outcomes of research. While translation of research comes at a later stage, researchers should proactively think about the downstream impact. Does the project potentially have positive outcomes for society, industry, country, or the ecosystem in general? The Impacting Research, Innovation and Technology (IMPRINT) initiative of the

Ministry of Human Resource Development (MHRD), for example, lists major science and engineering challenges that may be addressed by researchers. Similarly, the United Nations Sustainability Development Goals (SDG) are another example where researchers can contribute towards creating a sustainable future.

Once an initial objective is identified, it is imperative that researchers are familiar with the state-of-art in their domain and undertake projects that meet their objectives, keeping in mind potential unintended nega-

tive consequence of the proposed activities. Researchers should assess the feasibility of the study given resources in terms of expertise, facilities, funding, equipment, and other support.

Although the outcomes of research cannot be planned or perceived in advance, it is possible to have a well-documented plan in place outlining the objectives, roles, and responsibilities. Researchers must have appropriate data management systems in place with detailed and easily traceable records for outcomes and milestones, systematic and rigorous analysis, any ethical and regulatory

approvals keeping in mind that they might need adjustment as conditions change in the future. All appropriate licenses, participant consents, and requisite permissions should be secured before starting the research. Researchers should ensure they are abreast of all the relevant regulatory and governance requirements.

Research organizations should support researchers with an appropriate research governance system within a sound research and project management framework (WHO, 2020).



Checklist for planning research

- ▶ Describe the research objectives and rationale
- ▶ Develop a project plan with milestones, roles, and responsibilities
- ▶ Ensure the viability of the study in view of resources expertise, facilities, funding
- ▶ Keep abreast with the relevant regulatory, ethical, organizational, and other guidelines
- ▶ Seek requisite licenses, approvals and permissions in advance

3.1.2 Research Questions and Documentation

Any research activity starts with a research question. A good research question should be:

- ▶ **Clear:** with sufficient specificity so that it is readily understood.
- ▶ **Focused:** to ensure feasibility given the available resources and time frame.
- ▶ **Concise:** brief but comprehensive.
- ▶ **Nuanced:** with a research design that matches the complexity of the problem being addressed.
- ▶ **Logical:** to ensure that the available evidence supports the research claims.

The sound formulation of the research question requires:

- ▶ Consultation with experts.
- ▶ An understanding of relevant theories and the available data and records.
- ▶ An understanding of the relevant literature.

Detailed journaling, record-keeping, and documentation are an integral part of the research process. They not only help the researcher to keep track of the process but also serve as a historical record that can be

referred to long after the details are forgotten. Detailed plans are particularly useful for helping newly-minted researchers understand what is to be done and to describe to potential funders the nature of the research approach and its feasibility. This planning also helps prepare for implementation. Careful planning and documentation also create an evidentiary trail that can be referred to in case of a dispute regarding the importance and timing of a researcher's contributions to a scientific discovery.

3.1.3 Literature Review

Describing the research questions and locating them properly in the existing literature are important aspects of research planning. A literature review involves searching and compiling the literature available on a specific topic. A meaningful literature review, however, is much more than a collection of summaries of papers or an annotated bibliography of research manuscripts. It involves using the ideas in the literature to ensure an understanding of earlier research, their methodological approach, and contributions. A literature review also serves the important function of preventing the duplication of research and redundant publication (Martyn, 1964; Garfield, 1993).

The essential steps in a literature review involve:

- ▶ Framing research question in terms of the existing literature.
- ▶ Consulting relevant databases and texts for the search.
- ▶ Listing relevant keywords and phrases, as well as known key references.
- ▶ Ensuring search results are easily retrievable and traceable.
- ▶ Revising the original research question, if necessary.

Researchers must carefully ensure that they rely only on high quality and reliable sources. Before incorporating search results in a review, it is essential to evaluate each reference for accuracy, authority, objectivity, currency, and coverage (Goundar, 2012).



Checklist for information for scientific literature review

- ▶ Is the information reliable?
- ▶ Is the information error-free?
- ▶ Is the information factual?
- ▶ Is the information verifiable?
- ▶ What are the professional credentials of the author(s)?
- ▶ Does the author have the subject matter expertise on the topic?
- ▶ Is the information relevant?
- ▶ Is a clear distinction made between facts and opinions?
- ▶ Is the information biased?
- ▶ Is the information current?
- ▶ Does the information meet current needs?
- ▶ Does the information provide in-depth coverage?

Citation analysis is a powerful approach for selecting articles for literature reviews. It can help quickly identify authors and research articles with substantial research citation impact. Citations analyses also help to identify research that other scholars have found useful and have cited in their own work. Citation and co-citation analyses can further assist in identifying articles and scholars that have been particularly influential in the field. Such an approach is particularly useful for junior scholars who are not fully conversant with the full breadth and depth of the literature and journal quality.

Literature reviews must be thorough. One way of ensuring proper coverage is using the relevant keywords and phrases. To avoid the restrictions imposed by keyword-based semantic searches, citation-based searches are useful. Citation searches that operate on the premise that two conceptually-related articles will share several references, often reveal hidden connections.

Conducting a literature review is usually recursive. Reviewing previous research should lead to further lines of enquiry and take the

researcher to relevant literature and so on. This process should help the researcher to refine the search to most relevant sources. Suggestions in the literature for future research are often a good source of ideas and novel formulations of research questions.

It is not easy to critically and objectively analyse scientific literature. A senior researcher can guide the junior scholar to fully understand the multiple paths that have led to the current research landscape, the underlying arguments supporting contemporary understanding, and the strengths and weakness of the methods and data used to support or question those arguments.

In describing the current research landscape, the literature review serves a dual purpose:

- ▶ Informs the reader of what the reviewer considers to be the relevant antecedents and how they inform the proposed research.
- ▶ Provides an assessment of that work by pointing to the strengths and weakness of the preceding literature as perceived by the researcher writing the review.

3.1.4 Data, Research Methods, and Analytical Approach

Once the research questions have been clarified, contextualized, and located within the existing literature, evidence must be obtained to support or refute the research claims. Typically, this evidence is presented through data.

A sound, systematic, and rigorous research practice depends upon the underlying ontological, epistemological, and methodological assumptions. Hence, the method used to systematically address research problems vary by discipline, the ontological and epistemological assumptions, and traditions (Kaplan, 1964). These assumptions and the underlying logic define the various steps that are generally adopted by researchers (Zimring, 2019).

Thus, once the research question has been defined, the researcher should prepare a research design, which serves as the foundation and scope of the research project. Preparing the research design usually involves accounting for availability of resources, skills and time.

Choosing the appropriate research methods is a crucial decision. The methods vary depending upon the type of research questions, the sources and nature of the data and the purpose of the research (Outhwaite and Turner, 2007). Primary data sources are where the researcher collects the data for the purposes of the research; secondary data are those that already exist and could contain information that might shed light on the research questions. Primary data are often obtained from experiments, surveys, focus groups, interviews, case studies, and other sources. Field research often involves detailed observation, document review and

analyses of natural phenomena, human artifacts, and objects as well as behaviours and action.

The chosen research method needs to be further detailed out. Researchers must also define the target population to collect data from and the sampling strategy to be employed for choosing a sample from the target population (Bhattacharjee, 2012). The statistical technique for analysing the data also needs to be defined, based on the research question and the data collected.

The methods employed to analyse, synthesize, interpret, and make sense of such data vary just as much as the sources and nature of the data. For instance, experiments are quite common in natural and physical sciences and in engineering, however, conducting reliable and robust experiments in the social sciences is not always feasible. The prevalent model of the “scientific method” of reducing research problems into manageable sub-problems that has been so successful in advancing research in the physical and natural sciences and engineering does not always transfer effectively to addressing research problems in the social sciences and the humanities (Bhattacharjee, 2012; Donovan and Hoover, 2013; Latour and Woolgar, 1979). Social science research tends to leverage theory-building wherein a researcher observes events, establishes the relationships between events and associated factors influencing the events, locates the common factor, verifies the explanation in various contexts to generalize the explanation and finally, confirms the explanation as a theory. Theory-building is perhaps the most difficult aspect of social science research because of the

complexity of human systems in terms of the dynamic interdependencies and interactions among the underlying causes and effects. The role of feedback and emergence in these systems makes it difficult to develop theories that are generalizable across time and space (Burrell and Morgan, 2017).

Careful data collection, the systematic use of rigorous methods, and the proper interpretation of the findings are essential aspects of research integrity. Through social media and other forms of data on how people lead their daily lives, social scientists now have access to data on almost every form of human behaviour and action. This abundance of data makes it important to ensure privacy and ethical use of data.

Systematic, rigorous analysis is essential for producing consistent, reliable results. Over the last few decades a lot of attention has been focused on the replicability and reproducibility of research (Replicability-Index, 2020). For instance, the work on replicability and reproducibility of social and behavioural science research has its origins in Jacob Cohen's path-breaking work in psychology (Cohen, 1962). Following appropriate data analytic procedures ensures confidence in the results and the ability of other researchers to replicate and reproduce the results.



A discussion of the full range of available methods is beyond the scope of this document, however, it is important to keep the following questions in mind:

- ▶ Is the choice of research techniques defensible, for instance, supported by the existing literature?
- ▶ Is the selected method appropriate for the discipline and nature of data?
- ▶ Are the selected methods appropriate for answering the research questions?
- ▶ Will the results obtained by the selected methods be reproducible?
- ▶ Do the selected methods lead to results that can be easily and uniformly interpreted?

Interpretation of results should be confined to what the data and the analytical methods can support. Ethical research practice requires that the research findings be accompa-

nied by an assessment of the sources, nature, and magnitude of potential errors and a frank discussion of the limits of the data and the analysis.

3.2 Conducting Research

3.2.1 Research Execution, Documentation, and Data Storage

Robustness of the research results depends on thorough research execution, systematic documentation, and data quality. Careful collection of data is necessary not only for ensuring the quality of the results but also for maintaining records of collection methodology. These records are essential for judging data quality and for ensuring that future researchers can replicate the results.

Proper data management has been enhanced by the increased computing power and the almost negligible cost of storage. The “open data” movement is part of a wider open science effort to make research outputs more robust and reproducible. Scholarly

journals facilitate in enhancing research integrity. They ask their authors to submit research data and make them available for other scholars to use who can replicate the analyses and build upon earlier research without having to incur the cost of obtaining their own data. This ability to replicate analyses also gives the opportunity to correct errors and honest mistakes and detect potential ethical and moral oversights in the published research.

Guidelines (Pharmaceutical Inspection Convention (PIC): Data Integrity Guidance, 2016) for data collection are provided:



Checklist for data collection

- ▶ What data were collected and when were they recorded?
- ▶ Did the research involve an experiment?
- ▶ Were the data collected at different levels of analysis?
- ▶ Were the data on the population or a sub-sample?
- ▶ If a subset of the population was used, what were the sampling procedures?
- ▶ Was the sample set representative of the study population?
- ▶ Did the study design match the purpose, for instance, theory development or theory testing?
- ▶ How was data integrity ensured?
- ▶ Was the data-cleansing process properly documented?
- ▶ What were the specific rules used for defining, identifying, and handling outliers?
- ▶ Were data transformations satisfactorily documented and justified?
- ▶ Were the inferences from the data verified and validated?
- ▶ Were the computational procedures and platforms properly documented?
- ▶ Were sufficient metadata and annotations added in the data files to ensure meaningful interpretations?
- ▶ Were data privacy issues efficiently addressed?

Research data and related files need to be stored securely during all phases of the research process. A researcher needs to ensure:

- ▶ Clear data ownership and accountability.
- ▶ Access restrictions with appropriate protocols to ensure safety and privacy.
- ▶ Data integrity by using a copy of the original data.
- ▶ Careful and reliable data collection, storage, and retrieval.

- ▶ Data integrity and security through periodic back-ups and redundant storage in multiple media.
- ▶ Requirements from funders and other stakeholders with respect to data storage and sharing.
- ▶ Appropriate rules for data archiving, storage and retrieval, including the length of time for which the data would be preserved. Data that cannot be easily reproduced should probably be retained indefinitely.

3.2.2 Checks for Plagiarism, Falsification, Fabrication, and Misrepresentation

According to the US Office of Science and Technology Policy, "Research misconduct is defined as fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results" (Federal Research Misconduct Policy, 2000). The terms fabrication, falsification, and plagiarism are defined as:

- ▶ **"Fabrication:** Making up data or results.
- ▶ **Falsification:** Manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record.
- ▶ **Plagiarism:** The appropriation of another person's ideas, processes, results, or words without giving appropriate credit (The Office of Research Integrity, 2020a). Research misconduct does not include inadvertent errors or differences of opinion; however, generally accepted standards play a major role in describing

significant departures from accepted practices. "Knowingly, intentionally, or recklessly" departing from standard practice can be grounds for allegations of misconduct."

There are several ways in which researchers knowingly, intentionally, or recklessly misrepresent their data and findings. Given the variety of ways in which research can be misrepresented and the creativity of researchers in doing so, detecting such misconduct is not easy. Research misconduct and bias has become a focus of academic research (Ioannides, 2020) and a subject of study by government agencies (The Office of Research Integrity, 2020a) and private organizations (UK Research Integrity Office, 2020).

Data manipulation and image tampering, such as relabeling axes, distorting a visual representation of data, or using the same image to suggest that it represents results from multiple experiments are just a few

examples of the 'creative' ways in which researchers have misrepresented their research (The Office of Research Integrity, 2020b: Case Summary—Yakkanti Sudhakar). These problems have become more common with the ready access to software, which allows researchers to manipulate pictures of slides and biological specimens in minor ways to imply changes over time or represent multiple observations when in fact they are simply variations of the original picture (Cromey, 2010).

Fanelli et al. (2017) have studied biases in scientific literature and concluded that efforts to enhance research integrity are focusing on the right kinds of biases, but the type of biases and their intensity vary by field and location, suggesting a greater need for focused solutions tailored to meet local needs. The authors suggest that the effort to root out biases "...has to be a grass-roots movement. It has to be something that scientists believe is good for their science to do. Top-down approaches, such as institutions and funding agencies trying to promote best practices, could also help, but it has to be an agreement among all stakeholders. And scientists must believe that such efforts will help the results and their science to be more reliable." (Stanford Medicine News Center, 2017)

Plagiarism is the most common form of scientific misconduct (Martin, 2013). Plagiarism in research entails a researcher using other's material in such a way that it presents a misleading picture of being the researcher's own contribution. Thus, plagiarism can concern various aspects of research and its contents. Chaddah (2014) has discussed three types of plagiarism:

- ▶ Copying text from another author without appropriate permission or attribution and acknowledgement.

- ▶ Copying someone else's research ideas.
- ▶ Redoing other people's research and representing it as one's own without referring to the original work.

The use of automated textual analysis makes detecting plagiarism in the form of copying text relatively easy, but it is more difficult to assess when ideas or results have been appropriated inappropriately. Research often builds past results, ideas, and methods. Because the reward system of science depends on intellectual property claims, it is crucial that researchers assiduously attribute credit for the work of others. To do otherwise violates conventional research norms and constitutes a moral failure (Merton, 1973).

As stated by Horkoff (2015), the following basic practices should be observed:

- ▶ In general, a person using another author's text, data, methods, ideas, results or formulations should identify the author and document the source.
- ▶ All intellectual property, regardless of format, should be appropriately attributed to the original owner.
- ▶ Researchers should neither submit previously published results without proper attribution, nor submit the same manuscript to multiple journals simultaneously.
- ▶ Conference presentations may be regarded as published material and cited appropriately.
- ▶ References to unpublished work of other authors should be identified as a personal communication or directly attributed to the author as an unpublished source.
- ▶ Reviewers must be particularly careful in ensuring that the material under review is treated as confidential until it has been published. Using parts or ideas from materials under review without proper

attribution is not only plagiarism, but is intellectual theft, which places the entire evaluation system at risk.

- ▶ It is common for a researcher to refer to his or her earlier research. Again, when citing

one's own work, it is usually best to treat it in the same way as if one was citing another scholar's work. Neglecting to take such precautions is called self-plagiarism.

3.2.3 Collaboration and Authorship

Research is increasingly a collaborative enterprise (Wuchty, et al., 2007; Adams, 2013). Team science often brings different and complementary perspectives, skills, and competencies to a project. Collaborations, however, add another layer of complexity to research that is not usually present when a researcher is working alone (Parker and Kingori, 2016).

Many of the topics discussed in other sections of this document are relevant to collaboration, particularly those that pertain to: the need for clarity regarding the objectives of the research project; proper and timely documentation; specificity regarding timelines, roles, and responsibilities, especially regarding division of labour; intellectual property; and the allocation of resources and credit. As with any research task, there is considerable uncertainty at the outset, so flexibility is essential with the expectation that the initial commitments governing the collaboration are likely to evolve and crystalize over time. Communication and addressing issues promptly as they arise are important to establishing strong and healthy working relationships.

The ORI of the US Department of Health

and Human Services recommends that "before any work on a collaboration is undertaken, there should be some common understanding of:

- ▶ the goals of the project and anticipated outcomes
- ▶ the role each partner in the collaboration will play
- ▶ how data will be collected, stored, and shared
- ▶ how changes in the research design will be made
- ▶ who will be responsible for drafting publications
- ▶ the criteria that will be used to identify and rank contributing authors
- ▶ who will be responsible for submitting reports and meeting other requirements
- ▶ who will be responsible for or have the authority to speak publicly for the collaboration
- ▶ how intellectual property rights and ownership issues will be resolved
- ▶ how the collaboration can be changed and when it will come to an end." (The Office of Research Integrity, Roles and Relationships, 2020c).

One of the most contentious areas of collaborations is the attribution of credit and authorship of the research report and subsequent research publications and presentations.

There are several prevalent practices for deciding authorships (National Academy of Sciences et al., 1995)— including, but not limited to, authors' names being listed in order of their contributions with authors that have higher contributions being listed first; in order of author's seniority/influence; in alphabetical order, and so on. In some institutions it is customary to include the supervisor's name upfront whereas in some institutions it is either appended at the end of the authors' list or not included at all.

As a best practice for authorship, it is encour-

aged to give priority to the authors in order of their contributions irrespective of seniority. However, there is also the question of a corresponding author. Given that this role involves active correspondence with the journal or reviewers and other researchers, assigning it to a senior researcher may be more appropriate.

Whatever practice is followed, the collaborators are best placed to jointly reach a consensus and decision amongst themselves. It is important to clarify, in advance, the criteria for assessing contributions of the individual researchers and how those criteria will be used to allocate credit. The collaborators should discuss this matter at the onset of the project to ensure clarity and transparency.

3.2.4 Intellectual Property

Research in computer science, engineering, and the life sciences, among other fields, often yields intellectual property of significant commercial value, which can be protected by patents, trademarks, copyrights, and other forms of guarantees. The proper assignment of intellectual property and preservation of these rights takes on addi-

tional importance because of the associated economic value. Assigning intellectual property rights, to the extent possible, to the stakeholders at the start of the project is good research practice. Clarifying these aspects of the research outputs at the outset decreases the likelihood of problems and conflicts arising at later stages of the project.

3.3 Dissemination

3.3.1 Selection of the Right Medium for Publication

Research findings are truly impactful only when publicly shared and communicated. Moreover, researchers earn their property rights by giving away their findings in the

form of publications. Researchers must present all results, including favourable, unfavourable, and null findings. The honest reporting of all findings is essential as a

matter of record and to save time for future researchers, who need not redo the work that has already been done.

An important aspect of research is its dissemination. The primary purpose of dissemination is to inform the larger community of the findings of the research activity so that it becomes a part of the scientific knowledge-base for other scientists to replicate, test, challenge, confirm, and build upon. Often, research findings are of interest to others, such as practitioners, policy- and decision-makers, and the public. Seeking proper outlets and providing the information at an audience-appropriate level of comprehensibility and format become important criteria to ensure that the research reaches the appropriate audience in the correct format at the right time.

Peer-reviewed journals are among the key channels for research dissemination. Researchers often want to reach a broader audience, beyond their academic peers. Commonsense should guide the selection of outlets such as blogs, the popular press, and practitioner journals by focusing on those outlets that are most likely to reach the intended audience. While formats might vary, ethical considerations do not vary regardless of the audience or means of communication.

Unfortunately, in a “publish-or-perish” world, publication can become an objective in its own right, encouraging a market for predatory journals and introducing unethical publication practices. The editorial policies of publishers of reputable journals are the first line of defense in ensuring research quality and integrity. The recent increase in academic

journals with little or no editorial standards to ensure research quality is becoming one of the more flagrant examples of academic misconduct, apart from the commercial exploitation of the research community.

A 'consensus' definition of a predatory journal is, “Predatory journals and publishers are entities that prioritize self-interest at the expense of scholarship and are characterized by false or misleading information, deviation from best editorial and publication practices, a lack of transparency, and/or the use of aggressive and indiscriminate solicitation practices” (Grudniewicz et al., 2019). Researchers should avoid predatory journals both as an outlet for their manuscripts and as cited references in their research. In this context the UGC guidance document “Public Notice on Academic Integrity,” draws specific attention to predatory journals (UGC, 2019).

Some of the typical characteristics of predatory journals are:

- ▶ Guaranteed acceptance of manuscript upon submission
- ▶ No peer-review process
- ▶ Pay and publish, irrespective of quality of manuscript or relevance to journal scope
- ▶ No journal website and/or no clarity on aims and scope of the journal
- ▶ Use of misleading and inaccurate self-generated impact factors
- ▶ No editorial board
- ▶ Publication of obviously poor-quality content and/or content that is clearly outside the stated scope of the journal

Additional guidance on choosing an appropriate journal for publication is provided in section 3.3.2.

3.3.2 Choosing the Right Journal for Publication

Submitting a manuscript to an unsuitable journal is one of the most common mistakes that authors make and one of the major reasons for the rejection of a manuscript. First-time authors or those who are branching out into diverse research areas may be unfamiliar with the journals in the field. On the other hand, seasoned authors, too, tend to publish in the same journals, although new

publication opportunities are constantly arising in the form of online- and open access (OA) publications. As per the Directory of Open Access Journals (DOAJ), "Open access journals are journals that use a funding model that does not charge readers or their institutions for access." (Directory of Open Access Journals, 2020)



Checklist for selecting an appropriate journal

- ▶ Do the aims and scope of the journal match that of the research?
- ▶ Has the journal published articles of similar nature?
- ▶ What is the journal peer review process?
- ▶ Does the journal reach the relevant audience?

Criteria for journal selection

Authors should keep the following criteria in mind when choosing a journal as an outlet for their research:

Do the aims and scope of the journal match those of the research work?

Authors can readily find relevant information on a journal's homepage under sections such as "About the Journal", or "Aims and Scope". Careful review of this information can help determine whether their research might be a good fit for the journal. Scholarly journals are diverse in terms of their content and audience. Their variety can come from several sources, for example, journals vary by their level of specialization, disciplinary focus, and relative emphasis on contributions to theory versus applications of theory. In the natural and physical sciences a distinction is made between a focus on theory versus experiments; in the social sciences a distinction is often made in whether the target audience is academia or practitioners or some combination. It is up to the author to decide on the outlet that best meets the current scholarly requirements.

Has the journal published articles of similar nature?

After short listing journals based on their broad aims and scope, authors should consider a more in-depth search within the journal with keywords from their manuscript to determine whether the journal has published similar work. An indicator of where a manuscript might be submitted is to be found among its own cited references. Journals that are most frequently cited might be good outlets for the work.

What are the journal's submission requirements?

In preparing a manuscript for submission, it is important to review the "Information for Authors". Journals often specify the type of research they publish. Submissions outside the journal's scope are often rejected without review. Journals also provide guidance regarding the length of the article and the limits, if any, on the number of tables and figures. Most OA journals also charge article-processing fees, which might play a role in determining where to submit an article.

What is the journal's intended audience?

International peer-reviewed journals typically tend to have broader readership than regional journals. The latter may tend to publish articles with geographic or local significance (for example, endemic disease research) and may lack international readership. Similarly, details of a niche research topic are more likely to be accepted for publication in specialized journals. On the other hand, OA journals might be accessed by wider audience, leading to increased discoverability since there are no subscription fees associated with accessing them.

Recently, several OA journals have been on the receiving end of increasing criticism over the lack of proper peer review and poor-quality control. A quick check to assess journal quality might be to determine whether a journal is indexed in reputed citation databases. Although, potentially subject to manipulation, the presence of respected scholars on the journal's editorial board is another indicator of journal quality.

What is the journal's impact factor and rank?

The Journal Impact Factor™ (JIF) is the ratio of the number of citations to the journal's articles to the number of total citable articles published in that journal over a fixed period of time. One should also look at the relative standing of a journal in a given subject category based on JIF. The JIF is a journal-level indicator that is one of the many criteria that can be used to determine aspects of journal quality. While there are several journal metrics, the journal "impact factor" invented by Clarivate Analytics in the 1960s, has been one of the oldest reputed publisher-neutral metric trusted by researchers and research organizations worldwide (Clarivate Analytics, 2018).

What is the journal's peer review process?

Peer review process should be independent, rigorous, and unbiased. Authors should assess whether the journal provides: timely and comprehensive review of the manuscript; constructive and valuable comments that enhance quality; information on the number of reviewers involved; an understanding of how closely the editor is involved in the process.

Are there red flags in journal issues?

Diversity of authorship is often a good indicator of journal quality. For instance, the dominance of a small set of authors, or institutions in the journal is a potential red flag. Similarly, an implied promise of publication before submission, immediate acceptance of the articles upon submission or a lack of proper peer review could suggest lack of due diligence and/or improper publication practice. The ORI can develop special training focused on the topic of research publication and dissemination for young scholars and students.

Grey, et al. (2020) provide a checklist to promote publication integrity to pre-empt misconduct. The authors write, "the Committee on Publication Ethics (COPE) advises publishers to retract articles when there is 'clear evidence that the findings are unreliable,' but does not advise on how to determine whether that is the case. Their 'REAPPRAISED' checklist consists of the following items: Research governance, Ethics, Authorship, Productivity, Plagiarism, Research Conduct, Analysis and Methods, Image manipulation, Statistics and data, Errors and data duplication and reporting. The use of this checklist, can help to speed up the identification and correction of flawed papers, preventing wasted resources" All the items in this checklist are not relevant for a researcher who is seeking to publish or attempting to assess the quality of a journal. However, it is a comprehensive list and a good place to start. Vigilance to ensure that such practices are not rewarded has to be an important aspect of research integrity and ethical practice.

Reference management software offer journal match features that can be used to get suggestions on a journal's potential outlets. However, researchers should validate that manually to weed out low-quality journals.



Some of the common factors for rejecting a manuscript include (Ali, 2010):

- ▶ Manuscript content does not conform to scope of the journal or the overarching theme of a special issue or is not interesting to the target audience
- ▶ Manuscript style does not conform with the journal style, format, or guidelines
- ▶ Duplication or significant overlap with existing work (plagiarism)
- ▶ Insignificant results or incremental research
- ▶ Improper rationale of the study
- ▶ Superficial treatment of the subject matter
- ▶ Poorly designed study in terms of statistical tests, controls, etc.
- ▶ Preliminary results that lend to speculative interpretation
- ▶ Lack of clarity in writing

Journals rely on the peer review process to ensure quality and identify plagiarism or other forms of misconduct. Unfortunately, identifying research misconduct is difficult, especially when the authors and reviewers belong to a small community where it is to everyone's mutual benefit to increase the number of publications and citations to those publications. This problem is further compounded when journal publishers and editors also have an interest in increasing the number of citations to articles published in their journals, which result in subtle and not so subtle efforts at encouraging authors to cite specific articles or journals (Wilhite and Fong, 2012).

Authors, reviewers, and journal editors are not the only ones with a stake in enhancing the prestige of a journal via the number of publications and citations. Publishers want to maintain a portfolio of highly-regarded journals; authors and their employers want publications in prestigious journals to burnish their individual and institutional reputations; and funders are similarly motivated to support researchers who have published and will continue to publish highly-cited research in such journals. An extreme case of corruption has been noticed in journal publications where it is now possible to buy and sell co-authorships of articles that have been

accepted for publication even in some of the most reputable academic outlets (Hvistendahl, 2013).

The number of citations a journal receives in a given year, taken against the total citable items it published over the preceding two-year period, determines its Journal Impact Factor™ (JIF). The JIF provides an important and objective measure of a journal's contribution to scholarly communication.

A confluence of motivations can result in various forms of malpractice ranging from biased reviews arising from conflicts of interest between reviewers and authors, citation coercion, and inflated author and journal self-citations. Building a strong culture of research integrity along with constant vigilance is necessary to curtail such misconduct. However, that is not enough. Here again, the ORI has an important role to play in educating and training researchers at all stages of their career. Education and training can be built upon guidance from COPE, the REAPPRAISED checklist, and the Johnson Report on scholarly and scientific publishing (Johnson, et al., 2018), among others (See Appendix 1). The ORI can also organize regular discussion groups and workshops to reinforce an understanding and practice of publication ethics.

3.3.3 Translation of Research

Scientific discoveries are regularly translated into applications to benefit humanity. Public dissemination of the knowledge and products developed by researchers results in increased outreach and, hence more attention to and success of science. Scientific

knowledge has the power to enhance the quality of life and impart positive societal impact to the beneficiaries (Pope and Brandt, 1997).

"Technology transfer is the transmittal of developed ideas, products, or techniques

from a research environment to one of practical application, and thus is an important component of the research life cycle.” (Pope and Brandt, 1997). Focusing on practical problems as a source of research ideas and seeking applications of research that can be quickly brought to the marketplace are efficient approaches to technology transfer. Some good practices to be followed in ensuring efficient transfer of academic research findings to real-life application are:

- ▶ Focus on research that is aimed at real world problems.
- ▶ Use of experimental tools and techniques that are time-saving and inexpensive without jeopardizing rigour or high quality.
- ▶ Use of widely available materials and components, feasible on a large scale, and pose minimum hazard to life and the environment to aid manufacturing.
- ▶ Maintenance of complete records of all experimentation, surveys, and so on, so that technologies can be reliably and efficiently scaled up.

With respect to institutional support, the ORI can:

- ▶ Develop platforms or communities that provide the services, facilities, and networks to absorb some of the risks associated with commercializing new technology.
- ▶ Create mentorship programmes that educate principal investigators about obtaining patents and advancing product opportunities that emerge from their research.
- ▶ Develop collaborative networks between industry and academia.
- ▶ Support the development of university incubators/accelerators.

All considerations that apply to research integrity also apply to research that is focused on applications of basic research leading to invention and innovation. It is often believed

that basic research is conducted without proper consideration of the societal implications of such research. However, scientists have often taken moral positions regarding certain scientific advances. Einstein and fellow nuclear scientists urged that atomic energy be used only for peaceful purposes (Shamoo and Resnik, 2009). Ethicists discussing the responsible conduct of research have labeled certain types of research (for example manipulating a germline) to be unethical because it can endanger potential human and other life (Siegel, 2018).

In addition to such weighty ethical issues there are also mundane aspects of research integrity when it comes to the responsible conduct of research. An important part of research integrity is ensuring ownership, recognition, and acknowledgement of intellectual property. Additional consideration has to be given to financial conflicts of interest when dealing with applications of research, especially when the research is the product of collaboration.

As stated before, explicit and proper documentation of all the rights, responsibilities, and expectations regarding intellectual property at the start of the research project is extremely important, especially when there is potential for financial gain. In brief, maintaining the highest standards of research integrity, regardless of the nature of the research, is always a good practice both in the short and long-run.

Finally, although most academic research does not immediately or always yield direct commercial value, fundamental science often underpins applied science. Basic research is at times blamed for being disconnected from the real-world problems and is also criticized for absorbing a disproportionate share of government funding.

4

Institutional Research Programme Management

4.1 Office of Research Integrity

This document provides a general perspective on research integrity, which must be operationalized at each research institution to reflect its own practices, needs, and context. The ORI must be an integral and permanent unit within the research infrastructure of the institution, where it plays a dual role of coach and enforcer. As a coach, the ORI encourages and enables a culture of research integrity and provides training. As

enforcer, it monitors research activity for potential malfeasance and acts swiftly, with fairness and tact, when it notices or has instances of research misconduct brought to its attention.

There are resources, governance structures, models, and guidance available for establishing an ORI. Examples of such resources are included in Appendix 1.

4.2 Governance

As mentioned, research has always been a competitive endeavour, but this competition is now global and fast-paced. As competition for prestige and funding has grown, there is evidence that the incidence of research misconduct has also grown (Fanelli, 2009).

To cultivate and sustain a culture of research integrity, the ORI must:

- ▶ Build upon the principles listed in this document by developing its own Code of Conduct for its context in alignment with its local traditions, needs, and mission.

- ▶ Keep abreast of current good practices for promoting the proper management and conduct of research.
- ▶ Deploy a research management and monitoring system to keep track of grant proposals, research projects, publications, and other research products.
- ▶ Ensure that the research incentives are designed to reward research integrity. For example, incentives that reward high quality research over quantity (Finkel, 2019).
- ▶ Serve as a resource for sound confidential advice regarding research integrity.

- ▶ Develop a checklist and training programmes for researchers to familiarize them with research integrity, potential pitfalls, and how to avoid and address them.
- ▶ Build checks to minimize conflicts of interest among reviewers.

Each ORI would also have to develop its own guidelines regarding processes and procedures for dealing with allegations of research misconduct. In this context, its role would be to:

- ▶ Provide clarity regarding procedures for addressing allegations of misconduct, for example:

- ▶ Whose responsibility is it to report misconduct?
- ▶ What is the policy on whistleblowing?
- ▶ Who should receive the complaint?
- ▶ Who will conduct the investigation? Will the investigation be confined to the ORI, handed off to external reviewers, or to another part of the research institution?
- ▶ Who has the authority to implement the penalties?
- ▶ Define what is fair and timely adjudication
- ▶ Keep records and document the source of the allegation, how the allegation was addressed, the outcome of the investigation, and the penalties meted out, if any.

Investigations must be timely and be conducted sensitively (Welpé, et al., 2015).

4.3 Training

The research community has responded to growing concern regarding research integrity by holding conferences (World Conference on Research Integrity, 2020), offering training, (SRA International, 2020) establishing policies, and issuing codes of conduct (All European Academies, 2017) and protocols (World Conference on Research Integrity, 2010).

Education and training are important aspects of developing a culture so that research integrity becomes a “way of life”, a habit. Not only should researchers be aware of what research integrity means, but they must also have the skills to put that awareness into practice.

The ORI can play an important role in developing and delivering the training (Emerson,

2017). Support for such training from the senior leadership of the university or research organization as well as one’s immediate supervisor is an important factor in ensuring that the training is undertaken and the likelihood of it being a success (Vanderbilt University, 2020). The ORI should ensure development of checklists and other training materials and delivery of that training on a regular basis. To enforce awareness and adoption, the ORI can consider making the training programmes on research integrity mandatory for all researchers and students (Finkel, 2019). In addition, such programmes should lead to a certification based on the successful completion of a rigorous course of study. The certification could also be made a prerequisite for receiving research funding or promotions.

In addition to a general introduction to research integrity and misconduct, the training should also focus on the different stages of the research cycle and on specific forms of misconduct at each stage, as already discussed.

To familiarize researchers with the diversity of the research enterprise, the ORI can offer training on topics such as informed consent, communication (with funders, research collaborators, students, or journal editors), and other topics that are context-specific or pertinent for specific disciplines.

4.4 Conflict of Interest

A conflict of interest (COI) arises when a researcher can derive personal gain while acting in an official capacity. Conflict of interest has been defined as: "... a situation in which financial or other personal considerations have the potential to compromise or bias professional judgement and objectivity. An apparent conflict of interest is one in which a reasonable person would think that the professional's judgement is likely to be compromised. It is important to note that a conflict of interest exists whether or not decisions are affected by a personal interest; a conflict of interest implies only the potential for bias, not a likelihood" (Conflict of Interest, 2020).

In research, conflicts can arise in subtle and not so subtle ways. Conflicts often arise when

a researcher is called upon to review a grant proposal or a research paper. A researcher is usually asked to serve as a reviewer when a paper or grant proposal is aligned with that researcher's expertise. An obvious conflict could arise if the researcher realizes that the paper under review is similar to his or her research, and there may be some benefits in delaying the potential publication of that paper to gain more time to complete the personal research or to expedite it because it might shed favourable light on a product that he or she might be attempting to bring to the market. More subtle forms of conflict might arise from personal biases regarding the use of a particular research method or data source or the way in which the research is framed and approached.

To avoid potential conflict of interest:

- ▶ Declare any real or perceived financial or professional conflict of interest
- ▶ Be aware of and abide by the organizational regulations and guidelines regarding the management of potential conflicts of interest
- ▶ Constitute and follow a policy of complete disclosure especially with respect to the financial conflicts
- ▶ Focus on the scientific merits when conducting a grant or manuscript evaluation
- ▶ Undergo training to uncover personal conscious and unconscious biases and exercise constant vigilance



5

Mentoring the Next Generation

Senior researchers are responsible for training and mentoring students and junior scholars. The dominant model for learning how to conduct research is the apprenticeship model, where junior scholars learn by working closely with senior researchers. In this model of learning, mentors are responsible for instilling the importance of integrity, ethical behaviour, and good research practice. Lack of knowledge among junior members of a research team is not, under any circumstances, an excuse for unethical behaviour. Instilling good research practices in the apprenticeship model implies that senior scholars and mentors lead by example. It is imperative that they maintain the highest standards of integrity and ethical behaviour and serve as role models.

The relationship between the doctoral supervisor or advisor and students is both personal and professional in which trust plays an important role. Most doctoral programmes have formal or informal statements regarding the roles and responsibilities of students and their doctoral advisors. However, knowing the rules however, is not the same as knowing how to interpret the rules. Discussions between the mentor and mentee are impor-

tant for helping the mentee understand the rationale for the rules and how they work in practice. A good point of departure for discussion about research integrity is a code of conduct.

With a formal document as a starting point, the discussion can evolve into an interpretation of those rules in the context of the research institution, the mentors' roles and responsibilities as well as expectations of the mentees.

Not all mentors are good at such discussions and this is where the ORI can play a role in training the mentors. The ORI can also offer training for new students and junior scholars and perhaps facilitate the discussion between mentors and mentees.

Researchers, particularly at a university, serve multiple roles. They serve on committees at the university and for professional societies. They may also be called upon to share their expertise with the larger community of which the university is a part. They voluntarily contribute their time to conduct peer reviews for scholarly journals and research funders. Over time, mentors should provide opportunities for mentees to teach

and mentor other students. Mentors must encourage mentees to serve the profession and professional societies by offering them opportunities to help with research conferences and reviewing papers. The apprenticeship model is particularly well-suited for such training and for imparting experiential learning. With mentors and mentees working side-by-side, mentors can gradually give more responsibilities to their mentees.

Even before joining a doctoral programme, a student has the opportunity to learn what it means to be a beginning researcher. Doctoral training, unlike earlier education and training, is about becoming an independent researcher. While one can be taught the means of becoming a good researcher, the curiosity and motivation to be a successful and creative researcher comes from within.

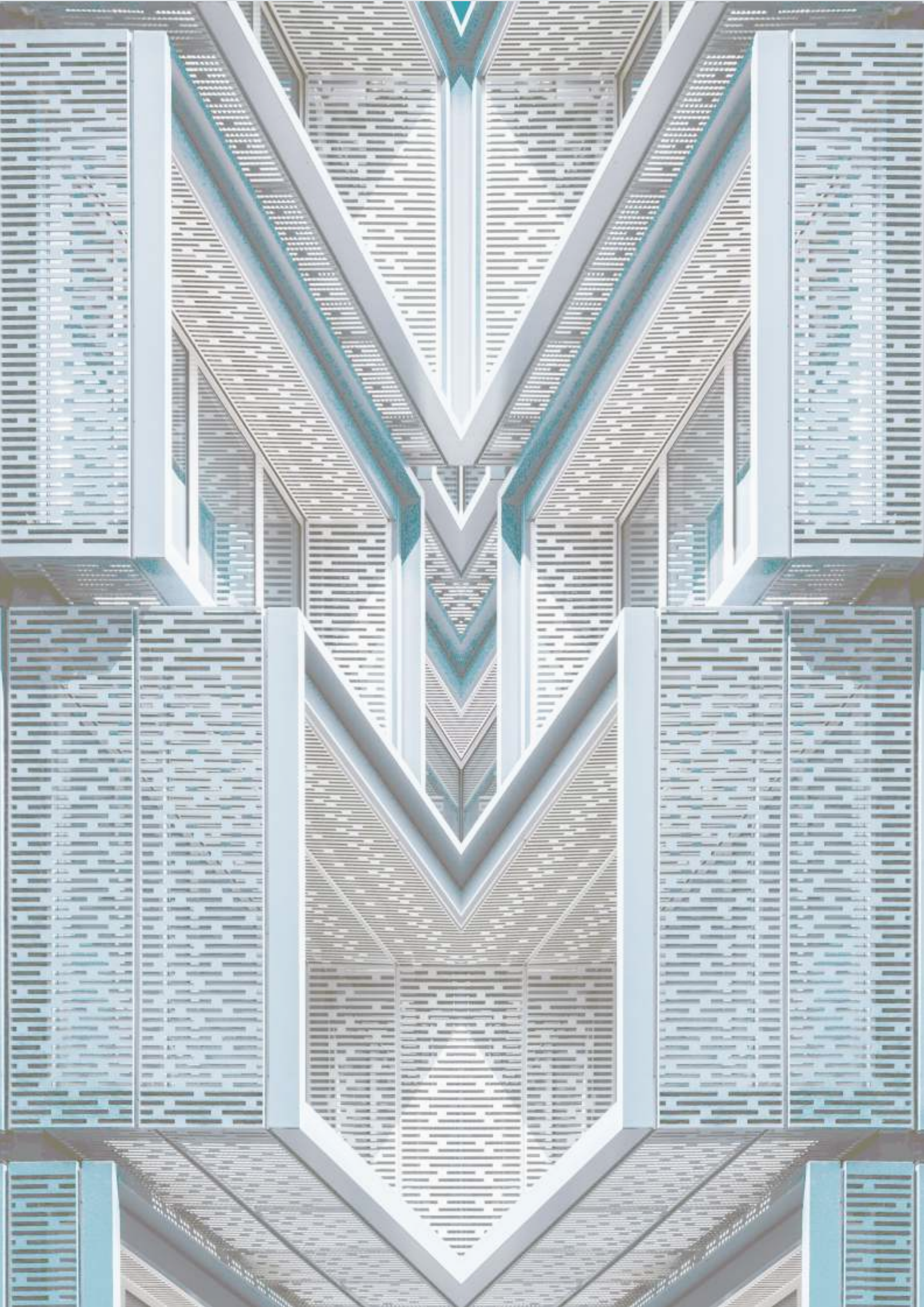
Good advisors, generally:

- ▶ engage with students in preparing a research project
- ▶ make students aware of ethical research practice and help them comply with the formal aspects of ethical and intellectual property regulations
- ▶ guide students through an institution's rules and regulations that govern the proper conduct of research
- ▶ provide academic advice, including specific guidance on how to conform to the norms and expectations of the academic field
- ▶ support students in developing their career both during candidature and beyond

- ▶ give constructive and critical assessments of the candidates' work
- ▶ ensure timely feedback, preferably in writing, regarding progress
- ▶ assist students with non-academic issues and if necessary, direct them to the appropriate student services offered by an institution
- ▶ engage external expert help, where needed, to supplement the internal expertise within an institution for comprehensive guidance.

The students are responsible to:

- ▶ know what it means to be a scholar in good standing with respect to the rules and regulations of an institution
- ▶ be systematic and rigorous in the conduct of research
- ▶ carefully plan and execute research protocols
- ▶ follow safety procedures
- ▶ diligently maintain accurate research records
- ▶ seek advice of senior faculty or researchers regarding ethical questions and practices
- ▶ disseminate findings in a timely manner in appropriate outlets
- ▶ present the findings in an unbiased, ethical manner in accordance with the highest standards of research integrity.



6

Conclusion

This document provides a framework for good research practices at academic institutions. It recommends the creation of an Office of Research Integrity (ORI) at each institution. Each institution is different and may use this framework as it best applies to its own context. It is hoped, however, that the framework will help place the research enterprise of an institution on a firm ethical foundation.

An important role of the ORI is to make appropriate recommendations for defining and refining an institution's focus on research integrity and ethical practice and behaviour. The value of good governance cannot be overemphasized in establishing the ORI, whose activities will be informed by evidence that is open and available to an institution's community and beyond. Partnering with researchers in participatory management of the ORI will inspire confidence in its leadership and help the managers of research achieve their goals in collaboration with researchers.

Individual honesty yields trust, and trust is paramount for a research community. It applies to the whole research enterprise, including but not limited to: peer review of research and research proposals; defining research questions; seeking and allocating resources for research; conducting research;

data collection, storage, and retrieval; interpretation; sharing data and results; presenting and publishing results; training and mentoring students; and contributing to the professional community. Another aspect of academic honesty is the proper acknowledgement of contributions drawn from earlier research, fellow researchers, and collaborators.

It is not always possible to know in advance when a particular line of research might lead to undesirable societal outcomes. In instances where the likelihood of adverse outcomes is high, careful procedures and constant monitoring are necessary to mitigate such risks.

Unfortunately, self-regulation does not always work. Regular training, seminars, and workshops conducted by the ORI, actively promoted and supported by the senior leadership, are potentially effective ways of sustaining a culture of research integrity. The ORI must also have systems for research management to provide institutional support for research. Research integrity is vital for science to thrive. The values articulated here can form a sound foundation for a research culture that emphasizes integrity in the daily practice of every scientist.





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Appendix 1: Reference Model Documents

There is a good set of reference documents that can add further insights into Good Academic Research Practices in general and

Research Integrity in particular. For ready reference we include a list of such documents and few highlights here.

International and National Guidelines

- ▶ University Grants Commission, India (Du.ac.in, 2018)
- ▶ National Health and Medical Research Council, Australia, 2018 (NHMRC, 2018)
- ▶ European Federation of Academies of Sciences and Humanities-ALLEA (All European Academies, 2017)
- ▶ Research Council, Sweden (Vr.se, 2017 The Swedish Research Council Report on Good Research Practice)
- ▶ Ministry of Higher Education and Science, Denmark (Ufm.dk, 2014, 2017, The Danish Code of Conduct for Research Integrity — Uddannelses- og Forskningsministeriet, 2014; The Danish Committee on Research Misconduct — Uddannelses- og Forskningsministeriet, 2017)
- ▶ National Academies of Sciences, Engineering, and Medicine, USA (NASEM, 2017)
- ▶ Korean Federation of Science and Technology Societies
 - ▶ The Manual for Research and Publication Ethics in Science and Engineering (Hwanget al., 2016)
- ▶ Australian Code for Responsible Conduct of Research (2018) on Research Integrity (WCRIF, 2020)
 - ▶ Singapore Statement on Research Integrity (World Conference on Research Integrity, 2010)
 - ▶ Montreal Statement on Research Integrity in Cross-Boundary Research Collaborations (WCRIF, 2013)
 - ▶ Council of Canadian Academies (Council of Canadian Academies Expert Panel on Research Integrity, 2010)
- ▶ The UK Research Integrity Office (UKRIO)
 - ▶ "Integrity and high ethical standards in

research, as well as robust and fair methods to address poor practice and misconduct” (UKRIO, 2020)

- ▶ Universities UK, a membership organization

representing over one hundred universities in the UK

- ▶ Concordat to support research integrity (Universities UK, 2019)

University Guidelines

The following webpages contain few examples of statements on research integrity and codes of research integrity from universities around the world.

- ▶ Australian National University (ANU, 2020)
- ▶ Delhi University (University of Delhi, 2020)

- ▶ Massachusetts Institute of Technology (MIT, 2020)

- ▶ University of Cambridge (University of Cambridge, 2020)

- ▶ University of Cape Town (University of Cape Town, 2020)

Other

- ▶ The Clarivate Analytics journal selection criterion provides several criteria for determining journal quality (Clarivate Analytics, 2019)
- ▶ The Retraction Watch to examine retractions as a window into the scientific process of

self-correction (Oransky, 2020)

- ▶ The Society of Research Administrators International offers certificate programmes on research integrity (SRA International, 2020)

The text below outlines highlights from some of the international and national guidelines:

Good research practices guidelines have been made available by a variety of stakeholders including government, funders, associations and think tanks. These guidelines describe best practices to be followed

during various phases of the research life-cycle—planning, conducting research, and publishing the results thereof (Vr.se, 2017—The Swedish Research Council Report on Good Research Practice).

Research Design

The Swedish Research Council Report (Vr.se, 2017) and the Singapore Statement on Research Integrity (World Conference on Research Integrity, 2010) advise researchers to understand thoroughly the state-of-art in their domain and undertake projects that will not cause societal harm. However, most of the guideline documents (European Science Foundation, 2011; Wellcome Trust Guidance Document, 2020; Wellcome-Sanger Institute Research Guide, 2020) refrain from commenting on the wider ethical context of science but focus on research integrity.

Designing good research practices for certain fields need addressing additional requirements, such as protection of the rights of human test subjects, care of laboratory animals, safe laboratory practices, and prevention of the misuse of the research findings (Irish Council for Bioethics, 2010; NASEM, 2017). For example, the National Institutes of Health (NIH, 2009) has identified nine core areas of responsible conduct of research instruction which include guidance on conflict of interest, handling of human and animal test subjects, mentor-mentee rela-

tionships, collaborations, peer review etc. The ethics document of the Medical Research Council UK (Medical Research Council, 2012) urges researchers to include an assessment of all resources needed to ensure feasibility of the study within the available means. Further, all previously listed guideline documents advise:

- ▶ Rationale of the study to be supported by scientific literature.
- ▶ Well-documented and easily traceable records for clear outcomes and end points.
- ▶ Compliance with all the applicable regulatory, ethical, and governance requirements.
- ▶ All the required licenses, and permissions to be secured before initiating research.
- ▶ Appropriate research governance systems in the institutions.

Several other guideline documents from India (Indian Academy of Sciences, 2018) including those listed above and others from various international agencies prescribe the best practices for data collection and handling.

Dissemination

In order to discourage a rat-race for publications, and thus to prevent researchers from publishing in low-quality journals that do not follow rigorous peer-review procedures ("predatory journals"), several regulatory bodies advise publishing only in high-quality reputed journals. With respect to publishing

in peer-reviewed journals, there are guidelines by the Committee on Publication Ethics (COPE) (Wager and Kleinert, 2012) and the International Committee of Medical Journal Editors (ICMJE, 2006) for the roles and responsibilities of various stakeholders (editors, writers, others) including peer review.

Collaboration and Authorship

Contemporary science has developed into a truly collaborative and international activity. The Coordinating Committee of the OECD Global Science Forum recommends establishing an agreement for collaborative research for responsible conduct in research and describes the procedures for the investigation of allegations of research misconduct within the project. The Committee has produced a boilerplate text for International

Agreements, which should be embodied in the formal documents that establish the collaborative project (OECD, 2008; All European Academies, 2017). A similar statement on research integrity in cross-boundary research collaborations was developed as part of the 3rd World Conference on Research Integrity, 2013, in Montréal, as a global guide to the responsible conduct of research.

Governance

Several government and regulatory bodies have published a draft guidance mandate that research institutions should have appropriate procedures for expeditiously addressing allegations of misconduct and irresponsible research practices and for protecting whistle blowers (National Policy on Academic Ethics, India draft, European Science Foundation; The Office of Research Integrity, 2020c).

Plagiarism of any kind is unacceptable and researchers are encouraged to use their novel and original ideas and provide proper acknowledgement and citations (du.ac.in, 2018) while referring to prior research work by self or others. Plagiarism-checking software must be used and evidence of plagiarism can disqualify theses, grant proposals, along with manuscripts.

When research misconduct is reported, prompt and appropriate investigation and actions are essential as per the defined process and guidelines (The Danish Committee on Research Misconduct, Uddannelses-og Forskningsministeriet, 2017), including correction of the research record.

Research institutions should develop and maintain an ecosystem that promotes responsible conduct of research and research integrity through appropriate guidelines and training (World Conference on Research Integrity, 2010, 2013). Finally, regulatory and government agencies have developed several research assessment and evaluation frameworks for evaluating research quality at individual or institutional levels (Cagan, 2013; Hicks, et al., 2015).

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The UGC Portrait

This emblematic portrait of the University Grant Commission captures an essence of the education philosophy from our traditional knowledge systems.

The Orange colour scheme represents Knowledge. The Swan represents Goddess Saraswati spreading her wings of Knowledge. The merged icons from the national emblems, the lion and the Dharma Chakra signifying forward and onward movement and Buddhi in the form of the open books below is the emblem of UGC. The owl eyes stand for the Goddess Laxmi and Ghara representing wealth in the form of Grant. The space between the Gyan Chakra and Sahasara Chakra signals transcendental knowledge and consciousness.

Further, the image in totality communicates the balance of thoughts from an array of disciplines acquired through the logical-analytical processes by the brain's left hemisphere brain and the creative and artistic disciplines acquired through the brain's right hemisphere. The zodiac signs in the foreground symbolize the different characters, thoughts and opinions. Each head has its own world, while the question marks inscribed on the eyes signify curiosity and inquiry which are integral to education, teaching and research.