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Department of Higher Education

ज्ञान-विज्ञान विमुक्तये
University Grants Commission
Ministry of Education
New Delhi

Academic Integrity and Research Quality

Designed by **Professor Him Chatterjee,** Department of Visual Arts, Himachal Pradesh University, Shimla

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.

ACADEMIC INTEGRITY AND RESEARCH QUALITY

University Grants Commission
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TABLE OF CONTENTS

	Foreword: D.P. Singh, Chairman, University Grants Commission	v
	Acknowledgements: Prof. Rajnish Jain, Secretary, University Grants Commission	vii
1.	Chapter 1: Academic Integrity and Research Quality — *Bhushan Patwardhan and Archana Thakur*	1
2.	Chapter 2: Philosophy and Ethics of Research in Science — *Subhash C. Lakhotia*	8
3.	Chapter 3: Ethics in Research Publications: Fabrication, Falsification, and Plagiarism in Science — *Praveen Chaddah*	18
4.	Chapter 4: Research Ethics in Social Science — *Padma Prakash*	34
5.	Chapter 5: Research in Languages in the Light of Research Ethics — *Uma Vaidya*	54
6.	Chapter 6: Research Methodology and Fallacy in Humanities and Social Sciences Research —*Kiran Pandya*	66
7.	Chapter 7: Ethics in Biomedical Sciences —*Sanjay A. Pai*	74
8.	Chapter 8: Roles, Responsibilities, and Ethics of Research Supervisors — *Parimal H. Vyas*	82
9.	Chapter 9: Strengthening Research Integrity in Higher Education Institutes — *Debendra C. Baruah*	88
10.	Chapter 10: Academic Dishonesty and Scientific Misconduct — *M.R. Yadav*	91
11.	Chapter 11: Sooner or Later Ethical Violations Get Exposed — *Ramesh Ch. Deka and Ajanta Deka*	95
12.	Chapter 12: Promoting Ethics through UGC-CARE and NEP 2020 — *Vinod K. Jain and Gaurangi Maitra*	99
13.	Chapter 13: Databases and Research Metrics — *Manmohan Gupta*	104
14.	Chapter 14: The Impact Factor of Journal — *Pulok K. Mukherjee*	126
15.	Chapter 15: Predatory Journals: Causes and Consequences — *Shubhada Nagarkar*	131
16.	Chapter 16: Mentoring for Enrichment of Core Academic Values — *Shridhar R. Gadre*	143
17.	Overview of UGC-CARE — *Archana Thakur*	153
18.	Committee on Publication Ethics (COPE): Guidelines on Good Publication Practices — *Archana Thakur*	157
19.	*The Contributors*	166
20.	*Glossary*	168

FOREWORD

University Grants Commission (UGC), in its constant endeavour to ensure quality and excellence in higher education, has taken the initiative of "Quality Mandate" to continuously improve the quality in Higher Education Institutions (HEIs) in India. Moving ahead in this direction, the "Quality Mandate" of UGC, which emphasizes the importance of promoting high-quality research and creating new knowledge by faculty members, established a Consortium for Academic Research and Ethics (CARE) with the main task of improving the quality of research in Indian universities and to promote academic and research integrity as well as publication ethics.

Focusing on both process and product, UGC, in its initiative, has come up with an invaluable book on "Academic Integrity and Research Quality". I am proud to present this book, a work of dedication and commitment, which will be a torchbearer for the researchers and stakeholders of HEIs.

Research results must appear in the best places, bringing laurels and rewards to the researcher, the institution, and the country. This book does not merely focus on a regulatory set of rules but highlights norms and best practices that all of us involved in tertiary education, must adopt. It is a valuable collection of writings from serious practitioners, administrators, and observers of the research ecosystem in Indian HEIs. The 16 well-researched and written articles cover the basic parameters of ethics, publishing codes, and principles of research across diverse disciplines.

I have no doubt, that as a community of researchers, if we can implement and practice the ethics, principles, ideas, and ideals that appear in this volume, it will change the way we practice and publicize our research work. This volume is one of the remarkable initiatives of the UGC and I take personal and professional pride that India's highest regulatory authority has brought out this volume.

The practice of good research produces good results. How we undertake research, find out the best places to publish, how best we can present our work — these are concerns that all of us share. We need to strengthen research methodologies, reject dubious methods, and identify the best modes of generating quality.

I thank all the esteemed contributors to this book for their valuable cooperation and contribution. I also take this opportunity to acknowledge the significant contribution and sincere efforts made by Prof. Bhushan Patwardhan, former Vice-Chairman, UGC, Prof. Rajnish Jain, Secretary, UGC, and Dr. Archana Thakur, Joint Secretary, UGC to successfully publish this book during the COVID-19 pandemic period.

My best wishes to all researchers.

Prof. D.P. Singh
Chairman,
University Grants Commission

New Delhi
December, 2021

Acknowledgements

University Grants Commission, in its incessant strives aimed at improving the quality in Indian Higher Education Institutions to compete with the Global scenario, has adopted **Quality Mandate**. One of the initiatives of the mandate highlighted to be undertaken by the Higher Education Institutions for fulfilling its objectives is promoting high quality research and creation of new knowledge by faculty members. Establishment of a Consortium for Academic Research and Ethics (CARE) by UGC is a step forward to enhance research capacity and to nurture research culture in the Indian Universities and Colleges. This book "Academic Integrity and Research Quality", which is meant for the community of researchers, construes the principal tenets of CARE to improve the quality of research integrity as well as publication ethics across its 16 chapters on different titles contributed by renowned authors and experts. I acknowledge their valuable contributions and sincerely thank them. I am sure that this book will be received with great éclat in the research community.

I am grateful to Prof. D.P. Singh, Chairman, UGC under whose visionary leadership this initiative was taken and this book with well researched titles has come up. I am also thankful to Prof. Bhushan Patwardhan, Former Vice Chairman, UGC for his valuable contributions and guidance in publishing this book. I am thankful to Dr. Archana Thakur, Joint Secretary for her significant contribution and sincere efforts in bringing up this book. I earnestly thank Ms. Indu Ramchandani for taking up the task of editing the book and completing it in record time. I am thankful to Shri P.K. Thakur, Financial Advisor, UGC for his continued support. I appreciate and thank Dr. N. Gopukumar, Joint Secretary, UGC; Dr. Diksha Rajput, Deputy Secretary, UGC and the dedicated team of Publication Section of UGC for their sincere efforts in bringing out this book.

Prof. Rajnish Jain
Secretary
University Grants Commission

New Delhi
December, 2021

CHAPTER 1

Academic Integrity and Research Quality

Bhushan Patwardhan and Archana Thakur

Very rigorous, scientific, and responsible efforts through research and innovation are needed in the quest for truth, and for creating or presenting new and authentic scientific information, to contribute to socio-economic benefits for the global community. It is important to ethically improve quality and simultaneously prevent any academic misconduct, including plagiarism. Serious concerns have been raised over many years now, especially with the increasing trend for publishing research papers in international journals, regarding fake information following the debacle of the "Fabrication, Falsification and Plagiarism" crisis. Faculty members, scientists, and other stakeholders need to take a firm stand against any such trends. It has also been stressed that they must contradict those who promote it (Hopf, *et al*., 2019). The increasing occurrence of compromised publication ethics and deteriorating academic integrity is a global problem and it is a blot on all areas of research.

India is no exception and to get to the root of the matter, we must appreciate the complex and diverse higher education system in India. The University Grants Commission (UGC) is a statutory organization established by the Government of India (GoI) for the coordination, determination, and maintenance of standards of teaching, examination, and research in university education. India has over 40,000 colleges providing undergraduate courses and over 900 universities focused on postgraduate education and research.

According to the data of 2019-2020 of an All India Survey on Higher Education (AISHE), about 1.503 million teachers were present in the system at that time to train 38.56 million students, of which 4.312 million were in the Master's programmes and 202,550 in doctoral programmes. During 2019, about 38,986 students were awarded Ph.D. degrees. The GoI awards nearly 10,000 research fellowships every year. According to Scopus data, about 147,537 articles were published from India. Majority of the research articles published are contributed from over 100 institutes of national importance and from a large number of national laboratories managed through different research councils. Historically, a typical Indian affiliating university caters to degree education, whereas the national institutes and laboratories are focused on research. Except in a few cases, this bifurcation seems to be a major reason for the poor research culture in most Indian universities.

New Parameters

With the inevitable push towards better assessment of academics, new quantitative parameters emerged such as the *h*-index, which is a measure of how many times an academic, typically a scientist, is cited by others in the field, and the Impact Factor (IF) of a journal, which is roughly an equivalent measure for the publishing medium itself. The CiteScore is a new metrics from Elsevier that provides comprehensive, transparent, and current insights into journal impact.

The quantification of research output through bibliometrics has also become almost inflexible or confining worldwide, often even substituting for qualitative assessments that can supposedly become subjective and therefore whimsical. However, *h*-indices, CiteScore and IFs, while they may be precise in one way, need not always be accurate with respect to judging the quality and importance of a researcher's work.

India was at position 7 in the SCImago country ranking for 2020 with 2,128,896 cumulative documents. This ranking, however falls drastically to position 21 when citations are considered with *h*-index 691. The *h*-index is the largest number of *h* such that *h* number of papers are cited at least *h* times. The *h*-index measures both the productivity and citation impact of the publications. Higher value of *h*-index indicates higher degree of impact. Low *h*-index clearly means that majority of documents published from India remain uncited, which in turn indicates poor quality, inadequate originality, or relevance. The United States is ranked number one with 13,817,725 documents and *h*-index 2577. China is ranked second with 7,454,602 documents, however it falls to 11 with *h*-index 1010. Relatively smaller countries such as Singapore and Hong Kong, with much smaller number of publications than India, show impressive performances as reflected by the high *h*-index of 646 and 639 respectively (Figure 1). This indicates high quality research output, which in turn may also indicate higher levels of academic integrity. Data shown in Figure 1 indicates that both China and India have much lower *h*-index as compared to other countries. This means that a large number of publications have not been cited. The gap between number of publications and *h*-index is very high in China. India has to address this issue seriously by improving quality, relevance, and impact of research.

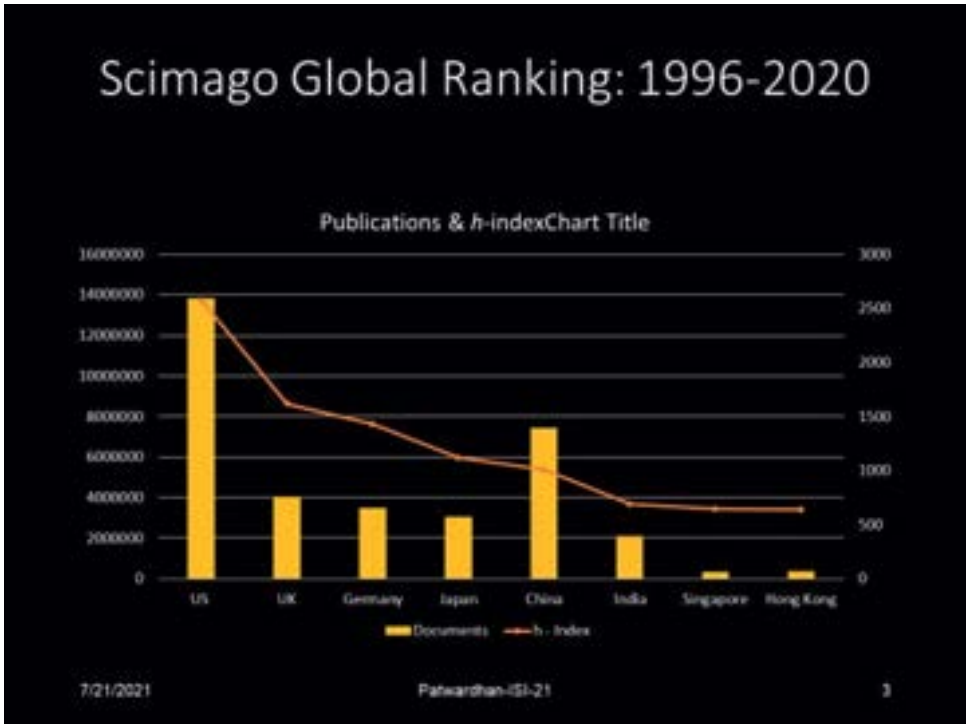

Figure 1. SCImago country ranking data year 1996-2000.

The University Grants Commission (UGC), New Delhi and the government science departments (DST and DBT) have been rightly concerned with the proper use of these parameters noting their application to schemes of promotions, funding, and recognitions in several countries. UGC also uses a simpler quantitative measure: the number of publications of a scientist, as a rigorous criterion for the appointment and certification as a research supervisor.

Regulatory actions by UGC and the science departments, while undertaken with the best possible intentions, led to at least two unfortunate consequences in the Indian context:

1) Careless application of bibliometrics while deciding appointments, promotions, and awards. There is now the distressing trend of appointing and rewarding people merely because they have

publications in high IF journals. A pedestrian 'follower' paper from India can appear in a high IF journal for various reasons, including but not limited to the patronage sometimes extended by a First World referee towards an author from the Global South, a sense of unwritten obligation as it were, or a tendency to 'allow' an Indian follower in the same field to publish in a high IF journal if he/she cites a big 'leader' scientist from the First World. Such a 'leader' may well be the referee; the Indian paper gets published but it is never cited. Such 'follower' papers from the Global South will not be cited where it really matters.

Indian committees for appointments, assessments or awards at the Central Government level often go, sadly enough, by IFs of the publication journals of candidates. These committees are necessarily of a general composition. They cannot be expected to go into the finer but more crucial details of the candidates' research to discriminate between truly insightful and adequately competent work. It is not a surprise therefore that average academics get elevated to positions of authority in India because it is normally only the receipt of such awards that elevates one to such positions.

2) Policy makers and administrators worldwide have been concerned for some time that research is being paid for twice over: the first time when it is funded and the second time when journal subscriptions are paid. Scientists should not be charged twice — once to undertake research and then to view its outcomes. This has led to the appearance of a new type of journal, the open access (OA) publication. In an OA journal, an author pays a one-time fee to publish a paper. Subsequently, its access is open to anyone. So if a government funding agency earmarks a certain amount (say 15 per cent) of a research grant towards OA fees, it would pay for research just once. The OA model has been successful and excellent OA journals now exist. The model has been widely adopted by European governments and there is little doubt that India should follow this path, because it is the future.

On the other hand, however, UGC regulatory provisions for appointment and accreditation, especially in smaller colleges and universities, led to predatory journals adopting a perverted version of OA. These journals more or less publish any submitted paper without the usual protocols of screening, refereeing, revising, and editing. Predatory journals are also able to fix IFs through fake citations. These dubious practices exploit the desperation of researchers who have found this loophole to attain eligibility for appointments, promotions, and accreditations through a certain number of points to be accrued from publications. Consequently, bribe and be published has become the norm. Regrettably, India heads the list of countries in terms of the number of predatory journals published (64 per cent) and 11 per cent of authors publish in these journals. According to the Nature Index (2014), a large percentage of research articles in India published in predatory journals are defined as, "entities that prioritize self-interest at the expense of scholarship and are characterized by false or misleading information, deviation from best editorial/publication practices, lack of transparency, and/or use of aggressive and indiscriminate solicitation practices." This is a disgrace to all individuals, employers, and institutions. "Retraction Watch" is full of papers from Indian academics, indicating potential compromise of academic integrity, publication ethics as also the quality of research and publication.

Emergence of Predatory Journals

Unethical/deceptive practices in publishing have led to an increased number of predatory journals worldwide. Predatory journals have severely compromised the integrity of scientific scholarship and polluted electronic databases. 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/publication practices, lack of transparency, and/or use of aggressive and indiscriminate solicitation practices" (Moher, *et al.*, 2019).

Predation and deception in scientific publishing has become pandemic in India, and there is an urgent need to take preventive steps. In 2015, it was estimated that over 8000 predatory journals were churning out more than 400,000 items each year (Shenand Björk, 2015).

Educating the academic community and creating more awareness about how to evaluate the integrity of a journal is crucial in combating predators (Cobey, 2017). Akin to resistant microbes, predatory journals are becoming increasingly invasive and adept at appearing legitimate. We need systematic efforts to educate authors and warn them to stay away from such predators. According to Nature Index analysis 2014, Indian science has shown a marked growth in high-quality scientific publications. However, it has also been reported that the percentage of research articles published in predatory journals is high in the country (Priyadarshini, 2017). This study showed that 51 per cent of predatory authors were from affiliated colleges, followed by 18 per cent in private universities and 15 per cent in state universities. The more worrying revelation is that 51 per cent faculty members and 32 per cent doctoral students were authors in predatory journals (Seethapathy, *et al*. 2016). This indicates the sheer desperation to publish poor-quality research just by paying money for pseudo recognition, employment, promotions and doctoral degrees. Predatory journals and academic pollution along with some factors responsible for this state of affairs have been discussed earlier (Patwardhan, 2013, Lakhotia, 2015). Serious concerns regarding increasing number of Indian authors in predatory journals and immediately regulating the quality of science and education have also been stressed (Seethapathy, *op. cit*.).

The expansion of predatory publications from India seems mainly due to overemphasis on quantity rather than quality of research publications as an academic performance indicator and the mandatory requirement to publish at least two papers prior to submission of a doctoral thesis. But good publications need very good research (Patwardhan, 2015). Although well meaning, the regulatory provisions of UGC apparently triggered a sudden spurt in predatory journals giving way to the "publish or perish" culture (Lakhotia, 2017).

Preventive Measures

Taking cognizance of the increasing menace of predatory publishing, UGC released a list of approved journals in 2017. Creating a white-list was a well-meaning, proactive step by the Commission, however, due to some flaws during implementation, it faced severe criticism. The large number of poor-quality journals opened the floodgates for desperate authors. The rapid penetration of predators in the Indian academic community became a major concern. After October 2018, UGC decided to take firmer steps to improve research quality, academic integrity, and curb predatory publishers. As a proactive step, the UGC list was critically reviewed using a robust protocol developed with the help of like-minded academicians.

The critical analysis of the UGC list showed that over 88 per cent of journals from the university source were of poor quality (Patwardhan, *et al*. 2018). The results attracted attention of the media, the academic community and regulators. Curating the UGC list resulted in removing over 4000 predatory journals. But this was just a beginning. Subsequently, the UGC Journal Steering Committee accelerated the work of curating UGC-approved list of journals on priority basis. UGC was only one of the ten common funders, which provided guidance about journal selection on its website (Moher, *et al*. 2017).

The Role of UGC-CARE

To help the Indian academic community, choose journals/conferences that follow standard ethical policies, improve the quality of research publications, enhance academic integrity and publication ethics, and improve the quality of research in Indian universities, the UGC created, CARE, a "Consortium for Academic Research and Ethics" of relevant stakeholders.

UGC-CARE is based on the well-known principle followed for quality management system by many regulators, Corrective And Preventive Actions (CAPA). The purpose is to collect and analyse information, identify and investigate problems, and take appropriate and effective action to prevent incidence and recurrence. The CAPA approach involves verifying, validating, and communicating action activities to responsible people, and documenting and providing information for management review. Systematic investigation of the root causes of problems is very crucial to ensure effective, corrective, and preventive actions. The CARE initiative to clean up research publications in India focuses on predatory publishers/journals.

An Empowered Committee steers the entire activity of CARE. Over 30 statutory councils and government bodies across disciplines are invited members of the Consortium to identify, continuously monitor, and maintain a reference list of quality journals across disciplines. It has done a good job in weeding out many suspect publications. The repeated public notices, gazette notifications and circulars to institutions are sensitizing researchers to the dangers of plagiarism/self-plagiarism, publishing in predatory journals and unethical publishing practices.

Proposals for new journals including consideration of inclusion in the UGC-CARE list can be submitted only through CARE members or any one of CARE universities including Jawaharlal Nehru University, Tezpur University, Maharaja Sayajirao University of Baroda and University of Hyderabad. The UGC Cell at Savitribai Phule Pune University, Pune analyses journals according to validated protocol. The UGC-CARE list is dynamic, to be updated every quarter. The first edition of UGC-CARE Reference List of Quality Journals was released in June, 2019 accompanying a "Public Notice on Academic Integrity". The CARE website provides useful resources such as, relevant publications, audio-visual materials, videos, and weblinks. It also provides FAQs, feedback and a grievance redressal mechanism.

Good Academic Research Practices

Responsible conduct of research, and safeguarding ethics and academic integrity in scientific research is extremely crucial. Compromised publication ethics and deteriorating academic integrity are contaminating all domains of research. Unethical, deceptive practices in publishing have led to an increased number of dubious/predatory journals worldwide. In India, the percentage of research articles published in predatory journals is high. It is important to prevent academic misconduct, including plagiarism, in academic writing among student, faculty, researcher, and staff. The Indian academic community needs to ensure that the journals/conferences it chooses to publish follow standard ethical policies.

Any attempt of compromised academic integrity should be challenged, questioned, and de-recognized at all levels. Unethical practices leading to a "pay and publish trash" culture need to be thwarted immediately. The UGC-CARE Reference List of Quality Journals is one step in this direction. The UGC, Indian Research Councils, Indian Science Academies as well as PSA office have published documents related to academic integrity and ethics (as listed in Additional Readings).

The UGC in collaboration with the knowledge partner Clarivate Web of Science has published a guidance document "Good Academic Research Practices" (GARP) for the benefit of the faculty and students from Higher Education Institutions (HEIs). This document can play a vital role in creating more awareness regarding importance of academic integrity and offer valuable guidance regarding good practices to be followed to improve quality of research and scholarly publications.

Going Forward

UGC has to make academics and students familiar with research methodology. Publications arise from research. If the research is poor, the output is naturally poor. UGC needs to be vigilant about the quality of research supervision. How research guidance is undertaken today has to be rethought, more so in the fund-starved post-COVID dispensation. A balance between quantitative and qualitative evaluation is paramount. Implementation of both these yardsticks needs a high measure of honesty and integrity.

In this book, we have renowned researchers, academicians and authorities sharing their candid perspectives. With the focus on research, Subhash C. Lakhotia, Praveen Chaddah, Padma Prakash, Uma Vaidya, Kiran Pandey, Sanjay Pai, and Parimal Vyas have covered the very wide fields of the philosophy, ethics, the roles, responsibilities of research, methodologies and fallacies of research in science, in research publications, in social science, in languages, in humanities and social sciences, and in biomedical sciences. Debendra Baruah, M.R.Yadav, Ramesh and Ajanta Deka, give insight to research integrity, academic dishonesty misconduct, and ethical violations. Vinod Jain and Gaurangi Maitra focus on promoting ethics through UGC-CARE and NEP 2020, while Manmohan Gupta and Pulok Mukherjee talk of the importance of databases, and the Impact Factors. While Shubhada Nagarkar highlights the causes and consequences of predatory journals, Shridhar Gadre rounds it off with the positivity of mentoring.

Hopefully, authors are discouraged from choosing predatory publishing as an easy way to earn academic benefits, and cut-off the flow of articles to predators. The initiatives such as UGC-CARE and GARP will hopefully create more awareness and help the cause of promoting academic integrity and ethical publishing. UGC's efforts are just a beginning. Active involvement of the academic community coupled with strong support from the government shall remain key drivers for successfully promoting research quality, academic integrity, and control predatory publishing in India.

Note

This chapter [is] based on the following articles published in *Current Science*:

Patwardhan, B. and A. Thakur. 2019. UGC-CARE Initiative to Promote Research Quality, Integrity, and Publication Ethics. Current Science 117 (6): 918–919.

Patwardhan, B. and G.R. Desiraju. 2020. Assessing Research: The slippery slope. *Current Science* 118 (12): 1869–1870.

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Additional Readings

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CHAPTER 2

Philosophy and Ethics of Research in Science

Subhash C. Lakhotia

Introduction

All living organisms have to be curious and need to gather information about their surrounding environment if they wish to survive. The organic evolution, generally leading to organisms with increasing biological complexity, has been associated with more efficient sensory systems for acquiring information about the surroundings. This has been paralleled by more analytical neural processing of the information and efficient decision-making capacity. While all living organisms have innate curiosity to know about their environment, the evolution of more complex biological organization has been accompanied by, and perhaps dependent upon, an enhanced and proactive curiosity about the surroundings. Among living organisms, the human species seems to have the highest degree of organized curiosity, which, when formalized, is named as research.

Acquisition of the power of highly articulated voice communication by the human species lies at the root of proactively planned and organized research as a social phenomenon. In the general sense, all living organisms are social since they communicate and interact with other individuals of their own kind, and with individual of other species. These communications in most cases are through chemicals released by individuals or by direct physical contacts. Sound, as a mode of communication between individuals is used mostly in the animal kingdom, especially in those that biologists consider as higher organisms or more 'evolved' because of their greater biological complexity. We are more familiar with sounds produced by various insects, frogs, birds, and mammals because our auditory sensory system can recognize those vibrations. Although, we can perceive these sounds, they remain mostly unintelligible to us. The patterns of sound vibrations produced by an organism are recognized as 'language'. The human species has evolved highly intricate language systems, which have played major role in the origin and evolution of human social systems. A quantum jump in communication between human individuals took place when besides the spoken language, based on production of sound through the larynx and sensed by the ear, was supplemented with language written by hand and perceived by the eyes. Spoken and written languages enabled mankind to transfer new information and/or new interpretation of phenomena not only to other contemporary fellow beings but also to future generations. The ability to pass on the information or knowledge gathered by an individual to generations that do not still exist has been the key factor underlying the remarkable progress of various civilizations through human history. Such passage of information and knowledge across generations transformed the knowledge base to be additively cumulative, which in turn, catalysed the rapid intellectual and technological advances witnessed during the past few millennia. This also generated the highly intricate and varied social organizations that human species displays, and which in our characteristic anthropocentric view, make us consider human species to be the most highly evolved social animal.

A society's orderly organization requires reduced entropy, which is achieved by placing certain restraints on individual freedom through rules and regulations. Most animal societies follow innate social behaviour, which seems to have evolved through the action of natural selection to effectively maintain the given social system and order. However, thanks to language and the long learning period,

the innate behaviour component is of less significance for the sustenance of the human social systems. Instead, adaptive learning has been the essential cornerstone for the human society's evolution and success. Such adaptive learning, however, has also facilitated the acquisition of selfish behaviours and actions that run counter to the larger society's well-being. In order to mitigate the entropy-enhancing consequences of such selfish behaviours and actions, human societies formulated various rules and regulations (religious and legal). In addition, each society also codifies certain moral principles (do's and don'ts) to further reduce the inherent entropy in a multi-component system. Such ethical behaviour, based on moral principles, is often self-formulated by a given social group.

What is Research?

The ability to wonder, *especially the ability to wonder at our ability to wonder,* is a unique feature of mankind. Curiosity and the self-driven efforts to satisfy the curiosity lie at the root of research, which involves systematic and creative investigations in any domain of knowledge. These can be related to philosophy or matter, or anything in this Universe that can be perceived by our senses. Research has owner/s who actually find something new, and recipients, who learn about the new discovery when the owner communicates the new information/knowledge to the larger group.

The unique ability of humans to wonder is an evolutionary outcome enabled by the greater complexity of brain in higher organisms like vertebrates. The greater complexity of brain's functional organization facilitates and co-ordinates the increasing biological complexity in different groups of vertebrates. Birds and mammals (including the human species) have more complex nervous systems than other vertebrates such as fishes, amphibians, and reptiles, and also display more complex behavioural patterns. The evolution of complex spoken and written languages, unique to human species, occurred in parallel with the enlarging size of brain as the primitive human species evolved into the extant *Homo sapiens* species. The brain size and acquisition of language and other skills in the human species are interdependent. Human curiosity has evolved far beyond any other animal species because spoken and written languages continuously expand the knowledge base, often on an exponential scale. The relentless exploratory behaviour of a toddler, who wants to know about everything that it encounters in the surroundings to expand his/her knowledge base, exemplifies the human curiosity to know the unknown. The more we learn about something, we instinctively become more curious about what still remains unknown. Thus the philosophy underlying the human learning is: *the more we know, we get to know what we still do not know*. Research is nothing but curiosity driven pursuit of the unknown. Centuries ago, Aristotle stated "The more you know the more you know you don't know". Likewise Albert Einstein said, "The more I learn, the more I realize how much I don't know."

The word research indicates that we are re-searching a phenomenon that in reality already exists and operates in nature or in the universe but whose underlying principles, mechanisms, or other qualities have so far remained elusive to us. Research is an attempt to transform these unknowns into 'known', and to demystify the 'mystery' associated with a phenomenon. Research follows systematic and rational methodologies, which involve defining the question (based on what is presently known), hypothesizing, making unbiased observations, analysing the observations, and finally interpreting the results to support or reject the hypothesis. A measure of success of research effort is the quality of new questions that research outcome generates.

Research as a Social Responsibility

Engaging in research and dissemination of its output is a social responsibility. While the research output is self-satisfying for the researchers as owners of the new knowledge/understanding, and

as a stepping stone for the next level of enquiry, its dissemination to a larger peer group is a social responsibility. Sharing of the new research output enhances the knowledge base of the recipients in a society and thus promotes overall advancement. If not shared, not only does the new knowledge remain largely unutilized or utilized in a very limited manner, it also 'dies' with the discoverer. From the very beginning of human civilization, informal and formal sharing of research output of individuals/groups with other members of the society has been the driving force that catalysed the remarkable cultural and technological progresses achieved through the millennia.

During the historic and pre-historic periods, much of the research was driven by individual's curiosity and pursued by individuals out of their own volition. Organized research was mostly limited to the few universities that existed in historical times. In some cases, organized research efforts in specific directions were also commissioned by the state or the more affluent members of the society or religious centres. Thus organized research has always been supported by society in one form or the other. With the widespread establishment of universities and other academic/research institutions across the globe during the past few centuries, research activity has transformed from the self-driven and self-satisfying activity to a largely state-driven and, to a varying extent, state-regulated activity. As the research efforts in science become more dependent upon rapidly advancing technologies, the cost of research has also gone up substantially in recent times. This has made most research, especially in the sciences, to be majorly supported by public funds routed through governmental agencies and to a lesser extent by individuals or private organizations. Such organized research and the financial support for it have completely transformed the face of research during the past 100 years or so. We cannot now imagine the scenario under which great scientists such as, J.C. Bose or C.V. Raman pursued their research interests, largely on their own.

The practice of organized financial support for research, while largely responsible for the remarkable progress in all spheres of our lives, has also generated ethical issues.

Research and Ethics

Ideally, research is the pursuit of truth. Therefore, at first sight it may look paradoxical that one has to ensure ethical behaviour in the pursuit of truth. It is common experience that new research studies reveal varying degrees of error in the earlier accepted inferences/interpretations that were based on past scholarly studies and were conducted on the basis of the then known principles and facts, using the best possible ethical, experimental, and other precautions. Such finding of 'error' does not, however, mean that the conclusions/interpretations advanced by the earlier studies were arrived at by deliberate or inadvertent erroneous or unethical methods. All research studies rely on the available base knowledge or as known to the investigator at the given time. As the knowledge base expands, it is more likely that something that was accepted as fact at a given point of time, needs modification or even rejection. Indeed, it is only when some established ideas/interpretations are shown to be wanting in some respects by subsequent studies that a perceptible quantum progress in our knowledge and understanding of nature becomes evident. Being proven wrong, therefore, does not by itself imply unethical conduct by earlier researchers. However, issues of research integrity and ethical conduct arise if the results and/or their interpretations in the previous study were arrived at by deliberately biased methods or with some other selfish motive.

Research is an essential and organized component of academic activity. The expansion and transformation of research activity from an intellectually self-satisfying curiosity-driven individual or group effort has transformed research into a 'market-driven' organized activity, mandated and regulated by academic and/or commercial institutions. While such expansion has indeed been the

major catalyst for the unprecedented rapid technological advances witnessed in recent times, it has also raised issues of research integrity and ethical conduct because of the global spurt in practices that are considered to be unethical.

Factors Contributing to Unethical Conduct in Research

Besides the base human follies like greed, egocentrism, the desire to be high up in the social hierarchy, and so on, a variety of other factors, associated with the prevalent practices in organized research, also contribute in a big way to the globally increasing incidences of breach of research integrity and ethical conduct (Sovacool, 2008; Nazemian, *et al*., 2017; Bellé and Cantarelli, 2017; Edwards and Roy, 2017). The major causative factors are briefly noted in the following:

Competition: Increasing numbers of researchers and greater societal impact of research outcomes have escalated the competition for the dissemination of research outputs through publications and other forms. The competition has become more intense because the research output, typically in the form of publications and/or patents, has now become the standard measure for *inter se* comparison between academic researchers. The increasingly stiff competition places unrealistic demands on "winning the race". The race may often not be related to seeking answer to the nature of the scientific question under pursuit but to personal gains such as appointment for a position, promotion, getting an award or any other kind of recognition. Such competition for personal ends drives some individuals to find 'short-cuts' and resort to behaviour and acts that are considered unethical. As discussed later, sometimes the rules and regulations formulated with the objective of maintaining order themselves make the system highly bureaucratic and stifling. This also can promote misconduct.

A different level of 'competition', emanating largely from commercial interests, is seen in the domain of applied or translational research. Misleading or unsubstantiated claims are made to compete and garner greater share of the market and thus, "make hay while the sun shines".

Claiming priority: Since research output is 'owned' by researchers/claiming the discovery, and such ownership is recognized and 'rewarded' by society in one form or another, the desire to claim ownership is natural. With multiple individuals/groups working on similar topics, especially those that are considered to be 'hot' at a given time, competition is bound to be intense, which may prompt some to find unethical shortcuts to stake the claim ahead of others.

Ranking: The expanded system of ranking of research now covers a wide canvas extending from individual researchers to journals and institutions at national and international levels. The ranking is not only associated with 'prestige' but also with funding that can be provided for research. With resources being limited, the race to win a higher ranking is becoming more intense and global, bringing in its wake a loss of academic and research integrity.

Prestige associated with journal impact factor: During the past three-four decades, the journal impact factor (JIF) has gained prominence in assessing the quality of research output of individuals as well as institutions (Bornmann and Marx, 2016; Larivière and Sugimoto, 2016). This has resulted in a hierarchy of journals so that some journals in each discipline are considered to be better than others because their arithmetic impact factor value is higher. The undue importance given to the numerical value of impact factor has generated a race between journals to achieve annually increasing impact factors. At the same time, researchers are made to aspire to publish their findings in journals with higher JIF since that is considered to provide a stamp of 'quality' and has become the most important bibliometric indicator of 'quality'. The high premium, and consequent intense competition, associated with publication in journals of high impact factors has generated unrealistic,

and often varyingly unethical, demands on the way research is conducted, and data generated and compiled for publication. Such practices lead to loss of integrity in the conduct of research and/or unethical practices in dissemination of results. Consequently, the methodological quality of scientific experiments does not increase with increasing rank of the journal. On the contrary, an accumulating body of evidence suggests the inverse: methodological quality and, consequently, reliability of published research works in several fields may be decreasing with increasing journal rank" (Brembs, 2018). In addition, many of the high-impact journals collect money from authors or their funders on various counts, including the open-access charges, resulting in the research publication industry becoming an increasingly profitable and competitive business.

Despite the very wide discussion that establishes the misuse and inadequacy of the JIF as a bibliometric indicator (Lakhotia, 2011, 2014; DORA, 2012; Schmid, 2017; Chaddah and Lakhotia, 2018), it continues to rule the roost and influence research practices. The undue emphasis on publication in so-called high impact factor journals has also left the research journals published in India (often categorized as 'national journals'), including even those published by established academies and universities in the country, in a poor state (Lakhotia, 2018). It is indeed unethical to distinguish between 'national' and 'international' journals for the assessment of individuals and institutions (Lakhotia, 2013; Chaddah and Lakhotia, 2018).

One of the glaringly unethical consequence of the transformation of research publication from an academic activity carried out primarily by academic institutions, learned societies and the like, to a hugely profit-making commercial activity is the mushrooming of predatory or greatly sub-standard journals during the past decade or so (Beall, 2012; Lakhotia, 2015, 2017b; Moore 2020).

Poor infrastructure for research in universities and colleges: Universities and colleges, as institutions of higher education, have the dual responsibility of disseminating knowledge to the learners and of creating new knowledge through research. The latter activity is especially more relevant for university faculty. Creative and original research needs an appropriate and "conducive environment", and adequate infrastructure. Unfortunately, most universities and colleges have neither the "conducive environment" nor the minimally-needed infrastructure. Yet the faculty is required to engage in research and get evaluated on the basis of published output. Such conditions would indeed encourage unethical practices since the requirements are unrealistic (Lakhotia, 2017a, b).

Emphasis on quantity rather than quality: The increasingly competitive organized research demands relative evaluation of research output of individuals and academic institutions for recognition, rewards, funding, and so on, bringing in its wake the "publish or perish" syndrome across the globe. With institutional requirements of certain minimal number of research publications for eligibility and calculation of the academic performance index (API) for *inter se* comparisons, the rush for research publications has become more demanding. As a consequence, the predatory journals appeared and are flourishing (Biele, 2012; Lakhotia, 2015; 2017a, b; Patwardhan, *et al.*, 2018; Panda, 2020The predatory journals have now been joined by predatory conferences and online webinars, and predatory prep-print servers. The sub-standard publication industry has also 'evolved' during the past few years so that the perpetrators successfully hoodwink the surveillance mechanisms put in place by various agencies (Grudniewicz, *et al.*, 2019; Jain and Singh, 2019) and continue their money-making research publication business because their 'prey', a large number of researchers remain in disparate need of some 'publications' to their credit so that they can fulfil the institutional requirements (Moore, 2020).

These and other factors have catalysed an increasing tendency for breach of research integrity and unethical practices in the conduct of research, interpretation of data, and dissemination of the research output. These practices have also been abetted by the increasing availability and usages of internet, automation and software for word- and image-processing.

Evolving Codes for Research Integrity and Ethical Conduct

Research integrity and ethical conduct are largely inter-related. Research integrity reflects moral adherence to the defined ethical code of conduct and professional standards as a personal conviction rather than because of compulsion of institutional rules and regulations. Ethical principles refer to honesty and trustworthiness of records and the dissemination of the research output.

Unethical conduct and the societal efforts to curb such undesired practices have been evolving parallelly since pre-historic times. A breach in integrity in conducting research and disseminating its output causes serious damage to society's progress. It also leads to a loss of public faith in scientific temper. Since maintaining integrity in conduct of research and following ethical practices in the dissemination of the output are critical for the well-being of society and essential to keep the sanctity of academic pursuit, research communities in different disciplines have, on their own, formalized discipline-specific ethical norms for the conduct of research and sharing its output.

Maintaining integrity is a common denominator in all research efforts. The norms for ethical conduct have, besides the many common guidelines for all disciplines, discipline–specific codes as well. For example, some of the defined codes for ethical conduct in bio-medical and health sciences do not apply to research dealing with non-living matter and vice-versa. Within the biomedical and health sciences, some of the ethical practices for clinical studies that directly deal with human subjects are different from those followed for research on animals or plants. The ethical codes of conduct of research are dynamic and evolve in time and space.

One of the first internationally adopted codes of ethical conduct, the "Declaration of Helsinki 1964", was in the biomedical field, which was developed by the World Medical Association following the Nuremberg trials for the Nazi atrocities. Since then, this has undergone multiple revisions.[1]

Each country and many international agencies have framed guidelines for research integrity and ethics. The International Science Council (ISC), a non-governmental organization with a unique global membership of 40 international scientific unions and associations and more than 140 national and regional scientific organizations including academies and research councils, has articulated code of conduct for freedom and responsibility in science.[2] The Committee on Publication Ethics or COPE[3] was established in 1997 as a non-governmental association to provide advice and guidance on best practice for dealing with ethical issues in journal publishing and "To educate and advance knowledge in methods of safeguarding the integrity of the scholarly record for the benefit of the public." As a general practice, all standard research journals are expected to follow the best-practice guidelines periodically issued by the COPE. The All European Academies (ALLEA) have also formulated conduct for research integrity.[4] Different governmental agencies/departments and academies in India too have formulated guidelines for maintaining integrity and ethical conduct in research. Some of these can be seen as Additional Readings.

Long-term Damaging Impact of Unethical Conduct in Research

As stated earlier, new knowledge builds on the existing knowledge. Consequently, if the existing knowledge relating to a given phenomenon/process/matter is based on results, the integrity of which is uncertain because of some unethical conduct, cascading ill-effects would follow on further advancements in the field. Since knowledge in different domains and fields has to be necessarily interconnected, the damaging consequences would be felt and visible in many other disciplines as well.

The increasing dependence on different metrics on part of the various decision-making committees and agencies on one hand, and the stiff competitive environment experienced by those seeking positions, research grants, awards on the other, are perverting the incentive system (Lakhotia, 2017a, b; Edwards and Roy, 2017; Paul 2018). As noted by Edwards and Roy (*op. cit.*), "If a critical mass of scientists become untrustworthy, a tipping point is possible in which the scientific enterprise itself becomes inherently corrupt and public trust is lost, risking a new dark age with devastating consequences to humanity. Academia and federal agencies should better support science as a public good, and incentivize altruistic and ethical outcomes, while de-emphasizing output."

For research to be, and which it must be, an essential catalytic ingredient for sustainable advances, Responsible Research and Innovation (RRI) is essential. RRI requires transparent interactive process between societal actors and innovators to achieve mutually responsive acceptability, sustainability, and societal desirability of the innovation process and its marketable products (Von Schomberg, 2012; Das, 2019). The current COVID-19 pandemic has brought out the pitfalls of compromise in RRI. H.H. Thorp, the current editor-in-chief of Science journals, while highlighting the worries of over-promising witnessed in present times states (Thorp, 2020), "When science addressed the HIV/AIDS crisis, it took years of careful virology, drug development, and epidemiology. The global scientific assault on COVID-19 is faster, and as I see the research that comes to *Science* and that appears on pre-print servers, I am hopeful that science will deliver on this challenge, too. But I worry that engendering false hope will cause complacency that will deprive us of the time needed to find a lasting solution. And I worry about lasting damage if science overpromises." The credo of RRI is under-promise but overdo!

The origin and rapid mushrooming of predatory journals is an example of the disregard of research integrity and ethical conduct (Lakhotia, 2015; 2017b; Beall, 2012; Petrisor, 2018; Patwardhan, *et al.*, 2018; Patwardhan and Thakur, 2019) on part of all the stake-holders — the policy-makers and administrators (who define and implement rules for academic jobs/rewards and implement them), authors (who write such so-called "research papers" for publication), and editors and publishers (who run such journals to publish anything for money).The increasing commercialization, coincident with the decreasing role of academic institutions, has made research publication a high-profit business venture.

Another serious issue is the mental health of researchers, especially the Ph.D. students and young principal investigators. Although less talked about in the past, this aspect has received considerable attention in recent years. The above-discussed factors that lead to unethical conduct by researchers also vitiate the environment in the research work place. The worst, albeit often silent, sufferers of the vitiated environment at the work place are the young students and other researchers (Guthrie, *et al.*, 2018; Nature Editorial, 2019; Hari Dass, 2019). The principal investigators also suffer mental health issues because of the pressure to 'deliver' and compete for the shrinking quantum of research funds. Additionally, they also suffer because the young students who join research as Ph.D. students have often not been prepared for research. Yet they join research either just to get a higher degree or to earn something till they can get an alternative source. Such conditions not only disrupt academic integrity and promote unethical conduct but also lead to a frustrated mental state of even serious researchers. Research labs in countries like India, especially in Science and Technology domains, suffer more on this count since the more competent among the aspiring research students are often encouraged to go abroad, which depletes the pool of serious and competent young research community in the country.

Conclusion

Research is primarily a self-driven and self-satisfying human enterprise, which has social extensions. The present scenario has unfortunately transformed research as a market-driven activity, which may generate wealth but often at the cost of the self-satisfying pleasure of discovery (Paul, 2018). Research integrity and ethical conduct are essential for researchers to really enjoy the pleasure of discovering something and of knowing the unknown. In order to achieve this, it is necessary that the future researchers are adequately primed about research integrity and ethics at their formative age. Effective training of enthusiastic young researchers in good ethical practices is as important as training them effectively in their chosen disciplines. The administrators need to create a conducive and healthy competitive environment that encourages creativity and novelty, while the evaluators need to learn to differentiate between quantity and quality. Personal integrity is essential at all levels.

The well-known evolutionary biologist G. G. Simpson (1950) stated, "It is one of the many unique qualities of man, the new sort of animal, that he is the only ethical animal. The ethical need and its fulfilment are also products of evolution, but they have been produced in man alone." The human society owes it to evolution to respect and maintain this unique feature.

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CHAPTER 3

Ethics in Research Publications: Fabrication, Falsification, and Plagiarism in Science

Praveen Chaddah

Introduction

The purpose of research is to add to human knowledge, and to create new knowledge. Research adds to human knowledge by addressing questions that are well-posed, and then trying to honestly find answers. The answers that researchers find are published (or disseminated) in a medium that experts, and students, will read sometime in the future. Publishing these results makes them available now, and for the future. But before these results are published, a few experts (known as referees or reviewers) will try to verify and validate them in, what is usually, an anonymous review process. Validation is necessary before our research output adds to human knowledge.

It can be that someone, somewhere, already knows the answer and the researchers (authors of the paper submitted) were simply unable to search out that answer. This certification of novelty of our results, with reference to existing human knowledge, is one of the primary roles of the reviewers (or referees). The referees also perform checks to ascertain that the procedure that the authors have followed to obtain the answer has no flaws. The flaws can be artifacts that invalidate our experiment or theoretical work, errors in logic, or mistakes in data analysis. The flaws are usually honest, unintentional, and classified as honest mistakes.

In some rare cases, whose number has been unfortunately increasing recently, such flaws are intentional, and amount to research misconduct.

Research Misconduct

Fabrication, falsification, and plagiarism (usually referred to as FFP) are three ethical issues characterized as research misconduct. The first two refer to misdemeanours during research, and the third refers to misconduct during the publication or dissemination process. All three are considered in one category because research is incomplete unless it is disseminated. Fabrication and falsification of data amount to fraud, and will result in some of the researchers, who read this concocted research, wasting their time if they try to follow up on it. Plagiarism is a more commonly discussed misdemeanour because there is a perpetrator of the misdemeanour, and there is also a clearly identifiable victim in the researcher whose work is being plagiarized and whose credit is being stolen. Fabrication and falsification are fraud, while plagiarism is theft of the victim's credit. My dictum to combating plagiarism is, "one should be neither a perpetrator, nor a victim, of plagiarism."

Such unethical behaviour is different from the behaviour involving the living subjects of a research process, encountered in life-sciences or social-sciences. The latter could involve violating the rights of human subjects, of animal rights, running the risk of mutating biological cells, etc. and is outside the scope of this Chapter.

Fabrication and falsification refer to not being totally honest in trying to find answers. Researchers may, for reasons that are guessed to be attempts to get recognition or rewards, not be honest while conducting the experimental or theoretical investigation central to the research, or may conduct the investigation honestly but be unethical during its analyses.

Plagiarism is when the researchers were honest in both these stages of the research project but became unethical while writing their research output. In plagiarism the researchers are, in the paper they have written, claiming credit for the contributions of others and not giving credit where it is due, attempting to steal the credit due of others.

Young researchers need to realize that the research community takes such unethical behaviour very seriously. There is growing effort to impose penalties on the perpetrators, and penalties are even being imposed ex-post-facto. The published research papers are open to scrutiny for posterity, and social media will highlight the allegations pertaining to unethical behaviour in old, published work only when the researchers achieve prominence later in life (Chaddah, 2018). Going by the increasing effort to impose penalties, young researchers must be conscious that the existing penalties may become even more severe as time progresses, and follow abundant caution.

Fabrication And Falsification

Fabrication and falsification mean not being totally honest in trying to find answers. Researchers may, for reasons that are guessed to be attempts to get recognition or rewards, not be honest while conducting experimental or theoretical investigation central to the research, or may conduct the investigation honestly but be unethical during its analyses. Fabrication is the act of concocting results, of reporting observations that were never made, of inventing something in order to deceive. Falsification is to alter (information, data, a document, or evidence) so as to mislead. It is the fudging of results, or of conveniently omitting the data that will not allow one to reach the conclusions being presented. These two are misdemeanours that distort the research work done during research, in that the paper is written showing results that do not exist, or not showing results that exist but would not allow the paper to be accepted with the conclusions that it draws.

Fabrication and falsification of data amount to fraud and cheating. Researchers, who read such concocted research papers, waste their time when they try to follow up on it. A researcher who proposes new research believing this paper, or tries to use these conclusions (which are clearly not valid), despairs when he or she finds out that the paper was fraudulent. The authors of the errant research paper are clearly identifiable perpetrators of the fraud. The victims of the fraud are anyone who believes the results of the paper, and could be many whose suffering will be hard to prove or establish. Unfortunately, the victims are not clearly identifiable. We shall discuss in the next section that plagiarism also has clearly identified perpetrators in the authors of the errant research paper, but the victims in that case are also clearly identifiable as the authors of the work that is being plagiarized, and whose credit is being stolen.

We must understand why fabrication and falsification are not immediately caught on submission of a research paper. When a research paper is submitted to a journal for publication, the anonymous referee (or reviewer) is not expected to repeat the entire experiment or redo the whole calculation. The anonymous referee will not reproduce the research to validate it; referees cannot invest that much effort, and no editors can give the referees that much time!

In a discussion published in *Physics Today* almost two decades back, Levi (2002) stated that "Referees need to assume that the authors are operating in good faith. Once you admit the possibility of

fraud, it becomes nearly impossible to evaluate the paper." The article further states that, "the main tasks of a referee are to ensure that a paper reports physically reasonable phenomena and includes enough detail for people to question the results." The reference to "physically reasonable phenomena" brings in a major cause for fraud. It can also be, as noted in the same article by Levi, that the person disseminating falsehood was like a crystal-gazer who believed that someone else would confirm these results and the crystal-gazer would get credit! Quoting from Martin Blume, the then editor-in-chief for the American Physical Society (APS), Levi (*ibid*.) writes, "He wonders why anyone would risk getting caught by publishing fabricated data that alleges spectacular results unless, perhaps, the person was what he termed a "true believer" who had hopes of getting credit when someone else confirmed the results." Fraud in an effort to be the first, without actually being the first, is the major cause for fabrication of results.

We now come back to "enough detail for people to question the results." The results will be questioned, soon after publication, by independent groups who might have been competing to answer the same question. The results will also be scrutinized, in some distant future, by researchers who believe them and want to take the work forward. Both these groups of researchers are investing a lot of effort and will feel cheated if the errant authors had published fabricated results. These researchers who follow up on the published work are not anonymous, and will go to great lengths to get the errant authors penalised (to receive some moral compensation for their wasted time and effort) if the results cannot be reproduced.

It can also be that the authors indulging in fabrication or falsification consider that the paper they are publishing is not important enough to be tested at all! Unlike the "true believers" that Martin Blume talked about, these authors are publishing only to add numbers to their list of publications and be rewarded based on the present scientometrics-based evaluation systems. This hope that their results will never be cross-checked, and never pursued enough to be questioned publicly, then opens a small window for unethical researchers to disseminate fraudulent results in standard respected journals.

Examples of Fabrication and Falsification from Literature

I am giving here in some detail one example that comes from my discipline, and that I am familiar with. The errant authors were penalized in an exemplary fashion. This should serve as a strong deterrent to our young researchers, especially as this indicates that the research community takes such unethical behaviour very seriously. As mentioned earlier, there is a growing effort to impose penalties on the perpetrators of FFP, and penalties are even being imposed ex-post-facto (that is, on misdemeanours committed before the penalties were listed in the rule-book). This calls for increased awareness of what is unethical since the penalties may become even more severe as time progresses.

Indian researchers have been accused many times of image manipulation. Most of these accusations have resulted in papers being retracted, but with no known case of a penalty that is more severe than that. These instances are not appropriate deterrents. There was one case alleging that a researcher from India fabricated geological data, and the genuineness of the fossil samples was questioned in prestigious established journals (Talent, 1989). A four-year enquiry was conducted and the errant author was, in a limited penalty, suspended from the post of director of the Institute of Palaeontology at the Panjab University in Chandigarh. The errant author was, however, subsequently reinstated following a court order and retired 'normally' with superannuation benefits, in 2002. This case does serve as a kind of deterrent in that the perpetrator was penalized with only a brief suspension.

I now present a case of fabrication and fraud, from my area of expertise, that was investigated in great detail. This case drew a lot of attention, and the penalties that followed included ex-post-facto penalties, and can be termed as providing 'closure'.

During the period 2000-2002 there were nine papers in *Science*, and seven in *Nature*, from the Bell Labs, Lucent Technologies with J.H. Schön as the first author. During this period there were in all at least twenty-eight papers published, with him as the first author, in various high visibility journals. These papers enthralled condensed-matter physicists because they reported organic materials behaving as superconductors, as lasers, as Josephson junctions, and as single-molecule transistors. Popular physics magazines ran news stories reflecting the enthusiasm amongst researchers in the area, but the experimental techniques described were at the cutting edge. As other research groups were unable to reproduce the results, it was believed that maybe the techniques were too difficult to master. But soon there were rumbles of disbelief and questions were raised on inconsistencies in the limited data reported in the papers. There were similarities in the figures, graphs, or plots, shown for different materials. Very similar data was noticed as attributed to different materials in different papers. These led to murmurs that the data being shown in some of these papers was not as it was claimed to be. Accusations of *falsification* of data resulted.

Researchers also noticed a high level of precision in the data in some papers, with signal-to-noise being uncharacteristically high. What was more intriguing that the background noise spectrum, in different plots in different papers, appeared identical. This led to accusations of *fabrication* of data.

Soon Bell Labs formed a committee to investigate, "the possibility of scientific misconduct", and the report of the Committee is now in public domain.[1] The report is very educative about the norms that must be followed in the compilation and archiving of experimental data, but that is beyond the scope of this chapter. The penalties imposed went beyond retraction of all these 28 papers; the papers were all listed as withdrawn. Schön appointment at Bell Labs was discontinued. He had received instant recognition and prizes for his contributions during this period. The prizes awarded based on these publications were later rescinded. Schön had received his Ph.D. from the University of Konstanz in 1997. The University of Konstanz revoked[2] Schön's doctoral degree in June 2004, even though none of the research reported there had been questioned.

Since the university investigation concluded that Schön had not committed misconduct while at the university, Schön appealed in court against the revocation of his degree. The University order was overturned, but there were appeals and it went to three higher courts! But unlike the Panjab University case, all three courts ruled in favour of his degree being revoked; the highest court noted that Schön could still find work as a physicist without a Ph.D. title! Therefore, in addition to penalties being imposed through *ex post facto* laws that may aggravate the offence by bringing it into a more severe category than it was in when it was committed, the revocation of the Ph.D. title definitely asserted that misdemeanours can even affect past events during which no offences may have been committed!

A much bigger fallout of this episode was on the responsibility of the co-authors. While all of Schön's co-authors were completely exonerated of scientific misconduct, the committee was bothered by the absence of widely-accepted standards of behaviour, or of the responsibilities of co-authors. The latter has been corrected subsequently by some publishers who insist on an explicit statement on the role played by each authors in the research process. This has, inter alia, also reduced the presence of honorary authors!

The committee considered the responsibilities of co-authors, specifically in preventing fabrication and falsification, as follows:

- What exactly does the joint or collective responsibility of all authors imply?
- Obviously, every co-author cannot be held responsible for everything in a multi-authored paper.

The report noted that, "Collaborative scientific research requires a high level of trust among participants. However, such trust must be balanced with a responsibility to ensure the veracity of all results. Shared credit for the accomplishment must be matched with shared responsibility."

The Remedial Measures

- Co-authors have, or can demand, access to technical details, and referees do not have that kind of access some Therefore, publishers now insist on an explicit statement that all co-authors have read the manuscript and agree with its content.
- Co-authors shoulder a major responsibility to ensure against fabrication or falsification and, they can be sure that some penalty for any such fraud will be imposed on them as well.
- While we must trust our collaborators, that trust should not be blind or absolute. Collaborators must ensure against fabrication and falsification.
- Penalties must definitely be imposed on the main author responsible for collecting data who obviously passed off fabricated or falsified data as genuine.
- In the future it is highly likely that penalties will also be imposed on the co-authors since they are the first to see the suspect data, and to analyse it. They also have the moral authority to seek its verification by asking for the raw and unprocessed data.

Plagiarism

Plagiarism occurs during the writing up of the research report when credit is not given where it is due to the earlier research publications, and violates ethics during the publication process. In fabrication or falsification there is a clearly identifiable set of perpetrators who author the research; the victims are not easily identified because they are those who believe the research and spend time trying to proceed further. Or those who are not happy with the conclusions and inferences of the published research and want to verify it by reproducing it. These are victims who have wasted a lot of time that they could have spent more productively, and their identity will be known only if they decide to protest publicly (at the risk of wasting even more time!). In plagiarism there are clearly identifiable victims in the persons whose work was plagiarized. Their credit has been stolen. Perpetrators who plagiarize are violators, and those who are plagiarized are victims who lose credit.

Plagiarism is defined as "the appropriation of another person's ideas, processes, results, or *words* without giving appropriate credit". Plagiarism does not give credit where it is due, and is an attempt to steal credit by unethical conduct during the dissemination and publication process. What exemplary deterrent actions can be taken against the violators, and what actions should be taken in support of the victims, will be discussed in this chapter. I mention here that there are many cases where the violators who have perpetrated plagiarism have been given penalties that will act as exemplary deterrents, the victims of plagiarism have been almost always left with a sense of having achieved only partial closure in that some regret is expressed but credit to their earlier work has not been ensured. We shall come back later to whether and how this correction of assigning due credit to the earlier work, or complete closure for the victims, can be ensured.

India is taking strict measures to ensure that researchers are ethical in that their research publications are free from plagiarism. Towards this end, UGC issued a Gazette Notification on promotion of,

academic integrity, on July 31, 2018.[3] This states clearly in the section titled : 2. Definitions under item l: *"Plagiarism" means the practice of taking someone else's work or idea and passing them as one's own.*" We shall refer to the use of another person's words as "text-plagiarism", and the use of another person's ideas as "idea-plagiarism". Text-plagiarism is also referred to as "cut-and-paste plagiarism", and is easily detected by commercially available software that detects text-similarity.

This UGC Notification ensures the use of software that check for text similarity of submitted manuscripts with existing literature, a practice that established journals also regularly follow. The use of such software should serve as a pre-emptive measure, and no future manuscript submitted from a Higher Education Institute (HEI) in India should be guilty of cut-and-paste, or text-plagiarism. There are no similar definitive measures to ensure that submitted manuscripts are free of idea-plagiarism.

The UGC Notification sets up Academic Integrity Panels to investigate complaints of plagiarism, and stipulates penalties in cases where plagiarism is established. The penalties recommended are graded according to the level of plagiarism, and can range from minor penalties to termination of service. It is thus imperative to ensure that our research publications are free of all kinds of plagiarism.

Text-Plagiarism or Cut-and-paste Plagiarism

One must put in some effort, using commercially available software that are reputed to check for text-similarity against the widest possible database (it must be remembered that many research publications are behind pay-firewalls, cannot be easily accessed, and the software has to pay money to access these), to ensure that one has not, even accidentally and inadvertently, reproduced something that one read at some point in time and that got embedded in the subconscious. It is possible that one bypasses some software checks while submitting a manuscript, but one must remember that, "Hobbyists and political opponents have made a cottage industry out of searching the back catalogues of high-profile individuals for evidence of such misdeeds." (Chaddah, 2014, *op. cit*.) This targeting of individuals by non-experts is also worrisome because accidental text-plagiarism may be used as a 'weapon'. You are open to scrutiny for posterity, and social media will highlight the plagiarism allegations pertaining to your old work when you achieve prominence later in life! My considered advice is that one must be generous and give credit wherever it is due, rather than paraphrase and avoid giving credit (Chaddah, 2018).

Self-plagiarism

There is also a possibility of repeating a string of one's words when one is pursuing a novel idea and doing a series of research projects. This is termed as self-plagiarism. This is different from multiple publication of the same research work. It is unfortunately often used to target high-profile individuals. To ensure that we are not victims of this accusation of "self-plagiarism", we must refer to our earlier work not just to avoid charges of self-plagiarism, but more importantly to highlight our continuing and sustained contribution (*ibid*.). We must take special care when we report some results at a Conference, and then include them in a subsequent submission to a journal.

The Ethics of Using Text From Earlier Works

How does one use text from an earlier published work, whether it is authored by others or by one-self, so that it does not amount to plagiarism? The first basic criterion is that one must give credit to the earlier work, and it should be obvious to any reader that one is giving such credit. "Plagiarism-

detection software has opened up scrutiny of scientific publications to non-experts and text that has been copied and pasted without proper attribution" (Chaddah, 2014). This issue can now be raised even on social media.

We must give credit wherever it is due, rather than paraphrasing and avoiding giving credit! It is best to quote from an earlier work, delineating with quotes the text corresponding to idea you are using, rather than paraphrasing. This is especially true if we are building on earlier published research, or using it as a template. As an example from a paper we published (Roy, *et al*., 1998), we quoted (verbatim, clearly delineated) from a 1973 paper of others in the main part of our paper. We believed (and apparently so did the reviewers!) that this did not reduce the importance of our contribution. Quoting from a 25-year old landmark paper probably put our work in proper perspective!

Self-plagiarism or text-similarity by the same authors. It is quite possible that text written in an earlier paper gets embedded in one's subconscious, especially when we are seriously pursuing a problem where we have made some very novel or original contributions. We then do not give up working on a problem after one publication; we pursue the same problem in a series of papers. In such a situation there is bound to be overlap or unwarranted repetitiveness in the introductory section. Often the results of an earlier paper are incorporated in subsequent results to make the current report complete. A common comment from a reviewer seeking 'completeness' in a manuscript, is that the reader cannot keep looking up the same authors' earlier works. This is particularly true if a new concept or protocol was introduced in the first paper. The reviewer rightly asks that the second paper must introduce or justify the findings of an earlier paper in the subsequent paper. We must refer to earlier works; we must quote and cite the earlier papers as needed, to ensure that self-plagiarism is avoided. This happened with us (Roy, *et al*., 2007) where we were asked to reproduce a schematic we had published earlier in the same journal (Kumar, 2006). The schematic introduced our new ideas that had to be re-discussed in the text. Therefore, the earlier paper was cited several times in the later paper. Since both the papers were in the same journal, there were no copyright issues. Copyright is another issue that must be taken care of if one is submitting papers on an ongoing research theme, to different journals.

In all cases it is only ethical to make the reviewers aware of what is new and what is not. With such transparency one does not risk the manuscript being rejected. In a co-authored paper (Lakhani, *et al.*, 2011) we reused figures showing our previously researched data after slight modification. The figure caption (and the text) clearly stated where the data had first appeared. There was, of course, substantial new work to advance new conclusions. The reviewers accepted the advances and the papers were published.

Reusing text within quotations, rather than paraphrasing, is also a particularly good idea if a new phrase or keyword has been introduced in earlier papers, especially so if we want that keyword or phrase to stick in literature and, hopefully get associated with our names. We introduced a new phrase that reformulated the Critical State Model for the magnetic response of hard superconductors (Chaddah, *et al*., 1989). We reasserted this in quotation marks, with an elaborate justification, as we applied this to a case where the original formulation of the Critical State Model was difficult to solve (Bhagwat and Chaddah, 1992). This helped us much later in necessitating a correction when another author used our reformulation without giving us credit (Tulapulkar, 2002)!

We need to take special to prevent charges of self-plagiarism when we report some results at a Conference, and then include those results in a subsequent submission to a journal. The paper that appears in the Conference Proceedings, and the paper that appears in the regular journal, are two publications on the same work. There is bound to be some repetition, and the later publication must cite the former. The sequence of events dictates that the paper in the regular journal must cite the

paper in the conference, even if the paper for the Proceedings has not yet been accepted. This overlap must be brought out very clearly by stating, "The work reported in this paper was presented earlier in the following conference..." as a footnote in the manuscript submitted to the journal. If this is done then it pre-empts any accusation of self-plagiarism. This is an increasing problem these days, but would not be relevant if the Conference proceedings eventually do not get published.

Idea-plagiarism or Paraphrase-and-claim-as-original Plagiarism

As explained, plagiarism includes the appropriation of another person's ideas without giving appropriate credit, and passing them off as one's own. If the idea is copied verbatim, then it amounts to text-plagiarism and would be detected by standard software that UGC requires, and most reputed publishers, utilize. "Idea-plagiarism" involves plagiarizing the idea while paraphrasing the text. We classify it as of the "paraphrase-the-idea-and-claim-as-original" type, as distinct from the "cut-and-paste" type. Since the text-similarity is intentionally destroyed, computer software cannot detect the similarity of ideas. Plagiarism of an idea can be detected only by involving area-experts who go through the contents of the errant paper of the perpetrators, and the original paper of the victims.

"Idea-plagiarism is worse than cut-and-paste plagiarism not just because it is *intentional* paraphrasing, but also because scientists value the originality of ideas more than originality of language" (Chaddah, 2014, *op. cit.*). New ideas lead to breakthroughs, to innovation, to patents, while a particular way of stating the idea does not. This form of plagiarism is of great concern because some articles are exhorting researchers to paraphrase (Roig, 2012). The benefit of this suggestion will be reaped by those who have good command over the language!

Novel ideas in a manuscript submitted for publication necessarily face some scepticism, and this is compounded by referee bias if the authors and/or their institute is not well established. Unusual ideas in the manuscripts of established researchers do not face the same level of referee bias. As discussed earlier (Chaddah, 2014, *op. cit.*), established researchers can assess the validity of novel ideas when they are exposed to them at a Conference when an enthusiastic young researcher describes his ideas seeking a reaction, gets into an intense discussion in pursuit of a post-doctoral position, or communicates an unpublished manuscript. God help us if the established expert has a weak moment because such manuscripts from experts are accepted rapidly and frequently cited. It is important to recognize that idea-plagiarism is not very uncommon.

Unlike the case of text-plagiarism, there is no quantitative measure by which a non-expert can be convinced that ideas have been plagiarized. It is more hurting to the victims than cut-and-paste plagiarism, and is in need of a corrective mechanism. It is quite common to find plagiarism of ideas that have been already published in a reputed standard journal. We shall discuss specific examples of this because original ownership of the ideas is well documented, and there is a possibility to fight back. We shall discuss how one can fight back, and the limited corrections currently available.

Corrections for Plagiarism

1. *Penalties for text-plagiarism*

Earlier, we discussed a very serious case of fabrication and falsification of data in which some penalties were imposed on the first author. The co-authors were not penalized, although their reputations could have taken a mild hit.

The UGC Notification[3] does prescribe specific penalties for plagiarism in paragraph 12. These penalties refer to text-plagiarism or cut-and-paste-plagiarism, because it quantifies the level of plagiarism. This document (it is free to read and in public domain) specifies separately the penalties to be imposed on students, and on faculty and staff. In each case, it categorizes (text) similarities at levels up to 10 per cent, up to 40 per cent, up to 60 per cent, and above 60per cent. The penalties become increasingly stiff for higher levels.

The penalties are stiff, and should serve as exemplary deterrents. We can hope that there will be no text-plagiarism in research output from Indian HEIs. Eradication of idea-plagiarism needs a more complicated process because: (i) it cannot be quantified, and for this very reason, (ii) complaints against it cannot emanate from non-experts, and cannot be decided by non-experts or on social media.

2. *Correction mechanisms for idea-plagiarism*

How can idea plagiarism be prevented? How do journals ensure that every published paper gives credit to ideas that have appeared in earlier papers? This is done by ensuring that relevant earlier papers are cited appropriately. A very frequently quoted editorial that was published in various journals of the American Physical Society stated, "The quality of referencing must be a responsibility primarily of authors, but also of referees, as all should be aware of pertinent previous work. Citations should be as complete and up to date as possible…."[4] It further stated, "Failure to reference can cross the line to plagiarism when a deliberate omission creates the impression that authors of the later paper conducted the research reported in the omitted reference." This highlights the importance of appropriate references (or citations) in ethical publishing. The emphasis on referencing of earlier work was clearly an effort on ensuring proper credit to potential victims of idea-plagiarism. 'Registration', or recording date-stamped priority, is one of the five functions of research journals.[5] It is expected that journals register priority not just by publishing the date on which the manuscript was received, but also by ensuring that papers published in their journal are referring properly to earlier works, published in their own journals or elsewhere, in the spirit of 'giving credit where it is due'.[4]

3. *Penalties for the perpetrators*

In case the failure to cite and give appropriate credit is pointed out (usually by the victim authors) after publication, and the need to give credit to the complaining victim authors is upheld by expert referees, the editors need to ensure a suitably worded erratum. These errata basically set the records straight, and give some satisfaction to the victim whose credit has been appropriated by the authors of this errant paper. Is that satisfaction justified? Will subsequent papers refer to the original paper restoring credit of an idea to the actual originators of the idea, or will they refer to the later errant paper that wrongly appropriated credit by plagiarizing the idea with clever paraphrasing?

This practice of publishing errata does not help enough because the erratum is "less likely to be found and cited" (Chaddah, 2011). This could be because errata papers that correspond to adding missing references and are supposed to give credit where it is due are not even separately categorized. The ineffectiveness of such errata for correcting idea-plagiarism is exemplified by data showing that publishers do not ensure that the erratum is subsequently cited along with the errant paper even in the same journal A few journals have recently been following the suggestion, "Such an Erratum has to serve any purpose towards …commitment to Ethics, then it must become a part of the pdf file of the original paper"(*ibid.*). Some journals actually post (all) errata as the first page of the pdf file of

the errant paper, where it cannot be missed! These are very few instances, but they represent laudable initiatives.

A recent editorial in the journal Experimental Economics (Cooper, *et al*., 2017) has highlighted the start of a contrary, and disturbing, trend. It states, "The policy of Experimental Economics in the future is that we will not publish errata to correct a failure to cite previous work, except under unusual circumstances." It goes on to advise researchers who feel their work or ideas have been plagiarized with clever word changes, stating that "Those authors who feel that they should have been cited or that were cited inaccurately in an article that we have published will have to use other means, such as posting notices on their own websites" (*ibid*.). This sets a dangerous precedent of putting the burden of correction totally on the victims, and issues have been raised with well-reputed publishers Hopefully this unsettling trend will not persist. Researchers must be cautious and ensure ownership of their ideas.

4. *Justice and closure for the victims*

The current status of justice for the victims of idea-plagiarism is best discussed through examples. The victim of idea-plagiarism is up against odds, and unlikely to get even partial, leave alone complete, closure (Chaddah, 2019). For various reasons ranging around complete knowledge of the events surrounding each episode, I shall use only examples where I was a victim, and where I filed complaints that were upheld by experts as evidenced by the fact that reputed journals took visible corrective actions. There were however, limitations of the corrective actions taken. The limitations reflect the fact that no active researcher (as most victims are) can invest more than a very limited time and effort in seeking corrective actions. However, all active researchers can take various precautions to protect and register their original ideas. It has been stressed (Chaddah, 2018, *op. cit*.) that the onus of claiming date-stamped priority rests with the researchers, and it has been suggested that the first step is to upload their manuscripts on well-established preprint archives when, or even before, these are submitted to a journal.

Here I briefly list the three episodes where I could obtain partial closures (Chaddah, 2019, *op. cit.*).

- The first episode was in 1975-1977. My first paper as a Ph.D. student, published on December 16, 1975, introduced the concept of "geometrical broadening" and how higher energy photons worsened the effective resolution in Compton Profile measurements, overturning conclusions that prevailed until then (Chaddah and Sahni, 1975). Six months later McIntire (having affiliations to University of Houston, Texas, and Argonne National Laboratory, Illinois) submitted a paper where the title talked about "angular-broadening effects" in Compton profile measurements, with the term angular-broadening occurring about 20 times in the paper (McIntire, 1976). This paper used the idea we had proposed, drew the same conclusions that we had drawn, appeared eleven months after our paper, and did not cite us. As a 25-year-old, I was stunned, protested, and the journal agreed to publish an erratum (McIntire, 1977) that cited both our journal paper and our conference paper. Many years later, I realized that this erratum was never cited in any subsequent paper, and my 'closure' was incomplete and was only a psychological 'sop' that I gullibly swallowed. We must ensure that if we succeed in getting a correction, then that correction receives visibility. Towards the end of this Chapter I will propose a mechanism, preferably under the aegis of UGC, to ensure such visibility.
- In 2001-2005, we observed novel features in our study across the first-order magnetic transition in doped $CeFe_2$.We published our results during 2001 and 2002 in two papers (Manekar, *et al*., 2001; Singh, 2002), and in 2002 (Manekar, *et al*. 2002). In these papers we also published our

new and out-of-the-box explanation for these observations. We were clearly attempting to give wide visibility to our novel observations, as also to our explanations that invoked slowing down of the kinetics of the first order transition. We argued that the kinetics was getting hindered, and finally arrested, as in the formation of a structural glass. In one of these papers (*ibid.*), we stated in the abstract that our observations, "can be understood in terms of kinetic arrest of a first-order transition". Our dissemination through these journals also indicated acceptance in respected peer review channels. In our paper in 2001 (Manekar, *et al.*, 2001, *op. cit.*), we highlighted, while summarizing our unusual findings, the novel observation of, "butterfly R-H and M-H hysteresis loops (that) have an anomalous virgin curve at low temperatures, in that the virgin curve lies outside the envelope hysteresis curve in both measurements." Thus, butterfly loops, along with virgin curves lying outside the envelope hysteresis curves, were new observations that we clearly brought out in 2001 and discussed also in our papers in 2002 (Manekar, *et al.*, 2001, 2002, *op. cit.*).

It was with some shock that we noted, in the following year, a paper (Zhang, *et al.*, 2004) in the same journal, *Physical Review B*, where we had published two papers in 2001 and 2002 highlighting our observation of butterfly hysteresis loops and anomalous virgin curve, stating in the abstract itself that, "We also observe that the magnetization versus field butterfly loops occurs, while the virgin curve lies outside the envelope magnetization curve." There was no obvious acknowledgement of our earlier observations reported in the same journal (in fact, these two papers in the same journal were not even cited), or of our explanation thereof. A close look at this "errant paper" revealed a lot of ethical problems, and this is summarized in the slightly detailed erratum that the journal made them publish after about six months (Zhang, *et al.*, 2005). In contrast to the episode of 1975–1977, here the authors did express regret. But, as we shall argue, there was no remorse from the authors and the journal did not ensure complete closure; we had to be satisfied with this partial closure. As a supporting statistic, the original errant paper published in 2004 is shown on the PRB site as having been cited 28 times, whereas the erratum in 2005 is shown as cited only three times. We cannot expect a victim of plagiarism to give up active research when pursuing novel ideas, and continue a relentless battle for complete closure. I propose for UGC to undertake this task of helping Indian researchers who have become unfortunate victims of idea-plagiarism.

- The third episode corresponds to the time period 2009–2011. In 2005 we published our concept, supported by a lot of experiments, that the kinetic arrest of this first-order magnetic transition causes the formation of a nonergodic state, that we called a magnetic-glass (Chattopadhyay, *et al.*, 2005). In a paper published in 2006 we established that the magnetic-glass could be devitrified to the low-temperature phase on heating in a different field, and then transformed to the high-temperature phase on further heating (Banerjee, *et al.*, 2006). We could show re-entrant magnetic transitions in two contrasting materials if we chose suitable different magnetic fields for cooling and subsequent heating. The data was visually drastic.

  Over the next few years, we published papers on various materials using this CHUF protocol, an acronym we created following a general suggestion of Nobel Laureate Kurt Wuthrich (see Chaddah, 2018) to show a re-entrant transition on using appropriately chosen cooling fields and heating fields (Banerjee and Chaddah, 2009, Dash, *et al.*, 2009, Kushwaha, *et al.*, 2009, Sathe, *et al.*, 2010.) A few other groups did the same, referring to our initial work and giving us due credit (Roy and Chattopadhyay, 2009). In the middle of 2011, over two years after our claim of CHUF was published, we again got a shock. We were amazed to see a paper from Prof Raveau's group (Sarkar, *et al.*, 2011a), where "kinetic arrest", "magnetic glass" and "CHUF" were used extensively, a whole section was devoted to introduce, utilize, and applaud the CHUF protocol.

What amazed us was that this section described the protocol as "specially designed", and carried no reference in the entire section, implying that the protocol was specially designed by the errant authors. The entire paper had no reference to our various publications on CHUF, no credit was given and was therefore, implicitly and quietly, usurped (or stolen?) by the authors. We were also amazed that the thorough refereeing process of a reputed journal allowed this to slip through, even though two papers had already appeared in the same journal where this protocol had been used and our paper appropriately cited. Our protest to the editors resulted in an Erratum (Sarkar, *et al.,* 2011b), but hardly anyone reads an erratum. I pointed this out to the editors, illustrating my point with the examples already discussed here. The response was interesting because it agreed that pointing out this type of omission in an erratum is less likely to be found and may even be ignored by those who do find it. Was this an acceptance by the journal that the erratum would only provide partial closure? As I have asserted earlier (Chaddah, 2015), physicists often study first order transitions that can be caused by two (or more) control variables; the self-explanatory acronyms CHUP and CHUE would be used if the second control variable is pressure (as in liquid-solid transitions) or electric field (as in dielectric transitions). More detailed discussion on this protocol can be read in my recent book (Chaddah, 2018b). Would anyone give us credit when the analogous protocols like CHUP and CHUE are used?

A Proposal for Ensuring "Complete Closure"

What are the issues if a victim gets only partial closure? I have described episodes that occurred during 2001-2005, and during 2009-2011. We had obtained peer-reviewed corrections in 2005 (including an expression of regret) and in 2011 (including an explicit apology). I shall now describe events that happened in 2012 and later, emphasizing that various other groups are still trying to usurp credit for our original ideas.

In 2012, a group of researchers from institutes across the USA, Japan and Russia published a detailed study of kinetic arrest phenomenon in a magnetic shape memory alloy (Monroe, *et al*., 2012). Though kinetic arrest was referred to close to a hundred times in this paper, the manuscript has no reference to our contribution. This was apparently noticed at the Editor office at some late stage, and two references to our works appear as "Additional Relevant References" in the final print version. That these were added as an afterthought is clear from the fact that these two papers are not cited in the text, and no justification is given for listing these additional references. It is a conjecture that such heavy sprinkling of "kinetic arrest" alerted some radar and some reference to our works was deemed essential.

What followed was unusual. Some of these authors were apparently unhappy in drawing attention to our works, and giving us any credit! Three of these authors (viz. Umetsu, Kainuma, and Ito) were part of a bigger group from Japan that submitted a paper within a few months of this episode, and this was published six months after Monroe, *et al.* (*ibid.*). This later paper stated (Umetsu, *et al*., 2013), "We have also observed the thermal transformation arrest (which was called "kinetic arrest" in our previous papers) phenomenon." It was obvious that they were changing the terminology with the likely intention of not giving us credit. I recently saw a paper published almost four years later (Wakamori, *et al*., 2016) titled "Thermal Transformation Arrest Phenomena in $Mn_2Sb_{0.9}Sn_{0.1}$", with Umetsu as one of the authors. The title makes clear that Umetsu is consistently following what was enunciated in their 2013 paper, and trying to stop the use of the term "kinetic arrest", at least by researchers in his sphere of influence! I wish to put on record that these researchers from Japan are the only ones that have tried to rechristen the phenomenon. As is obvious from their having to cite many of our papers even in this paper, the checks and balances in the peer review process have not allowed them to take away our credit. But I cannot attribute this protection of our credit to any support from any Indian body.

We now present a case where a well-established group abstained from acknowledging our work, and desisted from giving us credit. A paper in 2013 (Nayak, *et al*., 2013a) showed the magnetization hysteresis loops of Mn_2PtGa having an anomalous virgin curve that lay outside at the temperature of 2K. The anomaly became less prominent as temperature was raised, disappearing at 40K. This was exactly what we had shown in 2001, in doped $CeFe_2$ in our paper in *Physical Review B*. We had explained this as due to kinetic-arrest. This paper appeared 12 years later, in the later journal from the same parent journal, apparently oblivious of our paper and of our explanation.

Within a few months, in April 2013, the same group published another paper (Nayak, *et al*., 2013b) on the same material. This paper was titled "Kinetic arrest related to a first-order ferrimagnetic to anti ferromagnetic transition in the Heusler compound Mn_2PtGa". The abstract started with the sentence "We report a magnetization study of the Heusler compound Mn_2PtGa that shows the existence of a magnetic-glass state." The references to our published papers were in passing, but there was no reference to our papers published after 2007, specifically none to our creation of the CHUF protocol. However, their main experimental results section starts with "To probe the existence of a magnetic-glass state in Mn_2PtGa, we have performed M(T) measurement in 1T after cooling the sample in different fields." They performed measurements using the CHUF protocol, without using our words. Their paraphrasing avoided detection of text-similarity, and also avoided giving us credit. Or was this just another case of plagiarizing our idea, with clever manipulation of words to avoid the radar of software that detects text-similarity?

In these instances, there is an attempt to usurp credit by using different terminologies. We shall now discuss whether active researchers must bear the burden of victims, continuing to highlight the plagiarism of their work or ideas, or there can be an institutionalized mechanism for closure of such misdemeanors that leaves them free to pursue their research. Young Indian researchers, particularly, should not be distracted from their research activities. We recognize that researchers who propose out-of-the-box ideas are more likely to suffer from reviewer bias and be victims of idea plagiarism. Research in India is expanding with many new HEIs being set up in smaller cities. Young researchers in such emerging bylines, if they become victims of idea-plagiarism, should not be left to fight individual battles for ownership of their novel ideas.

It is clear that we need a mechanism to help Indian researchers retain their ownership, to safeguard our IPR (Intellectual Property Rights). I now propose such a mechanism, for consideration of UGC.

I propose that there should be, on the UGC-CARE website, a well-publicized invitation like "Has someone taken your published work or idea, paraphrased it to escape detection by software, and passed it as their own? Do independent area-experts agree that you should have been given credit?"

Any submission (I would not use the word 'complaint') in response to this, by individual researchers, must then be evaluated by an independent set of area-experts. These experts could even be the peer-reviewers of established journal who approve the publication of an erratum or a comment, or could be area-experts selected by UGC-CARE. Experts would have already approved the correction or notice that is published by the journal; UGC-CARE area-experts could approve a suitably worded notice. In either case, this notice would then be posted on the UGC-CARE website, and given enhanced visibility as IPR for "non-patentable research". Such extensive visibility is necessary to ensure that Indian researchers are not victims of plagiarism, of *someone else taking the work or idea of a researcher in an Indian HEI and passing it off as his or her own.* Ethics in publishing research must ensure that researchers in our HEIs are neither perpetrators nor victims of plagiarism.

Conclusion

- We in India have already set up mechanisms to ensure academic integrity, to prevent plagiarism by Indian researchers, and to penalize our researchers when they do wrong.
- We must similarly set up new mechanisms to enhance the visibility of Indian research output, to ensure that it receives due credit and is not ignored.
- We need to change our servile mentality of living with humility (*aankhein jhukakar*) and teach our young researchers that they have to live with self-respect (*aankhein milakar*). We must set up mechanisms to provide support to our researchers when we are wronged, just as we in India have set up mechanisms to penalize our researchers when we do wrong. Such new mechanisms would ensure that Indian work is not ignored and receives due credit.
- We must provide support to our researchers when they are wronged (by someone from abroad taking their work or idea and passing it off as their own) and denied due credit.
- My dictum to combating plagiarism is, "one should be neither a perpetrator, nor a victim, of plagiarism". There are various precautions that I have suggested earlier (Chaddah, 2018a, *op. cit.*) to ensure that we cannot be scooped, and that we can register and protect ownership of our novel ideas in an academically accepted way. Designing our research problems, utilizing Chanakya's philosophy, will ensure that we are not scooped. This was outside the scope of this Chapter but has been discussed elsewhere (*ibid.*). Registering and protecting ownership will benefit from the proposed mechanism under the aegis of UGC.

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Endnotes

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CHAPTER 4

Research Ethics in Social Science

Padma Prakash

The purpose here is to make social scientists aware of the ethical issues that may arise while conducting research and communicating these to the research community and to the public at large, in various ways. As social scientists, we need an understanding of ethical practices so that we can utilize these to make ethical choices and resolve the ethical dilemmas that are bound to emerge in the course of any research inquiry. Social scientists need to take responsibility for their ethical practice.

Traditionally, social science includes sociology, psychology, anthropology, economics, law, and political science, although there is no rigidity on which disciplines may be included. For instance, public health sciences may also today be regarded as a social science. Several subfields, such as, human geography, cultural studies, business studies, development studies, forensic and criminological studies, and creative economics may all be included in social science. This diversity offers a challenge to evolving ethical perspectives in social science research and defining guiding principles.

Background

Ethical consideration in social science research is of more recent origin than it is in the biomedical sciences. In medical practice and health research, ethical codes were prompted by the horrific Nuremberg trials conducted in Nazi Germany in 1946. This gave rise to the Nuremberg Code that insisted on voluntary participation and informed consent that has been developed further and finely embedded and is updated periodically in all medical research (Mandal, *et al*., 2011).

This was followed by the Declaration of Helsinki in 1964. Despite these there have been travesties, such as, the ghastly Tuskegee Syphilis Study in the US that began in 1932 and went on for 40 years. The study involved 600 black men, with the objective of studying the natural history of the disease. Patients were denied treatment even though penicillin became available in the 1950s. Only when a reporter broke the story did it come to light. These dramatic and tragic incidents have made for a body of ethics that is applied in medical/clinical research.

To what extent do ethical issues in the sciences apply to behavioural and social sciences? There are some classic cases of extreme violations of ethics within social science and humanities, some documented and others not. An oft-mentioned case is the Stanley Milgram's "obedience to authority" study in the US in 1963, which was supposed to examine if administering shocks would enhance learning. No consent was taken from the study volunteers and nor were they allowed to quit midway (Mandal, *ibid*.).

The watershed moment for the development of ethics in the social sciences was perhaps the 1960s Norwegian study, the so-called Metropolitan study, involving school children. One part of the study aimed to follow boys from age 11 to adulthood so as to provide better vocational guidance and social assistance in the future. The government supplied the required information on the cohorts to the researchers, which attracted enormous public criticism for revealing private data without consent and demanding better safeguards. But the reluctance of the researchers in amending the project led to severe backlash for social research in the country and in Europe (Johansen, *et al*., 2001: 35–37). This

led to establishing a data-protection secretariat within the Norwegian Research Council for Science and Humanities and eventually in the late 1960s and 1970s to various laws ensuring protection of data (*ibid*.) and spurring the development and codification of ethics in Europe and the US.

Social scientists have long pointed out that ethics has always formed an implicit part of the discourse among the founders of sociology such as Durkhiem and Weber and of later scholars too. Even as these founders of sociology strived to establish a discipline based on scientific principles, free from the moralizing and values of contemporary society, they engaged with ethical concerns, even implying that the very practice of sociology in fact, involved the developing of guidelines to assess social good. Shils, for instance, asserts, "The true calling of sociology is to contribute to the self-understanding of society" (Shils, 1980).

There has been long-standing debate and discourse on the issue of ethics in social sciences (see Barnes, 1977) and there has been considerable resistance to a codification of ethics. On the other hand, some social scientists have strongly argued that social sciences should get out of the "Imperialism of a research ethics constructed for the purposes of governing biomedical research…" (Emmerich, 2016). He further argues for "a practical or pragmatic diversity in the ethical standards that guide practice" cautioning that this was not a claim for accepting contradictions in ethical practice or allowing for loose definitions of ethics. Rather, Emmerich writes, "It is, simply, to recognize that the ethical requirements of a profession as a whole need not be an entirely aligned, and that there may be a justification for the adoption of alternative perspectives in professional sub-domains" (*ibid.*)

In sum, codes, guidelines and principles in social science and behavioural science research had begun to be established across Europe and the US only in the late 20th century with their further development and codification gathering pace with the expansion of social science disciplines across the world and encompassing many cultures.

The Modern Scenario

The American Sociological Association (ASA) published its first modern code of ethics in 1989 and focused on three general areas:

1. *Full disclosure of motivations for the research*: This addressed the fear among social scientists that they may be used to extract information from the general public by agencies of social control (government, police, and the like.). The code exhorted sociologists to disclose agency and not to misuse their position as researchers to gather unnecessary data.
2. *Avoidance of harm*: This referred to the need for sociologists not to issue assurances if they were not able to fulfill those obligations.
3. *Assurance of adequate qualifications for conducting the research*: This third code anticipated the continuous developments in the discipline in that it needed the researcher to make an assurance that the expertise used was adequate to the research on hand. This part of the code is extraordinary, say commentators, in that it spells the conflict between a sociology that by definition and practice is critical of authority of established institutions and the acknowledgement of the limitations of current theories, tools and technologies available for sociological inquiry. (ASA, 2018).

Acknowledging the legitimacy of these differences in an ethical principle reflects a strenuous attempt by sociology as a social system to accommodate subgroups whose basic approaches to the discipline are inconsistent with each other in important respects".[1]

In 1974, the US Congress passed the National Research Act and set up the Office of Protection of Research Risks (OPRR). This, over time, produced the Common Rule adopted by all federal agencies that mandated the setting up of institutional review boards that examine all research that involves working with human subjects and animals (ch. 4).[1]

Professional associations like the British Sociological Association (BSA, 2017), have periodically revised ethical codes for sociological research. It was only in 2005 that The Economic and Social Research Council (ESRC) in the UK came up with a framework for guidelines for social science research (ESRC, 2015). The Norwegian National Research Ethics Committees' Guidelines was published in 2006 (NESH, 2006). In 2015 a report was published as part of the project "Stakeholders Acting Together on the Ethical Impact Assessment of Research and Innovation – SATORI" of the European Commission (SATORI, 2015). The report on ethics assessment, pointed out, "Ethical guidance and standard setting in the social sciences is largely in the domain of national and international professional associations" and are not subject to national or international regulatory norms. In its conclusion, the report states

> …a field or discipline-specific approach is needed. While basic principles and issues – such as avoiding harm and doing good, informed consent, privacy and confidentiality – are equally as important in social sciences as they are in biomedicine, the nature of risk and ways of avoiding it are significantly different due to different objects and methods of research (SATORI, 2015 :22)

Clearly, the need for comprehensive and elaborate codes of ethics for social science research is self-evident and well-established. Without codification it is difficult to implement ethical conduct. Further, with the growing dimension of international collaborations in social sciences, and the increasing use of multi-method research and the development in analytical methods using Artificial Intelligence and machine learning, the need to establish and recognize a common set of ethical practices has become more urgent (Wassenaar and Corbella, 2005).

Status of Research Ethics in Social Sciences in India

Surprisingly, the codification of ethics in social sciences has not received much traction in India. Not many universities have ethical guidelines for social science research. The Indian Council for Social Science Research (ICSSR) does not have such guidelines either. The University Grants Commission's Research Development and Innovation Programs Implementation Guidelines (UGC, 2017), deals with a long list of areas, but with little elaboration. Under the section on research ethics it simply states:

> The higher education institutions receiving the UGC research funding are required to have a Responsible Conduct of Research Guideline and an instruction program to instruct the researchers about the guideline.(*ibid*., p. 24).

It lists the following areas that should be covered by the institutions:

1. Data acquisition, management, sharing, and ownership;
2. Supervisor/trainee responsibilities;
3. Publication practices and responsible authorship;
4. Peer review;
5. Research collaboration;
6. Research involving human subjects;

7. Research involving animals;
8. Research misconduct, and
9. Conflict of interest and commitment. (*ibid*., p. 25).

But the institutions are expected to develop their own codes.

The Indian Sociological Society [2] too has a code of ethics that is easily accessible on its website. It is however only a brief three-page document that does not elaborate on ethical issues in research nor the various responsibilities of the researcher.

The National Institute of Advanced Science (NIAS)[3] is among the small number of research institutions in academia that have a set of ethical guidelines. It has a well-developed code that is wide ranging and is available on their website. Several Central Universities have their own codes of ethics, most focus on plagiarism and data dissemination rather than the conduct of research, the rights of participants or the need to prevent harm, and so on.

What about research ethics in social science disciplines other than sociology? In 1986, Amartya Sen gave a series of lectures under the Royer Lecture series at the University of California, Berkeley on 'Ethics and Economics', put together as a small volume that the Foreword by John M. Letiche calls "A terse synthesis of the relevant literature on ethics and economics". In the course of this series of talks, Sen pointed out that a 'distancing' had occurred between ethics and economics and called for determined inclusion of ethics in economics that he said would infinitely benefit economics, especially welfare economics, but also how the study of ethics may benefit from economics. The lucidly written volume drew considerable debate and had an impact on current thinking on ethics in economic research praxis (Sen, 1989).

In a wide-ranging public discussion prompted by the award of the Nobel Prize in Economics to two development economists who developed and used RCTs, there has been a clamour for a law to be enacted and a regulator to be designated for ethical conduct in social science research. See for instance, Ila Patnaik's column in *The Print* (2017) where a particular focus on the issue of RCTs prompts an impetus to develop research ethics codes. (See Box 1).

However, one might venture to say that research ethics appears to weigh less in economics than say, in sociology. At the least, it is most evident in sociology and those branches of economics that impinge on sociology. Where multidisciplinary methods and perspectives are involved, there is generally a well-structured code of research ethics. For instance, the Economic and Social Research Council, UK (ESRC) has a most comprehensive code of research ethics and a website that features important issues and dilemmas in research.

Codes of ethics have also been formulated in the humanities. In psychology for instance, the code is far more detailed than any other discipline and leans towards codes in medical research and practice.

A big impetus for the growing interest in ethics in social science research has come from the expanding area of health- and welfare-related research, notwithstanding the fact that social scientists, such as Emmerich (*op.cit.*), have argued for viewing ethical practice in social sciences quite differently from biomedical and health sciences.

A comprehensive code of ethics across social science is yet to develop in India. To fill this gap in ethical guidelines for social science research in health studies, a National Committee for Ethics in Social Science Research in Health (NCESSRH) was set up in 2000 that formulated such a set of guidelines This was later revised and expanded as The Draft Code of Ethics for Research in Social Sciences and Social Science Research in 2004 (NCESSRH, 2004). and prompted the Indian Council

of Medical Research to include specific sections dealing with the social sciences in health research. The emergence of the *Indian Journal of Medical Ethics* gave impetus to discourse on ethics that led to an interest in the subject among social scientists' bodies. In the absence of a comprehensive and universally applicable code or guidelines that are applicable across institutions and types of research, researchers can only apply institutional guidelines, if they exist, or guidelines developed in other countries and for different purposes.

What Is Research Ethics?

Generally, most people think of ethics as rules that distinguish between right and wrong. Ethical codes are also considered moral codes. Most often ethics refers to rules that are a guide to doing the right thing, although, what the right thing is, remains relative to the context. In consequence, there are ethical norms to be followed at home, at school, at work or in society or in places of worship, or for that matter in a public space, and so on. They may also be different for different sets of people who are viewing the same phenomenon. For instance, abortion may be wrong or right. While there may be legal frameworks, they may not be the same as ethical frameworks, which are informal and subject to interpretation in a way that law is not. Ethics may be defined as, "A method, procedure or perspective for deciding how to act and for analyzing complex problems." (Resnik, 2015). "As a concept, 'research ethics' refers to a complex set of values, standards and institutional schemes that help constitute and regulate scientific activity." (NESH, *op. cit*.). While the subject of ethics is complex and has in fact generated volumes of discussion, at the core, ethics rests on human and humane considerations.

Research ethics is grounded in the principles and practice of science. In other words, research ethics may be defined as "codification of ethics of science in practice". There can then be no separation of science and ethics since the latter is embedded in the practice of science. The ultimate responsibility of scientific research in social sciences is to seek the truth. So, it follows that scientific integrity is a key component of research ethics. One cannot expect a poor scientific study to be ethically sound. Inevitably scientific standards or standard operating procedures (SOPs) related to research, influence the practice of ethical responsibilities in research. The former will include relationship among researchers, between researchers and institutions, and such acts as dissemination of research and how it is used.

While a consideration of ethics is an integral part of the structure of research, ethics exists within a social context and must be considered separately in each context without diluting the content of the ethical principle. Scientific methods and tools are also under constant development. Not using the most appropriate conceptual frameworks and methods leads to ethical inadequacy in the study. This constant questioning of methods and processes is necessary from both a scientific and ethical standpoint, to quote Yogendra Singh (1973: 27).

Whereas we do not have to become cynical towards the internationally accepted norms of scientific objectivity, theoretical generalization, measurement and prediction in the social sciences, we do have to closely examine the value-presuppositions of each social science paradigm which we use on our own or because of inspiration from abroad. It is these value-presuppositions underlying the hypotheses and definition of the problems of social research which delimit the relevance of social science research.

An ethically sound social science research must examine and reexamine the concepts, paradigms and methodologies to ensure its appropriateness and adequacy to studying the problem before applying them in the study. This is integral to ethically-sound research.

To sum up, the codification of research ethics is important in ensuring the relevance of social science research as well as its significance and utility. It also ensures that the best principles of scientific methodology are followed in the social inquiry. But it must be recognized that research ethics is evolving and, in that sense, is fluid rather than dense, although this does not translate to nonchalance in its application.

Currently, four well-known moral principles constitute the basis for ethics in research. These are:

1. *The Principle of Non-maleficence*: Research must not cause harm to the participants in particular and to the people in general.
2. *The Principle of Beneficence*: Research should also make a positive contribution towards the welfare of people.
3. *The Principle of Autonomy*: Research must respect and protect the rights and dignity of participants.
4. *The Principle of Justice*: The benefits and risks of research should be fairly distributed among people. (NCESSRH, 2004)

A more evolved set of principles, more appropriate to all social sciences may be broadly categorized as: (1) respect for individuals, and (2) respect for groups and institutions.

Respect for individuals*:* This includes respect for human dignity, respect for integrity and freedom, and the obligation to avoid injury; to obtain informed consent; to ensure individual's privacy; ensure confidentiality; to protect the rights of children, and guard and store information safely and securely.

Respect for groups and institutions: This includes regard for disadvantaged groups; for cultures and their preservation; for private interests and public bodies.

Respecting and protecting scientific integrity; affording and acknowledging contributions of others; eschewing plagiarism are other important principles.

Following from this the fundamental questions that every researcher must ask (Williams, 2003):

- What moral principles guide your research?
- How do ethical issues influence your selection of a research problem?
- How do ethical issues affect how you conduct your research: the design, sampling procedure, and so on?
- What responsibility do you have toward your research subjects? For example, do you have their informed consent to participate in your project?
- What ethical issues/dilemmas might come into play in deciding what research findings you publish?
- Will your research directly benefit those who participated in the study?

In keeping with these aims, the rest of this text is divided as follows: Research ethics as it applies to:

- Choosing the topic of research, conducting literature survey and framing the research question;
- Choosing the research design, methodology and constructing or tools;
- Responsibilities towards the participants of research;
- Data collection, data storage, data utilization, and data security and the analyses of the data;
- Responsibilities towards the community or society, which is the subject area of research; informing the participant population of the research findings;

- Narrating and presenting the findings, and
- Publishing the research.

A word of caution is that research ethics in India is still in an early development stage. Not only is it necessary to keep track of how individual researchers are dealing with ethical dilemmas, it is equally necessary to discuss our personal dilemmas in appropriate fora so that these add to the body of research ethics in social sciences in India. This is especially pertinent because we, in India, neither have laws governing or even impinging on research ethics, nor have the Indian social science associations and bodies developed a comprehensive code of research ethics.

Requirements and Consideration during the Research Process

Choosing a Research Topic

The primary consideration for conducting a research study is no doubt the fact that it presents questions to the sociological mind that have not been answered. This may be prompted by sheer curiosity. Or it may be that there are gaps in our understanding of the phenomena that need to be filled. These gaps need to be bridged for several reasons:

- The need to satisfy our curiosity.
- The fact that the new knowledge would enhance our understanding and directly or indirectly benefit the community.
- The fact that it might address policy concern.

All of these are not ethical reasons for conducting the research. While social researchers may be committed to the advancement of knowledge this does not give them an entitlement and does not allow them to overlook the rights of others. The questions that every researcher must ask are:

- What is the purpose of this research?
- What are its benefits?
- Who benefits?
- Does it harm?

As the British Sociological Association (BSA, *op. cit*.) cautions:

Sociologists as researchers should satisfy themselves that the studies they undertake are worthwhile and that the techniques proposed are appropriate.

And further…

Although sociologists, like other researchers, are committed to the advancement of knowledge, that goal does not, of itself, provide an entitlement to override the rights of others.

The Tri-Council (1998) code reminds us further that social research has a commitment to "advancing human welfare, knowledge and understanding and to examining cultural dynamics". After all, such research is funded on the premise that it alleviates human suffering, or validates social theories, may examine policy, and so on.

Research involving human subjects imparts at least three general categories of benefits:

- The basic desire for new knowledge and understanding is the driving force for research.
- The quest to advance knowledge sometimes benefits research subjects. Subjects may benefit from

improved treatments for illnesses; the discovery of information concerning one's welfare; the identification of historical, written, oral or cultural traditions; or the satisfaction of contributing to society through research.

- Research benefits particular groups and society as a whole. Thus, insights into political behaviour may produce better policy; information about the incidence of disease may improve public health; sociological data about lifestyles may yield social reform; and disciplines based on, for example, texts, dance, theatre or oral history, continue to illuminate past and present realities. (Tri-Council, 1998: i4).

The Canadian Sociological Society's somewhat briefer code of ethics charges researchers with the need to, "use utmost self-discipline and professionalism while choosing a research problem."

The Indian Sociological Society [2] appears to put more emphasis on whether the research focus will produce "original work":

> Researchers in sociology must be trained to use utmost self-discipline and professionalism while choosing a research problem; deciding about the methodology and theoretical formulations, with the sole aim to produce original work, with self- checks on plagiarism.

Sometimes, when researchers want to focus on a community or a social issue that has not been studied so far, the pursuit of originality in the choice of research topic itself comes into conflict with the community or parties' resistance to being studied. At such times, if the researcher cannot convince the target community of the general benefits of research, then he or she will have to abandon the project. Selecting a research also depends on such research being feasible from the point of view of the target/ participant group.

A researcher may select a topic of research because of personal interest in the problem to be addressed. Using research as "therapeutic action" in this manner could adversely influence the outcome of the research, notwithstanding the precautions taken. Under such circumstance it is better to avoid choosing such a topic.

Having said that, much of research that assists social movements is of this kind and it remains a relevant and necessary research area. While this does not prevent the topic from being selected, additional precautions must be used to ensure that the study remains unbiased at all levels.

BSA (2017) also points out that in choosing the research topic the researcher must be certain that it is within his or her skill and knowledge range. It is unethical to accept research commitments in areas beyond the scope of the researcher's training. In a collaborative study it is necessary that the requisite skills for research on the chosen topic are available within the group.

Literature Survey

It is the literature survey that narrows and refines the objects of research and leads to the framing of the research question. Today, there is a huge bank of literature available to researchers, more so than ever before. What ethical issues need to be flagged in the course of a literature review?

- Ensure that literature search is not influenced by the researcher's bias. The parameters of the research review must be clearly defined and constructed ensuring that bias, inadvertent or deliberate, is avoided.
- The researcher should determine if he or she has the tools to conduct the review. For instance, if it is a historical study, will the material be available to the researcher and is he or she trained

to do such a review? While this question does not itself impinge on ethics, it will contribute to defining the parameters.

- The tools of search need to ensure that the researcher is able to scan a wide range of literature. For instance, a study of IT workers will review literature on the topic in India but should also include literature in other countries because of the cross-national span of the topic. Leaving out the latter is bad science and bad in ethics since it introduces an uncalled-for limitation.

Most search strategies today yield more material than is required and the researcher's tendency is to aim for twice the spread of material as may be required. To avoid bias, select a good spread of material. This may mean selecting material that we may not agree with given our early perception of the problem, or with papers by authors we do not regard highly. Nonetheless, we must include full details of all the items in the literature review. This is not only ethically correct but also helps to avoid inadvertent plagiarism.

It is ethically necessary to read all the material carefully without cherry-picking them. We cannot allow personal likes and dislikes in selecting material. A fairly conducted research survey leads to an ethically sound research design and does not bias the study even before it is begun (See Salmons, 2019).

Framing the Research Question

Framing the research question is an important step in planning research. The research question feeds into the description of the project and defines it.

It defines the agency and the object and their relationship. An ethical perspective ensures that there are no distortions in the elaboration of this relationship.

Let us look at some illustrations:

Illustration 1:

The focus of this research study was the fishing community where mechanized trawlers had been introduced. The impact of the trawler was felt in several ways across the community. What should the research question be?

- Study the impact of trawlerization on the fishing community? Or
- Study the impact of trawlerization on the poorest sections of the fishing community?

The first study may well miss the finer impact on the poorest, but the second keeps the focus on the groups that are generally most vulnerable to change and therefore exhibit the impact of change sharply. Wearing an ethical lens allows the researcher to contribute to the levelling off the field, in that it will reveal information that might feed into interventions that will alleviate the worst impacts of trawlerization.

Illustration 2:

Teachers were frequently absent in rural schools without an acceptable reason. A study was designed to find out why this was so. The research question was framed thus:

- Rural schools suffer because teachers are not committed enough to attend school regularly.
- How can teachers be made to be more regular in their attendance?

The study assumed that the teacher absenteeism was merely truancy without even exploring to find out why teachers were irregular in their attendance. Ethical considerations would first inquire into why the teachers were absent so often and would try to resolve the problem from that perspective.

Constructing the Research Design, Methodology, and Tools

Sensitivity to ethics cannot be the sole responsibility of the researcher who designs and directs research. Every individual who assists in the research is responsible for adhering to the principles of ethics.

High quality of research is of course a prerequisite for a study that follows ethical principles. But often the quality of the research depends on how the research is administered. This means that the quality of research in an empirical study, for instance, it depends on how tools are administered in the field. (Molyneux, *et al*., 2009). Therefore, research designs are subject not only to ethical reviews but more importantly to scientific reviews. A scientifically sound research design does not necessarily mean that it is ethically sound. But a poor scientific design is most unlikely to be ethically sound.

The objective of research design, methods, tools is to maximize the gathering of data that the study requires. However, ethically, research methods and tools must also be appropriate to the competence, knowledge, contexts, and interests of the population under study. A research design that does not root itself in the study environment, considering the cultural and local contexts, will not yield appropriate information and data, and will not be an ethically sound study.

As an illustration, a research design that is premised on a patriarchal, class society will yield incorrect data in a tribal society. It would also yield an unfair presentation of that society.

Therefore, the underpinnings of a research design must be examined and understood before it is adopted to avoid inherent and historical bias.

Similarly, methods and tools must be appropriate to the participants of the research and to the data being gathered.

Illustration 1:

A study in Bangladesh among poor women was designed around the use of symbols to collect data instead of the usual methods like questionnaire or interviews. This yielded more accurate information. (Krause, 2020).

Illustration 2:

A study to assess the food a rural community of marginal and tribal farm folk could collect and store for the times of scarcity used an especially designed mapping tool. The tool required the types of food and location of such food items to be documented through the various seasons, allowing for deeper understanding of where and how food is gathered and preserved for lean times. This enabled the study population to become active participants in the study and acknowledged the fact that they would be able to best communicate through locational diagrams (personal communication).

Illustration 3:

A study examining saving behaviour in a semi-urban community devised an anonymized game that captured the many patterns of such behaviour without individuals revealing sensitive information.

A test study in a village outside Mumbai set out hypothetical situations in which participants had to select the way they would allocate money for particular needs given a certain saving target. The various saving behaviour of the groups were then analysed. The 'real life' situation produced a better perception of how people's saving behaviour than more conventional methods would have done.

Study Population as Participants with Equal Rights

Unlike a scientific study in a laboratory, in social research, the population under investigation cannot be regarded a passive and uninvolved. Even in a straightforward empirical research project relying entirely on quantitative methods of data collection, the study population is an active participant in the study. Without the subjects being involved there can be no study.

Given this, the population should be involved at every stage of the study. This involves

- Sharing the objective of the study
- Obtaining informed consent by the community before the study begins
- Sharing research design
- Describing the tools to be used

It is also necessary to consider participant objections and critical comments. If the population/group is not comfortable with the study design or a particular tool to be used and if they cannot be convinced, then the research design needs to be reworked and the tool to be redesigned.

Confidentiality and Anonymity

These are not synonymous. Confidentiality relates to the processing of the information once it is with the researcher and especially to the manner of its disclosure. If assured confidentiality, a participant may demur at the disclosure of information even if there is no attribution and the researcher is under obligation not to use the said information. In such cases the data may not be used in direct quotations. Anonymity has to do with attribution of the information. Participants may not want their participation to be revealed under any circumstances, even if no related information is revealed.

While anonymity may be preserved by not disclosing biographical or geographical details of the participant, sometimes these details may be easy to infer from the other details that are provided. This is termed deductive disclosure. Here Sim and Waterfield (2019) offer two cautions for the researcher to keep in mind:

1. The more detailed and vivid the information, the more is the likelihood of deductive disclosure.
2. The researcher, being an outsider, may not be able to assess which particular bits of information, when put together, may lead to unplanned disclosure.

Researchers may sometimes face a dilemma with regard to disclosure of information when their study focuses on participants who engage in illegal activity or stigmatizing behaviour. In such cases the researcher, "must understand the limits of confidentiality and address possible challenges to maintaining confidentiality." (ASA, *op. cit*.)

Informed Consent

Here is a topic that has generated much discussion in social research.

Consent has four essential components: disclosure; comprehension; competence, and voluntariness (Sim, 2010 as cited in Sim and Waterfield, *op. cit.*).

- Disclosure is the extent and adequacy of information given;
- Comprehension to how well the information is understood;
- Competence refers to the participant/s readiness to give consent; and
- Voluntariness to the degree of freedom that the participant has in giving consent.
- Consent serves to formalize and legitimize the researcher's ethical concerns.

Free and informed consent is at the heart of ethical research. It is also a process rather than an endpoint. Obtaining informed consent implies that the study population fully understands the study to be undertaken. This means that the objectives and purpose of research, the research design, methods, tools, and how the study results will be disseminated should be conveyed to the study population. The study population also needs to understand the methods being used to conduct the research and obtain the data. If audio- and video-graphing are used, then they need to be especially mentioned. The increasing use of information technologies in research makes the process of informed consent much more complex Further, and often contentiously, the study population has to be given the liberty to withdraw from the study at any point during the research.

Divulging all the above information may generate several problems, chiefly the following three:

1. Researchers often claim that the intricacies of social design and methods etc. may not be understood by the study population no matter how lucidly they are presented. This gives rise to the second dilemma,
2. If the study information is partially or incorrectly understood it can generate suspicion. A section of social researchers claim that consent is obtained more easily without divulging all the information about the research study.
3. The right to withdraw causes problems in the data being collected. This, researchers claim, leads to a conflict between the standards of research ethics and the quality standards of data gathering. (Colnerud, 2013).

Overall, however, with greater appreciation of the need for sharing information with the study population and of adhering to the principles of ethics, researchers have found ways and means of ensuring adherence to research ethics.

Informed consent covers a range of procedures that must be implemented before a research study begins. Consent must be freely given and may be withdrawn at any time [See Box 1]. As mentioned above, the study participants must fully understand the conditions under which they may withdraw from the study. The researcher must also explain how any injury, if it occurs during the research, will be resolved and define the nature of such possible injuries. While injury is easily understood in the biomedical context, it is more wide-ranging in social research. For instance, a study of the sexual behaviour of adolescent women may result in social repercussions on young women, even when there has been strict norms or privacy maintained. The very act of conducting such research may lead to an authoritarian response in a community.

The researcher has the responsibility to make the community elders and unofficial gatekeepers in a patriarchal society understand the objectives of the research. It is also necessary to state the objectives in a manner that does not arouse negative responses.

Obtaining informed consent cannot be a perfunctory action. It cannot be rushed, and the researcher needs to allocate time for this in the research plan. While informed consent is common enough in

clinical and health research, it has not been so widely accepted in social research. Several objections have been raised by social researchers. It is argued that obtaining informed consent is a complicated process in a community since it either requires taking a proxy consent from the local government, or tribal chief or a community leader, which would not necessarily mean that the community is aware of having given such consent.

To avoid such a situation, a meeting of the study community is organized where the details of the study are explained, and a voice vote obtained. However, voluntariness is essential. Informed consent may not be obtained under the orders of any authority or through coercion. The researcher has to understand the power relations or hierarchy operating in a community to ensure that it does not impact issues of consent. This implies some understanding of the caste and class relations in the society before embarking on the research.

In qualitative research the practice of respondent validation is used in which the study participants are offered a transcript of their interviews so that they can review and comment on the researcher's interpretation and offer corrections if necessary.

It is the responsibility of the researcher to devise ways of ensuring that the study population understands the objectives of the study and is a willing participant. Most importantly, the researcher should not inadvertently become an informant to the community elders/leaders/local government authorities.

Over time, as most studies get reviewed by institutional review boards, there has to be a stronger insistence of paper proof of informed consent at both the community and individual level.

Box 1

Ethical Issues in RCTs

Randomized Control Trials (RCTs) are experiments devised and used to investigate the effectiveness of certain interventions. RCTs involve the setting up of carefully chosen groups, one of which receives the intervention and the other does not. They may be used typically only in situations where the community or population would eventually benefit from the intervention if proved useful.

RCTs have long been used in medical, clinical, and public health fields. RCTs are the gold standard for determining the efficacy and safety of a new drug or vaccine. Their use in social research is more recent, though growing rapidly especially in development economics. In 2019 Abhijit Banerjee, Esther Duflo and Michael Kremer were awarded the Nobel Prize in Economics for their work on RCTs in social research. (See Ila Patnaik, *op. cit*.)

According to the American Economic Association, India tops the list of countries outside the US where RCTs have been conducted, numbering 247 since 2012. Although experts aver that RCTs are the best way of knowing if a certain policy or programme intervention actually works, they are very expensive to setup and run. Over the years, RCTs in social research especially in the developing world, have come in for heavy criticism. Apart from the cost, the main criticism has been on two counts: ethical and methodological. One opinion points out that RCTs focus on micro issues missing out the larger context. Also, the fact that two groups are created, one that receives the benefit, and the other that does not, two groups of haves and have-nots gets created, even if it is temporary, altering, social dynamics. On the methodological count, which also is an ethical concern, some development economists point to the questionable randomness

of the cohorts because of which the results may not be found to be applicable when generalized. Further, while causality may be explored through RCTs, uninteresting associations are created that may have no meaning or in fact be misleading. This again is an ethical concern. (See Economic Times, Oct. 17, 2019[4]; Fives, *et al.,* 2014).

For an RCT to be ethically permissible, it needs to follow several conditions: social and scientific values, scientific validity, Institutional Review Board [IRB] approval, comprehensive informed consent, protection of participants' rights, and equipoise (being in a state of equilibrium.) That is, in an RCT believing that there is no 'better' option for either group or that the solution being tested is neither better nor worse. Social scientists have argued that this does not happen in social science research using RCTs. Most poor countries do not have the framework to meet these conditions. India is yet to develop ethical guidelines for RCTs in social research although the Indian Council for Medical Research (ICMR) does have ethical framework for the conduct of clinical trials, which are RCTs.

It is likely that RCTs will be used more frequently in coming times to test the efficacy or new programmes or interventions. While randomization may well be a useful method in a programmatic context, it is imperative that social scientists be aware of the ethical and other issues that RCTs throw up.

Box 2

Ethical Questions in Qualitative Research

Deception in social research: In some kinds of research, especially qualitative research, researchers feel the need to be part of the community anonymously. A researcher may choose to go undercover to study a gang of drug dealers. Clearly, informed consent does not apply here.

What is the researcher to do when he or she sees illegal activity? Is there an obligation to reveal information to the law enforcement authorities? Or does the responsibility to the research participant community hold greater weightage? Is the data obtained through this process valid and useable in research? May such data be revealed to the relevant authority breaking the promise of confidentiality and anonymity to the participant?

While there is no clear answer, it is obvious that if medical professionals, psychologists, and psychiatrists, are bound by their professional ethics not to reveal information about their patients/clients, there is sufficient precedence for the social scientists to do the same.

Participant observation is another research strategy that poses ethical dilemmas. Often researcher find themselves so involved with the participants that it becomes difficult to retain the scientific detachment necessary for research. It is also difficult to decide whether information obtained may be used even if it is covered with anonymity.

Qualitative research often requires building close relations with the participant. This may affect how the researcher deals with the content of research. Often researcher engaged in sensitive research, devise ways and means of disengaging periodically in order to gain perspective and distancing so as to function as scientists.

Informed Consent for Focus Group Discussion (FGD)

Focus group methodology presents particular ethical challenges. Separate consent needs to be obtained for an FGD. This involves not only the material presented for obtaining consent at the individual level but also the need to explain that in the course of the FGD, information may come to light that an individual may not have divulged in a one-to-one interaction. Every participant of the FGDs needs to understand this issue before giving consent.

Here too, consent is, of course, revocable at all times. But in an FGD this presents a particular dilemma because the participant will have made disclosures not only to the researcher but to the group as well. Therefore, participant validation, as done in interviews is cumbersome. Revocation is meaningless. Further, in FGDs the participant is not in charge of what disclosures take place because the way a discussion progresses is beyond his or her control. In a sense, a consent is meaningless unless the participant knows how an FGD progresses.

Even if a researcher were to contrive to allow the participant to withdraw his or her data, it would render the entire FGD transcript meaningless and analysis irrelevant. The way around the problem probably lies in individual instances. It may perhaps be managed by explaining at the beginning of the FGD that while participants may withdraw from the FGD they may not withdraw their data (or contribution) that is an integral part of the FGD transcripts.

Ethics in Sampling Methods and Data Collection

An ethical dilemma for researchers is to conduct research so that it has the maximum validity while ensuring that the rights of participants are protected. In other words, what is the minimum numbers of participants to be involved while undertaking a study that might have maximum validity. Many researchers consider random sampling as the gold standard methodological procedure for maximizing external validity and optimizing sample size. Social researchers have an ethical obligation to construct the smallest representative samples possible and involve the least number of participants even while ensuring that the research is plausible widely and may be possible to generalize.

Dattalo (2010) offers this example:

> …if a study seeks: (1) sensitive information (e.g., from men in a study to compare the effectiveness of two residential substance abuse interventions); (2) information from a vulnerable population (e.g., children in a study to evaluate an intervention designed to reduce the psychosocial difficulties of children with diabetes), or (3) information during a crisis (e.g., from women seeking protective orders in cases of spousal abuse), it could be unethical to sample too many or too few people. If a sample is too small, a study could miss important effects, place unnecessary demands on participant privacy and time, or waste valuable resources. If a sample is too large, the study could make unnecessary demands of the participants or misuse other resources.

Ethical Issues Related to Collecting, Storing, and Handling Data

Data may be identified in different ways.

- *Identifiable* data will include data source and all the details.
- *De-identified* data will have had all the identifiable information removed. For example, transcriptions of interviews that have been permanently anonymized.

- *Anonymous* data refers to data that has been collected without referencing the informant so much so that even the researcher may not know how the data has been collected and from whom. For example, baseline data.

While collecting data, the highest ethical standards must be upheld. The research plan must describe how data is being collected and for what purpose. It should also state how the data is going to be stored and for how long, and who will be utilising it and whether in future, others will have access to it in any form.

Data protection today is a highly sophisticated area of technology. Several tools and methods are available to ensure that data can be stored securely. But here too the researcher cannot remain ignorant of the methods of storage because of the ethical obligation to ensure secure storage and handling. Data may be of two kinds: prospective data and retrospective data.

Prospective data is collected for the purpose of research. The researcher has more control over how this data is collected and stored. All information collected must remain confidential. The questions seeking information must be clear and succinct. Most importantly, a researcher must not collect more information than is required. The participant's time in providing the data must be acknowledged and there must be no misuse of that time.

Retrospective data is collected for different purposes and is now available for other researchers. Here questions have been raised about the ethics of using data that the participant has provided for a purpose other than the current one. This amounts to stealing information from the participant under false representation. It is therefore necessary to check how this data has been collected and if the participant has given consent to the data being used by others. Seeking the origins of the data is not just a methodological issue but it is one way of protecting the rights of the person who has provided the data.

Strictly speaking, this is difficult to achieve since not all datasets that are available have this information. However, it is possible to obtain access to raw data or at least to the provenance of the raw data. In fact, many journals insist on knowing the provenance of the data while reviewing an article for publication. Ethical concerns on using retrospective data are becoming increasingly important because today large datasets are available for sale from commercial data aggregators.

An example of how failure to obtain information about the origin of data can put the entire research in jeopardy revolves around a bunch of studies on the possibility of using hydroxyquinolines in controlling COVID-19. A major study showing that the drug was not of much use, based on aggregated global data that was made available by a commercial aggregator, Surgisphere, was hailed as an important one and the WHO even changed its policy suggestion based on this study. However, soon doubts were expressed on the validity of data in several countries, and this led to an examination of the data. When the aggregator refused to reveal the sources of the raw data, not only did journals withdraw the articles that had been published, but an entire slew of research based on this data had to be withdrawn and abandoned.[5]

Ethical considerations come into play even when analysis of the data is interpreted and presented. Data analysis is a subjective process using objective tools. The choice of data analysis software and tools must include an ethical dimension. The question should be whether the best possible interpretation may be given to the data in answering the research question and not how best to force the data to tell the tale that will fit the hypothesis.

Presented data must not inadvertently disrespect the participants of the research. The choice of what is to be presented lies with the researcher. Every effort must be made to ensure that the data does not

misrepresent the participants or the community. The researcher must also not deliberately visualize data that is not representative, for example, including different time periods on the same line chart to show a sharper change than the reality.

Research Misconduct and Obfuscation

Fabrication, falsification, and plagiarism in the conduct and reporting of research is termed research misconduct. Fabrication means making up data; falsification is manipulating information or research material or omitting data to misrepresent research to suit some purpose; and plagiarism is borrowing or appropriating another person's ideas, words, writings, without acknowledging.

Obfuscation is to hide information or twist findings, deliberately or otherwise, by using writing styles that are deliberately confusing.

Research misconduct is a serious offence and is a punishable offence in many academic institutions or at least attracts a reprimand.

The UGC Research Development and Innovation Programs Implementation Guidelines (UGC, 2017, *op. cit.*) say:

> Research misconduct includes deliberate fabrication, falsification, and plagiarism in proposing, performing, and reviewing research, or in reporting research results, and harmful activities. (p. 25)

Urging universities to formulate a policy on research misconduct, the document states that such codes must be based on principles of fairness and expedience. If such misconduct is reported the institution must examine the complaint and adjudicate.

Box 3

Research Ethics Committee (REC)/Institutional Ethics Review Committee (IEC)

The growing institutionalization of ethics committees and the process of mandatory ethics review in the social sciences has several critics who believe that adopting a process developed for and suited to biomedical research is not helpful to the social science community in its search to codify ethics in the disciplines. However, the trend towards systematic ethical review is advancing rapidly.

RECs are committees that review all research undertaken by an institution to examine the ethical dimensions of the research. Typically, all research is submitted to the Committee at all stages: the proposal, the research design; data collection design; after data collection; after analysis of data; final report. It examines these submissions to ensure that the rights of participants have not been violated and that they have not been harmed.

"Good ethics review requires sensitivity to the context in which a research study will be conducted, and good ethics reasoning requires careful thought and consideration," to cite the Economic and Social Research Council (ESRC) website.

Ethics review also examines whether researchers have been afforded safety and security during the course of their work.

Ethics review should be seen as part of research design, execution, and dissemination and should not be regarded as a mandatory, but bothersome process.

Reporting the Findings

The relationship between the researcher and the subject of the research, the participants, is inevitably a 'power' relationship. Every effort must be made to ensure that the researcher does not misuse the authority. Given this, the study population must be the first to receive the findings of the research. Clearly, this cannot be done through academic papers. At the same time, shorter reports should not be written before a full report has been compiled and peer reviewed. Every attempt, therefore, must be made to produce a lay report immediately after the technical report has passed review.

No report of findings should be made public or offered for publication without an ethical and technical review. This is imperative and cannot be ignored. The reasons for this are simply to ensure that an independent body must be unbiased about assessing the technical, and even more importantly, the ethical dimensions of the report. It is a safeguard not only for the researcher but also the participant community.

Ethical considerations in academic writing do not come under the purview here. But it is emphasized that it is not enough to integrate an ethical perspective in conducting research. It is equally necessary that the research report does not just pay lip service to ethics but, in fact, integrates it.

Conclusion

After recounting the development of ethics in social science research over time and in India in particular, we focused on how ethical consideration are operationalized in every aspect of a research study, considering the difficulties and dilemmas in the ethical conduct of research.

This is not an exhaustive study because ethics covers a very vast area. Moreover, ethics codification is in early stages still in India. There is a great need for normalizing ethical reviews for all social science research. All branches of social sciences need to make every effort to bring together a comprehensive and appropriate code of ethics for social science as many other countries have done over the last 15 years.

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CHAPTER 5

Research in Languages in the Light of Research Ethics

Uma Vaidya

Introduction

Three important issues in the field of Research in Languages are discussed here: Language of Research, Research Fields in Languages, and Ethics in Language Research. These three are the ever-present and ever-growing topics in the research field of Languages and Humanities because the language has wedded human beings from time immemorial and the relation will continue till the human race exists. The number of languages, their types, and properties have changed from time to time but the relationship between human beings and language is eternal and it is like a chemical compound, the components of which cannot be separated easily. Language research started from the day when man discovered his capacity to speak and to form words for the first time and then this research has produced countless offshoots extending in different directions and different regions of the world.

Language Research in Ancient Indian Knowledge Systems

Language research has entered various sciences as the study of vocal organs in physiology, the study of mental activities taking place in four steps in the process of expression of thought, which are traditionally called as *Para, Pashyanti, Madhyama,* and *Vaikhari*. This process is very scientifically discussed in Indian linguistics. Indian philosophical thought studied it as *Shabdabrahman* and offered the highest status to the language in general and to the word in particular. In short, the subject of the study of language occupied an important place in ancient Indian Knowledge Systems.

It must be noted with pride that in the field of Language of Research and Research in Language, ancient Indian sages were the pioneers. *Yaskamuni* of 7th Century BCE wrote a treatise entitled as *Nitukta*, which explains the principles of Etymology, that is, the science of word-formation. This was the first text in the world on linguistic inquiry. Taking his work ahead, *Panini*, the first and foremost grammarian of Sanskrit-language, compiled the whole edifice of Sanskrit grammar for all the three forms of Sanskrit Language: *Vaidika, Aarsha,* and *Laukika*, in the form of the text of *Ashtadhyayi.* This text was the systematic arrangement of grammatical rules and lexicon. It dates back to approximately the 5th Century BCE. *Panini* succeeded in his endeavour to the extent that his work *Ashtadhyayi* was complimented by the scholar linguist L. Bloomfield as "The highest monument of human intelligence" (Bloomfield, 1996: 11). Yaskamuni and Panini, the two stalwarts of India laid the foundation of research in language, more particularly in linguistics. It is very pertinent to note that even the earliest work on the grammar of Sanskrit contains meta-language, meta-rules, and other technical devices that make this system effectively equivalent to the most powerful computing machine. With such a glorious and pioneering tradition of Language Research, it is very unfortunate that the current generations of India are still to be convinced about the importance of language research.

Research in Language

The role of language in research is one aspect of language Research and Research in Language is another aspect of this study. The main objective here is to discuss the second aspect, that is the Research in the Language field. To achieve that goal one must know the role that the language plays in research. This study helps us to understand the problems creeping into modern language research.

From the experience of assessing Ph.D. theses and reviewing research articles to be published in journals for at least two decades and also from the discussions with other language teachers it is evident that the quality of research is declining at both fronts, *Aashaya* and *Abhivyakti* (content and presentation).

As a Sanskrit professor, I only know the status of research in Sanskrit but the overall situation in the field of languages and partly in the field of humanities is the same. This statement is certainly true when one discusses the role of language in research. An illustration will explain the point clearly. To make full use of the computer or laptop one has to learn the techniques of its use and the facilities provided by the device because it is a *sadhana,* that is, a means to collect the data and later to analyse it. Unless one has mastery over the use of the device one cannot take advantage of it to its optimum level. In the same way, any language as the means of research is to be learned thoroughly with all its properties, stylistic usages, shades of meanings, grammatical structure, and the abundant vocabulary in that language account. This preparation helps to enhance both the skills in any language such as reading and writing. It also facilitates observation by focusing on that which is seen by all but observed by nobody. The documentation of these observations, which is the important aspect of robust research depends on the language skills of the researcher. Therefore, to present a thesis in pure, sophisticated, stylistic, and accurate language is a value-addition to research and thus the contribution of language cannot be ignored in any field of research.

The Role of Language in Research

The role of language is purely human and it is an instinctive method of communicating ideas, emotions, and desires through a system of articulatory symbols, which are produced voluntarily. These symbols are auditory and produced by the vocal organs. There are four major skills for language proficiency: listening, speaking, reading, and writing. Speaking and writing are called "productive skills" as they involve some kind of creative activity by the language-user while listening and reading are called "receptive skills" as the language-user receives information using them, which are in spoken or written form. Among these four, reading and writing skills ascertain the core value of presentation and the content-value of research. Bloomfield also made a statement about writing as, "Writing is not a language, but merely a way of recording language by means of visible marks" (*ibid*.: 21). It becomes still more important, therefore, to master the language-recording methods. This then leads to the concept of Standard Language. A new trend is crawling in, which rejects the idea of standard language but adheres to the view of writing in free language as one speaks it, indicating a leaning towards the dialects. This is to escape from the tight clutches of grammar, which controls the quality of and changes in any language. However, in the so-called liberal society of today, any type of control is not acceptable under the garb of liberty and freedom, and therefore, the very idea of standard language is collapsing; in short, it is a journey towards dialects alone. This trend of the use of free language will prove harmful to the language of research and consequently to research in languages too. Disciplined language is a must in research. The data for research can be collected with the help of various technologies available in this new era but to analyse it and to decipher it, one needs the sound knowledge of the language in terms of style and culture. Every language has its own linguistic and

social culture and knowledge of both these attributes are very much required to master the Language of Research. This kind of proficiency cannot be obtained after registering for research or after the grant for a research proposal. Language learning is a process that starts from childhood and is expected to reach the ideal level to be useful for research gradually.

The researcher must master the skills to play the roles of encoder and decoder. Expressing the mental concept of an author to the reader is a communication process, which functions through an encoder and a decoder.[1] It requires the use of language. One person first processes the message in his or her mind in either spoken or written form and then it becomes available outside the mind as text. This text then is available to the other person who hears or reads it and decodes the message. Once it is decoded, the message enters the mind of the decoder and then the roles of decoder and encoder keep changing till the communication process is completed. If either of them fails to play the role appropriately the research is jeopardized because any research depends solely on the interpretation of the collected data. Therefore, to collect data accurately and to interpret it properly the researcher requires language skills, and then alone he can perform both the roles efficiently. As a society, in general, is ignoring the study of language, the knowledge of the language of children of the present generations is deteriorating. The problem worsens when these children enrol in research. If the researcher is not equipped with the proper medium i.e. the language of the presentation, then expression becomes difficult because of limited vocabulary and unrefined language. Here starts the copy-paste business. The ready constructions of sentences and ready contents (although sometimes not matching with the thought expressed in the document) are borrowed from elsewhere and presented as one's own. When this copy-paste is transferred directly into the contents, it is plagiarism, one more serious problem in research.

Language is a flexible entity and its interpretation depends on the mind-set of the interpreter. Therefore, in language research, there is every possibility of being subjective in interpretation. Whereas, objective thinking is the characteristic of any ideal research and therefore, the language researcher has to take care not to fall prey to any of the above-mentioned pitfalls. The researcher must understand the role of language in research and be equipped to use it skilfully and to the maximum, because, "The means justify the end".

The language-medium in which the researcher presents the theories and conclusions is an important factor. For many reasons, a thesis is generally presented in English. One important reason is that the English language has come down to us over the decades because of the pre-independence political supremacy of the British rule and the pressures inflicted on Indian Academics. Gradually, English has become the language of knowledge and technology and this has further boosted its importance. At present, it has become the ground reality that we have to take the shelter of the English language if we wish to take our research to the Global platform. Therefore, the research work on a topic from Sanskrit literature is also presented in English. This is the same with almost all language researches. This harms the language of research and also the research in language because any language has particular traits, styles, and culture behind it, which cannot match with English. As a solution to this problem, some universities, have started a new blended model of submission. The University allows the researcher or research student to write the thesis in the original language from which the topic is chosen but asks for 10 per cent of the contents in English as a summary, at the time of submission. In some cases the process is reversed, the thesis has to be written in English and the summary can be in the language of the topic. As most of the research students of this generation have completed their schooling through English medium, English becomes the convenient language of expression and not Sanskrit although the topic they may have selected is from Sanskrit literature. For Marathi speakers, the topic of research and the language of expression, both are the same, that is, Marathi. Unfortunately, many students in

various states and communities cannot write in the script of their mother tongue, even though they speak in their mother tongue in their houses. They find it easy to write in English. This is so because, firstly, the intricacies of most Indian vernacular languages, such as *hrasva* (short forms), *dirgha* (long forms) seem confusing. Secondly, the students have not taken formal education of that language and therefore they don't know its standard and correct usages and inadvertently resort to the use of slang words. A research document has to be an authentic and authoritative write-up and it should not transgress the canons of the language. Due to these reasons, researchers prefer to write in English. If we try to simplify the process, the standard of the languages may come down and the traditional users of the language may revolt against the over-simplifications. Therefore, new research in any language has to find a balanced solution to get rid of this problem and upgrade the state languages to bring them nearer to the status of English.

Expectation from the Field of Research in Language (RiL)

As an integral and comprehensive view about Language research a piece of information can be provided to know the expectations from this field. The international journal *Research in Language* says, "Research in Language (RiL) is an international journal committed to publishing excellent studies in the area of linguistics and related disciplines focused on human communication. Language studies, like other scholarly disciplines, undergo two seemingly counteracting processes: the process of diversification of the field into narrowly specialized domains and the process of convergence, strengthened by interdisciplinary studies. It is the latter perspective that RiL editors invite for the journal, whose aim is to present language in its entirety, meshing traditional modular compartments, such as phonetics, phonology, morphology, syntax, semantics, and pragmatics, and offer a multidimensional perspective that exposes varied but relevant aspects of language, for example, the cognitive, the psychological, the institutional aspect, as well as the social shaping of linguistic convention and creativity." [2] From this description it is very clear that a language is an all-inclusive and all-pervasive phenomenon. Research in languages has a very extensive scope and it demands deep insight into language culture and research methodology. A note from an Elsevier publication, *Journal of Second Language Writing,* is useful on the topic of an all-inclusive language. The journal has guided authors about the use of inclusive language. It says, "Inclusive language acknowledges diversity, conveys respect to all people, is sensitive to differences, and promotes equal opportunities. Content should make no assumptions about the beliefs or commitments of any reader; contain nothing which might imply that one individual is superior to another on the grounds of age, gender, race, ethnicity, culture, sexual orientation, disability, or health condition; and use inclusive language throughout. Authors should ensure that writing is free from bias, stereotypes, slang, and reference to the dominant culture and/or cultural assumptions. We advise seeking gender neutrality by using plural nouns ("clinicians, patients/clients") as default/wherever possible to avoid using "he, she," or "he/she". We recommend avoiding the use of descriptors that refer to personal attributes such as age, gender, race, ethnicity, culture, sexual orientation, disability, or health condition unless they are relevant and valid. These guidelines are meant as a point of reference to help identify appropriate language but are by no means exhaustive or definitive."[3] These quotations are presented verbatim to be used by the researcher as guidelines before sending the research work for publication.

There is an additional benefit of bringing the invisible thoughts residing in the mind in the visible text form with the help of a language. Thoughts in the mind are most often scattered. They do not follow a certain order, they are not necessarily categorical, but are in a complex non-specific form. When one starts writing them down with the use of language, they are neatly structured with a logical order. The stray thoughts in the mind get disciplined and are systematized because of the properties of a

language. This process of putting down thoughts in writing sharpens the activities of the brain. The discipline that the writer acquires in systematized writing is carried forward to all other activities and using refined language and logical argumentation adds to the overall development of the personality.

As a conclusion of the above discussion, it may be said that this generation of researchers is undernourished as far as language nutrients are concerned and therefore, is facing the problem of language deficiency, which is affecting their research and the overall personality as well. However, there are hopes of getting treatment for this academic-health problem in the form of a vaccine to be injected through the language syllabus as proposed in the new education policy to impress the importance of languages and of teaching them from childhood.

Research in Language

The first literary composition in world literature is the *Rigveda*, the first among the four *Vaidika Samhita*s. Traditionally, the *mantra*s in the *Rigveda* are seen by the *rishi*s, the sages, in the highest state of their realization, or *sadhana*, but it is noteworthy that the *mantra*s were seen with perfect metrical constructions and are not artificially composed by any human being; thus they are called as *Apaurusheya*. This phenomenal work took place more than five thousand years ago and therefore, the *Rigveda* is the first recorded literature of the world. It is in Sanskrit, the most ancient language of India. Since then Research in Language has started in ancient India with two main aspects, Linguistic aspect, and literary aspect. There were four main fields of research in literature at that time: *Samhita*s of Vedic literature, texts of *Darshana* — literature, books on the sciences studied in India at that time, and literary compositions. Social science was not a separate branch of study as it is today but all the research was socially oriented and its focus was on its application for the benefit of society. The field of language research was not only very vast but was interdisciplinary. Today, we have to promote interdisciplinary research by circulating guidelines about it. Maybe this is the consequence of specialization and super-specialization in various topics of study. This trend undoubtedly leads to the in-depth study of the topic, but it cuts away from other allied subjects and thus harms the methodology of research. There are different approaches to reach to the conclusion and they are taught in the pre-Ph.D. class as a preparation for research but unfortunately they are not used properly while studying a particular topic of research. There is a big list of approaches such as analytical, historical, philosophical, scientific, and so on. These approaches are the tools to study a given topic and are complimentary to review the topic from many angles. Research articles in the journals of the Bhandarkar Oriental Research Institute and many other institutes of that cadre have proved to be a heavy dose even for a research student because they are studded with several quotations from different branches of knowledge. That was the ideal research in the pursuit of truth and truth alone without any selfish motive or any compromise. Even the ancient Indian Commentaries were wonderful specimens of thorough research. The great Vedic commentator, *Sayanacharya*, while writing a commentary on Vedic *mantra*s records different opinions on the topic from the texts of *Nyaya-Darshana* (Indian Logic) or *Mimamsa-Darshana* (the science of interpretation),. It was possible for him because of the thorough knowledge of the Indian Knowledge Systems in general and study of the Vedas in particular. This was the method of research although it was not titled as Research Methodology. One illustration of the canons of research can be presented here, it is from *Mimamsa-Darshana*. It is the science of the interpretation of the Vedic *mantra*s but is useful to understand the methods and canons of research, which are not confined to any *Darshana* or *Shastra* for that matter but are useful for any researcher to carry forward his work. When the researcher works on a topic he should take care of the following points and assess his work in that light: It is a fivefold process of discussion, which is described in *Mimamsa* texts but it can be a method of self-inquiry and self-assessment of one's topic to arrive at

the appropriate conclusion. These rules should certainly be used as guidelines for research in any field. This five-fold process is beneficial for tailoring the research topic with perfect measurements.

1. Raising a doubt, *viśaya*
2. Identifying a dubitable topic, *viṣaya*
3. Examining arguments of the opponent, *purvapakṣa*
4. Posting one's argument, *uttarapakṣa*
5. Conclusion, *nirṇaya* [4]

Despite such guidelines from expert predecessors in the research field, the quality of language research, barring some exceptions is declining day by day. If one agrees with this statement, one must find the reasons for it. One of the reasons for language deficiency is discussed above, here is another about the choice of the research topic. Research in Sanskrit-Language is a continuous process of at least five thousand years. Research in Greek and Latin may come close to it but as far as the contemporary Indian languages are concerned their history goes back to seven-to-eight hundred years. Now, in this vast period, the popular compositions by well-known authors are worked on by many scholars from different angles, therefore it is necessary to deal either with the contemporary composition or with any serious problem, which the researcher has faced as a student or as a teacher in his or her early career. The students bring the experience or issue of the day, concerning the topic of research, to the nominated guide and select the suitable composition from what is available with the guide. The student's entry into the field of research may not be boosted by the proper aptitude but there are many other reasons to enter into the field. If the research is linked with any benefit other than the acquisition of pure knowledge then it is difficult to perceive the expected outcome. An important point must be noted here. If the research degree, be it M. Phil. or Ph.D. or any other degree awarded for research is utilized for getting a promotion, increment, or appointment, then the very purpose of research is questionable. The pursuit of the degree becomes a ritual to be completed in a maximum of four years even with the device of 'copy-paste'. With many other interventions and interferences, if the research work is to be completed within the stipulated time then unethical practices are sure to creep in.

From the titles of research projects or dissertations, it is very clear that the scope of research in the language is narrowed and is perhaps limited to the literary compositions of renowned authors or poets. Three words have become the keywords of research in language: a critical evaluation of a book, comparative study of two books of the same author or different authors, or the study of one literary form as presented through two books or analytical study of a particular work. No doubt, this is a good literary approach to research in the field of language but the contents of the thesis do not support the title. A stale and repetitive format has come into existence of Ph.D. thesis and students enjoy adding flesh and blood to the skeleton with their limited skills and with the data that they collect. They don't have time to go to the original books and therefore seek help from secondary sources or even from the incomplete data available on the concerned websites. Sometimes, even the websites caution about the dubious information and request us to judge the authenticity but ignoring this, students' lives matter and hurriedly quote the sources. Furthermore, although ample data is collected from the library or websites, the activity of the human brain is very much required to analyse the data, to work on it to reach a logical conclusion and verify it. The argument to support the conclusion is an important part of any research and without it, no one can leap from a hypothesis to a proven theory. This is not possible without research acumen and the academic discipline. Therefore, there seems a dearth of fresh fundamental research as an addition to the original fund of knowledge.

It is a new trend to accept a creative work (say a novel or composition of *Mahakavya*, epic poetry in Classical Sanskrit, or a publication of a *Kavyasangraha*, an anthology of Sanskrit poems) as the

research work. A wonderful novel, on the other hand, if it has social orientation, is certainly a work of great importance and fetches popularity to the author although it does not fall into the stipulated research format. Sometimes it is accepted as research work because the teachers are expected to fill up the column in the form of their report under, "Research did/supervised". To fill up this form satisfactorily, such concessions are given but the point remains debatable. The translation from one language to another is being accepted as research because it requires mastery of both the languages and knowledge of their linguistic and social cultures. Changes in research trends are bound to take place and should be accepted wholeheartedly but this must not lower the research quality. It will require to frame different guidelines for the research-works other than traditional research. The research in language includes all such emerging trends.

The main object of any research as far as society is concerned is the application of the searched matter for the benefit of society. Readers must turn to this research as it provides an up-to-date and detailed overview of what is happening in society and they will tend to tailor their careers and lifestyle accordingly. The researcher, therefore, has to be vigilant to know where improvements, new research agendas, better research methodologies are available and takes cognizance of these to help to move the field of research forward.

Research in language also expects to represent significant contributions to the current understanding of central issues in politics, the authenticity of historical research, cognizance of the changes in languages, and guidance to the society thereby, and so on. This is true for all Indian and foreign languages. Some areas of interest are:

1. Personal characteristics and attitudes of the authors in that language;
2. Features of the compositions of the texts in that particular language;
3. Composing processes and the structure of the language;
4. Response of the readers in the form of critical appreciation; and
5. Contexts such as, cultural, social, political, institutional, etc. [5]

The research must emphasize the pedagogical implications of the work.

Another field in research in languages can be entered in with the help of Information and Communication Technology (ICT). Many families from the Indian communities have settled in foreign countries yet they are not divorced from their Indian roots. This is particularly true for Marathi, Hindi, Gujarati, Punjabi, and South Indian families. They speak their native language in their homes although there is no scope for their language outside the house and at work. Children who are born and brought up there fluently use English or the language of that country, and more often they do not speak their native language at all. Their relatives here in India cannot easily communicate with them because even if they know English, the accents are so different that their Indian relatives require some interpreter to talk with the young generations living abroad. If this situation continues unabated then there is every possibility that the dialogue from both sides will slowly die out. Regional languages are in danger of dying out even within India also and the situation outside India is still worse. The loss of a language is the loss of a culture. The seniors in a family, who have stayed abroad for a long time, always have the fear of being distanced or cut off from their original culture, and thus they celebrate Indian festivals wherever they are, and sometimes these celebrations are mixed with local cultures. Keeping this in mind, a language researcher can plan for language festivals, which will include academics, cultural events in that language, quizzes based on the literature in that language, and many more language-related activities with attractive prizes. This will certainly work for promoting and preserving a language, and as a service to society. This can be done within and outside India by every language community and interested language researchers may document it in research format and it

will be an altogether new form of research in the field of languages. All Indian communities have to work to save their culture.

To save our cultural heritage, Indian languages need to be saved; first in India and then outside India. With the help of ICT experts, some devices have to be found out which will help to protect at least 22 Indian languages. As per Articles 344 (1) and 351 of the Indian Constitution, the eighth schedule includes the recognition of 22 languages. There are many 'apps' in almost all the languages but these are mainly for business advertisements or to provide information about the cine-industry. They are not geared to protect and preserve cultural specifications. Therefore, such devices, blogs, and apps, and many more have to be created; this will be a new and necessary field in language research. Some people believe that change is the law of nature and as in other fields, it will affect language and culture as well. Indeed, one or two persons will not be able to stop the changes but Manu, the first and foremost man, because of whom the entire human race is called *Manava*, also tried to save or better to say to revive the human race and human activities at the time of dissolution (complete annihilation of human culture). It will not be that difficult to raise the number of speakers or knowers of our vernacular languages and protect the regional cultures. Society is not interested in knowing the theories or intricacies of grammar or changes in the nuances of meanings and interpretation but will perhaps be interested in the kind of research to preserve languages in essence. This attitude of the society of ignoring the power of the spoken and written is not a new trend although it has become more serious now. Here is an interesting narration from an old Sanskrit text. *Patanjali,* the renowned grammarian of Sanskrit and author of *Mahabhashya* writes his experience about society's treatment to the grammarian and its attitude about word usage. He says, if a person wants to use an earthen pot to cook food, he will go to the potter and will ask him to make an appropriate pot. He will also give specifications for that pot. If the pot is not ready on time he will visit the potter's house again and request him to make it urgently because he cannot do without that pot. However, people do not approach the grammarian and request him to coin a word for the specific meaning which they want to convey (Shastri, 1947). They manage with the words that they have. They then adjust their thoughts within their limited vocabulary, they crop the sentences, abridge the contents but do not think of creating a new word or words to express explicitly the intended meaning. This is the experience of school teachers about almost all children in school while writing essays in a language other than their mother tongue. This means that if the convincing capacity of the language is ignored and if the vocabulary is limited, then the child fails to convey his or her thoughts, and will naturally fail to convince the listener. The language researcher has to be aware of all such dangers.

Learning a Foreign Language

In the current scenario of language learning in India, students are taking interest in learning foreign languages such as Japanese, Chinese, French, Spanish, German, among others although they are ignoring the study of Indian languages. The simple reason is the market connection of these foreign languages. Globalization has created a great need for staff in the workforce who can communicate in multiple languages. Common languages are used in areas such as trade, tourism, international relations, technology, media, and science but there is a country-specific use also. Whatever may be the reason, their acquaintance with these foreign languages will open new vistas of a comparative study of these languages with Indian languages. A piece of information can be provided here which is perhaps unknown to many of the researchers in the field of language. As per Duncan Charters (Charters, 2015), Esperanto, the most widely used international auxiliary language, was founded by L.L. Zamenhof, a Polish-Jewish ophthalmologist, in 1887, aimed to eliminate language barriers in international contacts. Esperanto is an artificial language created based on the Indo-European

languages, absorbing the reasonable factors of commonality of the Germanic languages. Esperanto is completely consistent in its speech and writing. The stress of every word is fixed on the penultimate syllable. By learning twenty-eight letters and mastering the phonetic rules, one can read and write words. With further simplification and standardization, Esperanto becomes much easier to master than other languages. The ease of learning helps to build confidence and learning Esperanto, as a learning strategy, constitutes a good introduction to foreign language study.

When Indians came in contact with English literature, the 'novel' as a new literary form of composition entered Indian literature. There were short stories, long stories like the *Kadambari* of *Banabhatta* (in Sanskrit) but not in the stipulated form of a novel. The novel became established as the dominant literary form during the reign of Queen Victoria of England (1837-1901). Victorian novelists portrayed middle-class, virtuous heroes responding to society and differentiating wrong from right through a series of human errors.[6] Sir Walter Scott is a big name as a novelist. The point to be noted here is that when a person comes in contact with a new language he can think of bringing the new literary form from that language if it is not available in his language. He can engage himself in the comparative study of the common words in two or more languages as regards the spelling, pronunciation, shades of meaning. This type of work was initiated by Late Dr. G.B. Palsule from Pune who was a stalwart in Sanskrit grammar and who has composed a *Mahakavya* in Sanskrit on *V.D. Sawarkar*. His scholarly book (*Yu bhatah Sanskritm prati*) studies the common words from the Euro-*Bharatiya* languages. Such studies can be taken forward with these languages as mentioned above.

There are many Language Institutes in India and some are under the control of MHRD, Government of India such as the Central Institute of Indian Languages (CIIL), Mysore. This institute has seven centres:[7]

- Centre for Classical Languages
- Centre for Tribal, Minor, Endangered Languages and Languages Policy
- Centre for Lexicography, Folklore, Literature and Translation Studies
- Centre for Literacy Studies
- Centre for Testing & Evaluation
- Centre for Materials Production, Publications, and Sales
- Centre for Information in Indian Languages

But it is difficult to know what other types of research are going on there except for linguistic research. There are three principal approaches of language learning, which also provide new directions to language research and some institutes are perhaps working on them:

1. The structural view treats language as a system of structurally related elements to code meaning (for example, grammar).
2. The functional view sees language as a vehicle to express or accomplish a certain function, such as requesting something.
3. The interactive view sees language as a vehicle for the creation and maintenance of social relations, focusing on patterns of moves, acts, negotiation, and interaction found in conversational exchanges. This approach has been fairly dominant since the 1980s (Richards and Rodgers, 2001).

The talented researchers in India must learn to use the soft powers of the Indian nation as America does it? Products such as Coca-Cola have been advertised in such a way that people all over the world think that having a bottle of coke in hand is a prestigious symbol. The origin and development of

American culture are not more than five hundred years old but the supremacy it claims and enjoys over the world is worth noticing. As compared to them India has a legacy of five thousand years with innumerable positive ideas, objects, theories, cultures, and languages to boast about but the humility, selflessness, and spiritual orientation of our lifestyle across all Indian communities does not allow us to blow our trumpets. But it is necessary to make the world aware of the contribution of Indian languages, especially of the Sanskrit language. Instead of repetitive topics such as translations and literary appreciations of famous works or the character-sketches of the roles in dramas, it is necessary to bring to light the value-orientation of such compositions. Even after the hundreds of attacks by foreign invaders India is firmly rooted in its culture because of the eternal values, which are inculcated in the minds of natives from their childhood. In this era of competition for supremacy, greed for wealth, land, and power, the human mind is restless and is in search of peace. It can certainly be provided through the literature in Indian languages in general and in the Sanskrit language in particular. Even the Indian canons of critical appreciation, which are used by the Western critiques is the literary contribution of India to the world. The linguistic theories propounded by Bhartrihari, the stalwart of the philosophy of grammar, are immensely appreciated by foreign scholars such as Noam Chomsky. Current language research should take note of these points, take this research ahead, and prove the Indian supremacy over other languages of the world, which Sanskrit has already done.

Ethics in Language Research

What exactly is conveyed by "research ethics"? It is concerned with the moral issues that arise during or as a result of research activities, as well as the ethical conduct of researchers. Harvard Ethicist Louis M. Guanine describes the 'kernel' of intellectual honesty to be, "A virtuous disposition to eschew deception when given an incentive for deception" (Guanine, 2005).

The term "research ethics" is the product of medical research and research in other fields such as social sciences, information technology, biotechnology, and engineering, which may generate different types of ethical concerns to those in medical research (Iphofen, 2011). Intellectual honesty is an important component of any research and so also in research in language. It is an applied method of problem-solving characterized by an unbiased, honest attitude, which can be demonstrated in several different ways says Wikipedia.[8] These are listed here and clear measures are needed for the ethical governance of research to ensure that:

- Personal beliefs or politics do not interfere with the pursuit of truth.
- Relevant facts and information are not purposefully omitted even when such things may contradict one's hypothesis.
- Facts are presented in an unbiased manner, and not twisted to give misleading impressions or to support one view over another.
- References, or earlier works, are acknowledged where possible and plagiarism is avoided.
- Intentionally committed fallacies in debates and reasoning are called intellectual dishonesty.

As mentioned earlier, dishonesty comes in the way of the pursuit of truth for various reasons discussed above. It is not expected from the research to have positive results, supporting the hypothesis all the while but one has to accept the results, which may be contrary to the hypothesis as well. Genuine research includes both: positive and negative results and at that time the researcher has to analyse the negative results and find out the reasons for that, or state and accept them boldly. If the researcher hesitates to record the findings that are contrary to his or her hypothesis there is every possibility of twisting the results to suit the hypothesis, which would be a transgression of research ethics. The

impartial, transparent attitude of the researcher is an important part of true and authentic research. In the absence of this, there is fear of unethical practices.

A document entitled "Good Academic Research Practice" (GARP) was published by UGC, New Delhi, prepared by Dr. Bhushan Patwardhan, then VCM, UGC, and his team, which speaks of various facets of good research in the light of expectations and fulfilments. Under the title "Good Research Practices" it says, "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 presents itself in multiple forms and can occur at any stage of the research cycle from the initial stage of selection of the research problem through the dissemination of research outputs to the fellow-researcher, decision-makers, and the public at large." It is an extensive document worth reading to understand about GARP (UGC, 2020).

Ethics in research and a publisher's ethics are two different issues. The first one is about the personal attitude of the researcher and the second is concerned with the publisher. All renowned publishers display their ideas on "Publishing Ethics" of their journal but the researcher must be aware of it before sending the research outcome for publishing. Again, there is some information provided by Elsevier about the publication of an article. "The publication of an article in a peer-reviewed journal is an essential building block in the development of a coherent and respected network of knowledge. It is a direct reflection of the quality of the work of the authors and the institutions that support them. Peer-reviewed articles support and embody the scientific method. It is therefore important to agree upon standards of expected ethical behaviour for all parties involved in the act of publishing: the author, the journal editor, the peer reviewer, the publisher and the society of society-owned or sponsored journals."[9]

Many universities publish research journals and upload their criteria on their website. Just as an example: Uttarakhanda Sanskrit Vishwavidyalaya has uploaded the guidelines for their research journal *Shodhpragya* on their website. It also says that they invite authentic, scholarly, and unpublished research papers for publication. Research papers submitted for publication will be evaluated by the referees of the journal and only those that receive favourable comments, will be published.[10] Although there are several rules and regulations framed as "Ethics in Publication", they are violated by those who have made this as a money-making business. There are publishers who ask for thousands of rupees for publishing articles, which are in fact not worthy of publication. It is an open secret that such publishers are ripening their harvest at the cost of research quality. Researchers have to take care not to fall prey to such practices.

Conclusion

"The increase of data availability and computational advances has led to a plethora of metrics and indicators being developed for different levels of research evaluation. **…**These advances have also highlighted the fact that metrics must be applied appropriately depending on the goal and subject of the evaluation and should be used alongside qualitative inputs, such as peer review. However, this has not solved the challenge of finding core quality and validity measures that will guide the current and future development of evaluative metrics and indicators. **…**This means that the field now faces a divide: although new metrics exist, they are oftentimes not suitable or cannot be scaled up to the global research ecosystem. For lack of agreed-upon alternatives, such metrics are being used routinely in inappropriate circumstances despite their shortcomings."[11]

The above quote indicates that there is a serious requirement for quality and validity measures of research metrics and it is to be ensured that they are applied appropriately and fairly. This also shows

that language research has to spread its wings with the help of metrics and ICT. The five copies submitted for assessment at the time of submitting the thesis to the thesis section(one for the guide, two for two examiners, one to the library, and one as researcher's copy) rest in the cupboards forever and it is doubtful whether the researcher himself takes it out to go through it again after getting the degree. Therefore, the research should be open to public, the other students, teachers, interested people in the society. They may read, think, comment, challenge, support, and apply the findings for societal benefits, and then only this process will be complete. The ethics in publishing must be followed at both ends, that is at the points of both the researcher and publisher. Such authenticity and authority in the language-research field will confirm the place of India on the Universal Map of Scholarship as an important facet of *Vishwagurutva* of *Bharata*.

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CHAPTER 6

Research Methodology and Fallacy in Humanities and Social Sciences Research

Kiran Pandya

Research in social sciences can be traced back to the 17th century. It is well-documented in literature that industrialization and capitalism gave boost to social science research (Alastalo, 2008). The writings on social research methods are documented from the 1920s and they discuss the development of methods in the context of the United States. The Chicago School and Columbia University are credited with developing and discussing social research methods, especially during the interwar period. Later, important developments in quantitative and qualitative methods took place. While, the origins of qualitative research are attributed to the Chicago School, its contribution to survey research methods cannot be undermined. The decades of the 1940s to 1960s saw the emergence and use of survey research methods in social sciences. The terms 'qualitative' and 'quantitative' were not used in common parlance, in those days, but the debate between the superiority of a case study (qualitative) method over statistical (quantitative) methods, and vice versa were quite popular. It was only in the beginning of the 1970s decade that the distinction between qualitative and quantitative research came to the forefront. The divide, debate, and discussions of qualitative and quantitative research approaches brought forth the epistemological foundations of these two approaches. Because of the radical differences in epistemological foundations of qualitative and quantitative research, it can also be said that qualitative approach is a paradigm shift from the quantitative approach. *Albeit*, the Chicago School considers both these approaches to social research as complementing each other.

The following aspects are covered here:

- The paradigms of research in social science and humanities,
- Research designs,
- Methods of data collection,
- Reliability, validity and standardization in social science research, and
- Fallacies in the context of both — qualitative and quantitative research.

The Paradigms of Research in Social Sciences and Humanities

Bryman (2008a) discusses paradigms in social research by quoting the *American Historian of Science*, Thomas Kuhn, that scientific revolutions result in developments in sciences, while replacing the old paradigm by the new.

In the context of social research methods, the differences in epistemological foundations of quantitative and qualitative research, represents two paradigms. If both these methods are employed for undertaking social science research, it is also known as the mixed-methods approach. The mixed-methods approach represents intra-paradigmatic differences but according to the Chicago School, they complement each other (Alastalo, *op. cit.*).

The quantitative approach is associated with positivism. The concept of positivism was given by Auguste Comte and it is based on the premise of circular dependence of theory and observation in

natural sciences. This foundation was applied to the survey and quantitative approaches in social science research. Positivism is often interpreted as empiricism, which is based on the premise of seeing is believing. Qualitative research is an outcome of the challenge to the positivist paradigm. Thus, qualitative research is said to be based on post-positivist stance, where knowledge could be based on human conjectures.

While, some areas of social science research such as, psychology, social psychology, education, and behavioural economics make use of an experimental approach, other disciplines such as, sociology and linguistics make use of the non-experimental approach. This could be survey-based or could utilize the designs of the qualitative approach.

Designs

Five types of research designs are described here: experimental; cross-sectional or survey; longitudinal; case study; and comparative. The details of these designs can be found in any good reference book on research methodology (See Bryman 2008b).

Experimental Design

As already discussed experiments are undertaken in disciplines such as psychology, social psychology, behavioural economics, and geography, among others. Some researchers, however, also utilize experimental design to examine the impact of policies on various sections of society. These experiments differ from the laboratory experiments typically used in pure sciences. Laboratory experiments are undertaken, mainly in pure sciences, in a closed environment. Field experiments, on the other hand, are undertaken in real-life settings. Experiments in social science research are also undertaken in real-life settings. Randomized control trials, in which the samples are organized in two groups — controlled and experimental, is one of the popular experimental designs in social science research today.

Cross-sectional Design

Cross-sectional design is also known as survey design. Those with a limited exposure to research often construe survey research in the narrower context to include only questionnaires and structured interviews. Therefore, the terminology "cross-sectional design" is preferred to provide a wider dimension to the survey research. Cross-sectional/survey design includes, but is not limited to, structured observation, content analysis, official statistics, and diaries, over and above questionnaire and structured interviews.

Longitudinal Design

When a sample is surveyed on more than one occasion, at least twice, it is said to be a longitudinal design. Longitudinal designs are broadly classified as: (1) the panel design, and (2) the cohort. A panel design administers the same survey on the same set of samples (which implies, same number of samples) twice or more. The British Household Panel Survey (BHPS) is an example of panel design. A cohort, on the other hand, is a sample selected from the people sharing the same characteristics, for example, the millennials. The sampled element and the sample size in a cohort may remain the same or may vary in each subsequent round of the survey. But the sample continues to be drawn from the same cohort, for example, millennials, in each round. In either design, the selection of the sample is

preferably done using random sampling. The National Child Development Study (NCDS) of England is an example of a cohort study.

Case Study Design

This design is suited more to studies in sociology, psychology, and anthropology. It is appropriate in situations where the attempt is to study in detail, a single community (including online communities), a single school of thought, a single family, a single organization, a person (such studies often make use of the life or oral history, or biographical approach), or a single event. These entities of study on which a case study design can be applied are generally called "social settings". A case study design is used for a detailed, intensive study of the complexity in nature of one particular social setting. Cases could be categorized into: a critical case, an extreme or unique case, a representative or typical case, a revelatory case, or a longitudinal case.

Comparative Design

A comparative design is appropriate when two or more contrasting social settings or cases are studied using identical methods, at almost the same point in time. This design is also suited to cross-cultural and cross-national comparative studies. The issues of reliability, validity, replicability, and generalizability of comparative designs are similar to those of the cross-sectional design. A comparative design gives an opportunity to the researcher to examine the causal mechanisms in contrasting or similar situations or contexts. It is a variant of the comparative design, known as multiple-case study approach. The multiple-case study approach is suitable to qualitative case studies as well.

Data Collection Methods

Social scientists have, of late, been making a distinction between: (1) naturally occurring data, and (2) non-naturally occurring data. Conversational analysts and discursive psychologists strongly recommend working with recordings of naturally occurring data and their transcripts (Speer, 2008). The methods of collecting non-natural or contrived data are discussed as follows:

Self-administered Questionnaires and Standardized Interviews

Self-administered questionnaires are handed over to the respondents, for reading and filling in their responses. They are characterized by the complete absence of the interviewer. This gives rise to concerns about non-responses, item non-responses, and the quality of data. This is because the question and its response alternatives would be interpreted differently by different respondents. In contrast to that, in the case of structured interviews, the presence of the interviewer can help in explaining the questions and the response alternatives. This enhances the data quality and reduces item non-response. Moreover, the non-response rate in case of structured interviews would be relatively less because the interviewer may successfully convince the reluctant respondents, who would, in the absence of the interviewer, might be non-responsive. Standardized interviews are better to get responses on sensitive questions. On the other hand, interviewer effects would have to be accounted for, in the case of standardized interviewing (De Leeuw, 2008).

In case of self-administered questionnaires, the respondents see the questions and the response alternatives themselves. Self-administered questionnaires can be designed using online services such

as, Google Forms and SurveyMonkey, and can be distributed through e-mails, WhatsApp or social media like Facebook, Instagram, and through LinkedIn, to the sampled respondents. Using online forms ensures safety during pandemics like COVID-19 and also gives access to larger geographical areas. In case of structured interviews, the respondents only listen to the questions, at the most, materials such as flash cards are shown to get the response.

Qualitative Interviewing

Doucet and Mauthner (2008) argue that, according to Ann Oakley, one of the early critics of positivist paradigm, a rapport between the interviewer (observer) and the respondents (observed) is essential to understand the position of the respondent better. She is skeptical about the positivist approach of objectivity and separation of the observer from the object or person observed, and insisted on investing one's individual identity in the observer-observed relationship. Qualitative interviewing focuses on empathy, rapport, and reciprocity in interview situations; to the extent of interviewer revealing her or his own situations, views, and stands. However, this might get a bit complex when the interviewer and the respondents have diametrically opposite opinions on the issue being examined. Qualitative interviewing is also construed as a feminist paradigm, and feminists suggest focusing on ethnomethodology while conducting the interview. The respondent may identify herself or himself with a place and the responses might be influenced by the place where the interviews are conducted. Thus, ethnomethodology emphasizes noting the details about the place and its connection with the respondent, to accord meaning to the responses given by the respondent in the qualitative interview.

Focus Group Method

Focus groups were used for the first time in the 1920s in sociology but eventually started getting used for market research. However, in the 1990s, focus group discussions started gaining acceptance in social science research (Smithson, 2008). In a focus group method, usually a group of 6 to 12 persons is formed, they are given a specific topic or subject and are asked to discuss among themselves. The role of the observer or the interviewer is merely to moderate the group in case there is any digression or any relevant aspect is getting missed out. However, in certain situations, the group is not mature enough or not informed enough to have a discussion on their own. In such a situation, the role of the moderator becomes that of an interviewer. The interviewer poses the question and the individuals in the group respond to those questions, usually, one after the other. Therefore, there are focus group discussions and group interviews. In each of these methods of data collection, there is a difference in the manner in which the responses of the participants are influenced by the interviewer, and this requires to be considered while analysing the responses. Focus groups are now commonly used in social science disciplines as well as in health studies, education, political science and economic geography (*ibid.*).

Biographical Methods

Biographical methods have evolved and adapted to the advancements in technology and also to the methodology and theories, over time. The origins of biographical methods trace back to the Chicago School, known as narrative analysis in those days, involved the respondent or participant narrating his or her life events, by the way of story-telling, to the researcher (Bornat, 2008). This is a phenomenological approach to study and analyse an individual's (respondent's) perspective or stand in an observable historical and structural context. While the basic focus is on interpreting the story

told by the respondent, for implicit as well as explicit meanings, it also helps in identifying themes, a process that is associated typically with the grounded theory.

Reliability, Validity, and Standardization

Reliability, validity, and standardization are essential for the replicability of a research.

Reliability: is used to examine the accuracy or precision of a measurement instrument, questionnaire or a focus group / qualitative interview-guide. Reliability is also an indicator of consistency in measurement. For example, if a weighing scale consistently measures the same weight for the same object, the weighing scale is said to be reliable.

Validity: is used to examine the accuracy, with which a test measures the construct it is intended, planned, or required to measure. Validity is categorized into four types:

1. Construct validity: the extent to which an instrument measures, what it claims to measure;
2. Content validity: the extent to which the questions or constructs of the instrument are representative of the concept or research questions;
3. Criterion validity: the extent to which the results from the data collected using the instrument matches the results from the data collected using already tested or well-established and widely-used instruments; and
4. Face validity: the extent to which the contents of the instrument are suitable to the research question. Face validity is similar to content validity but is relatively informal and subjective.

Validity is also categorized as: (1) internal validity, which refers to the context in which the results of a study are applicable; and (2) external validity, which refers to the extent of generalizability of the results from a study.

Standardization: refers to the uniform procedures to ensure that the instrument is administered and constructs measured, in the same way each time they are used or measured.

Fallacies in Quantitative Research Approaches

Quantitative research is based on a positivist paradigm and it makes use of self-administered questionnaires or standardized interviews to generate data. These data are normally, quantitative in nature, as they are measured on attitude scales or using metric measurements (like the age of the respondent) and therefore, statistical methods are used to examine the hypotheses. These processes of data collection and statistical analysis are not free from misconceptions, called fallacies. These fallacies require to be understood and corrective actions be taken to ensure correct treatment to the data, statistical analysis, and in turn, to drawing inferences about the research hypotheses.

Qualitative research is based on naturalistic paradigm and their data collection, analysis, and interpretation approaches are different compared to those of quantitative research. The processes of qualitative research are also not free from fallacies.

In the context of quantitative research, contextual variable fallacies, measurement error fallacies, and missing data imputation fallacies are discussed here.

A contextual variable is one that is dependent on the predictor and it influences the outcome. There are many misconceptions associated with this type of variable. The most common misconception or fallacy with contextual variables is that it should not be confused with the interaction effect; a

contextual variable has to be treated using the stepwise approach (predictor –> contextual variable –> outcome). This process is called 'mediation'. It is not necessary that the predictor and outcome have to be related independently of the contextual variable. Mediation is appropriate to longitudinal studies and should not be used with cross-section designs.

Instrument quality influences measurements and in turn, influences the inferences drawn. Measurement error fallacies are associated with aggregation, reliability, and complex constructs.

Summing across individual items would result in compromising the quality of data if: (1) there is a high proportion of item non-response, and (2) when the scale comprises a mix of positive and negative constructs. High item non-response would result in underestimation of the total score, while summing the items. In the case of a mix of positive and negative constructs, it is a common practice to reverse-code the responses of the negative constructs. However, reverse-coding sums up with actual codes (positive constructs are untreated and therefore, actual scores of these items are taken) would incorporate inconsistency in the measurement. Therefore, getting composite scores by summing individual items should be exercised with caution. There are instances, where the inclusion of certain variables in a complex structure, results in unintended yet systematic errors. Such variables are called "nuisance variables". While sub-scales are used to enhance the reliability, nuisance variables accidentally get included in the design. These variables need to be identified and their effects are required to be controlled.

Modern approaches to imputation of the missing data include Full Information Maximum Likelihood (FIML), the Multiply Imputed (MI), data-based Expectation Maximization (EM) and Markov Chain Monte Carlo (MCMC) algorithms. The estimates of a statistical model fitted to the data using these methods are more accurate in comparison with the complete-case analysis or the classical methods of imputing missing data.

The detailed discussion on the other fallacies, that is, statistical significance fallacies, statistical power fallacies and factor analysis fallacies can be found in Wang, *et al*. (2013).

Fallacies in Qualitative Research

Much work has been done in the domain of quantitative research. Qualitative approach to undertake research has gained acceptance only in the recent past. Thus, relatively less literature is available that discusses the fallacies in qualitative research.

Fallacies Associated with Descriptive Theorizing

Classifying all measurements into relatively similar and relatively different gives rise to a false dichotomy. It is recommended that measures should be capable of devising a continuum that gives information on the relative distance (or similarities) between the cases studied.

There are three issues associated with aggregation are:

1. Lack of clarity about the need to aggregate,
2. Inability to fathom the impact of measurement scales on aggregated scores, and
3. Lack of clarity about the terminology used to refer to the values of the aggregate scales versus disaggregate scales.

Therefore, the absence of clearly chalked out procedures to undertake aggregation results in conflation fallacy, when aggregation is performed.

Fallacies Associated with Causal Theorizing

To draw a conclusion based on a single case (observation) is possible only if:

1. There is a deterministic causation and there is no element of stochasticity,
2. There is a theory that lists all the variables required to explain the outcome (of the deterministic model), and
3. All variables are measured without any errors.

If any one of these conditions are violated, it would be incorrect to generalize with N=1.

The dilemma of whether to adopt a case-based approach or a variable-based approach, is actually a "false dilemma". Researchers may use either or both the approaches depending upon the nature of inquiry for the research.

Contextual factors in qualitative research vary from case to case, and that has a bearing on the outcome of the research. Context is of prime importance in qualitative research. Therefore, generalizing the observations, without giving appropriate importance and treatment to the context results in *ad hocism*.

The details of these and other fallacies can be found in Munck (2005).

Conclusion

Researchers should have a clear idea about the approach that is suitable for their research problem; usually, research involving sensitive social issues adopts the qualitative approach. This is because the data collection methods are different for a quantitative approach as compared to the qualitative approach. Data collection instruments, on the basis of their characteristics and content, would influence the reliability, validity, and potential for their standardization. The researcher should take into consideration and should discuss these issues in their research reports / theses. Researchers should have clear understanding of the fallacies, so as to ensure the appropriateness / correctness of their research findings.

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CHAPTER 7

Ethics in Biomedical Sciences

Sanjay A. Pai

Ethical issues abound in the field of scientific research, including medical research, and have been addressed in various fora for many decades now. However, the topic has not been given much thought or importance in India until fairly recently. The interest that has now been seen over the past few years is probably linked to many reasons — the presence of journals such as *Indian Journal of Medical Ethics* and *The National Medical Journal of India* (both of which I am associated with), which often contain articles on the subject; the realization that research misconduct does take place even though it is rarely recorded in India; and finally, contemporary emphasis on research publications being necessary for promotions in Indian academia.

The ethical issues that come to mind when one thinks of the word 'ethics' or "research misconduct" include authorship issues such as plagiarism, fraud, and fabrication, publishing in predatory journals. These topics have been addressed elsewhere in the book. I address other, less well-known subjects, but which are of importance.

General Overview

Why does the question of ethical issues arise in biomedical research, or indeed, in science? In looking at the concept of ethics in biomedical research there has to be some reference to science in general as well. In that case, there may be some overlap between this article and some of the others in this book . We need to examine one wonderful definition of science provided by Linus Pauling, the two-time Nobel prize awardee (one in chemistry, 1954 and the other in peace, 1962). "Science is the search for truth, that is the effort to understand the world: it involves the rejection of bias, of dogma, of revelation, but not the rejection of morality." All of these components are important — that science is the search for the truth is what all of us are taught; that it involves questioning dogma is also known to us. Few, however, are told about the importance of morality and ethics in the concept of science. Ethics deals not just with the black and white areas, but also with the grey zones. There is, obviously, an overlap with legal issues, but all that is legal is not necessarily ethical (many, including me, would consider the death sentence as a prime example of this) and all that is illegal is not always unethical (examples of which I shall not elaborate on!). Thus, science and scientific research consists of doing what is correct and of following the golden rule: Do unto others as you would have them do unto you.

Research is, of course, essential at all times, as it is the curiosity that human beings have shown that has made them different from animals. However, this curiosity and the explorations that it involves must be done within established boundaries. The science must be performed in such a manner that the methods and the results must be reproducible by other groups of scientists. Further, the research must be performed within the existing social and scientific norms and must be useful to society or at least, expand the horizons of our knowledge. Protection of the research participants is paramount and researchers must take great care — this is morally as well as legally binding on them. A major role of the ethics committee or the institutional review board is to carefully study the research protocol and establish that the risks to the participants are reduced and that there exists an acceptable risk- to-benefit ratio.

A good research project always begins with the researcher studying the available literature to learn what is already known and what is unknown about the subject. It is unscientific and unethical to waste time and resources and put participants to potential risk for a study in which the results can be predicted on the basis of existing knowledge. The appropriate scientific method must be used, for obvious reasons. Records must be maintained with great care — this may also be of use in the future when there are questions of priority in discovery. Further ethical aspects of research publication are discussed elsewhere in the book.

Stephen Lock (1997) writes that most modern histories of scientific fraud begin with William Summerlin, a dermatologist and immunology researcher at the Sloan Kettering Institute, New York in 1974. Of course, there have been multiple earlier examples of serious research misconduct and just some of them include the Nazi experiments on humans in the 1940s, the release of Thalidomide as a drug for morning sickness in pregnant women, without adequate safety data, and the Tuskegee trial in the USA which went on for 40 years from 1932 to 1972, until a whistle-blower alerted the world to it. More recent examples (and a far from complete list) of misconduct in biomedical science include: Malcolm Pearce and his fictitious patient with a successful reimplantation of an ectopic gestation in 1994, as well as his non-existent cohort of women with polycystic ovaries; Andrew Wakefield and his views on the MMR vaccine and autism in 1998; Werner Bezwoda and his publications on autologous bone marrow transplantation with chemotherapy as a cure for breast cancer in the 1990s; Jon Sudbø and his concocted research on non-steroidal anti-inflammatory drugs (NSAIDs) and oral leukoplakia/ cancer in 2005; Hwang Woo-Suk and his pseudo-research on stem cells in 2006; and perhaps the biggest fraud of them all, Scott Reuben and his misguided papers on anaesthesia, detected in 2010 (Mukherjee, 2010; Tharyen, 2012; Wells and Farthing, 2008). Paulo Macchiarini, the tracheal transplant surgeon at the Karolinska university Hospital provides another very recent example, in 2018, of fraudulent science (Berggren and Karbag, 2019). The details of all these examples of misconduct are beyond the scope of this article; nevertheless, they make for fascinating reading and readers should look up these stories of treachery in detail.

India and Indians have had their own share of unethical experimentation. Vijay Soman, Ranjit Kumar Chandra, and Anil Potti are examples of Indians who were exposed for research misconduct in North America. In India, the study evaluating the follow-up of women diagnosed with cervical dysplasia on Pap smear in the 1980s and the Regional Cancer Centre, (Thiruvananthapuram, Kerala) trials on oral cancer are prime examples (Mudur, 1997; Pai, 2018; Srinivasan and Pai, 2001). India has also been a fertile ground for clinical trials for the past 15 years and there have been concerns that many of these trials do not follow the tried and tested principles of ethical medical research. These are, of course, extreme examples and there are many 'lesser' amounts of research misconduct such as, plagiarism, predatory journal publishing, gift authorship, among others, and therefore, it is a matter of shame to read the statement, "Along with economic strength, space technology and software expertise, India is also a leading nation in fraudulent scientific research" (Patnaik, 2016). I have covered the Indian studies mentioned above as well as some other aspects of research misconduct elsewhere and I encourage the interested reader to study that as well (Pai, *op. cit.*).

Causes of Research Misconduct

The reasons for fraud in medical research have been discussed by Lock and include pressure on researchers to publish, greed, vanity, mental illness or deviancy, and the Messianic complex (Lock, *op. cit.*). The first three are the most common but deviancy (mental illness) and the Messianic complex (the belief that one's views are always correct) are also of importance. It has been shown that most of the offenders indulge in serial misconduct and that fraud is rarely a one-off phenomenon and thus, perhaps, the last two examples are more common than we think.

Gunsalus and Robinson (2018), in an article on research misconduct, have coined the mnemonic TRAGEDIES (Temptation, Rationalization, Ambition, Group and authority pressure, Entitlement, Deception, Incrementalism, Embarrassment, and Stupid systems). These are the factors that can lead scientists astray from the straight path that they should follow. Educating younger colleagues about the existence of these undisguised, almost transparent, devils is the first step to prevent research misconduct and further tragedy.

Codes of Ethics

To address these issues, various codes of ethics have been established. Just some of these include the Nuremberg code, Declaration of Helsinki, the Belmont report and the ICMR guidelines (Timms, 2019). The Hippocratic oath does not specifically refer to medical research and hence, we included a mention of it in a revised Hippocratic oath, which we believed was relevant to Indians, for this era (Pai and Pandya, 2010). Specifically, we stated, in that revised oath:

"My research will depend on my circumstances but my enquiring spirit will search for problems, the solutions to which will benefit patients. Just as I would not like to be treated as a guinea pig, I will ensure that my patients participate in my studies as well-informed individuals, fully conversant with the purpose of the enquiry, the questions asked, answers sought and how these may benefit others. All my dealings will be honest and transparent."

These codes follow these essential principles: honesty, objectivity, integrity, carefulness, openness, respect for intellectual property, confidentiality, responsible publication, responsible mentoring, social responsibility, non-discrimination, competence, legality, animal care, and protection of human subjects (Resnick, 2020).

Unexpected Ethical Issues in Science

The leading information scientist, Arunachalam and his group have recently posited an even more interesting idea: they suggest that even the question of where to publish (in research in general, not necessarily for the medical sciences only) is an ethical issue! Madhan, *et al.* (2017), point out that many Indian researchers publish their work in certain open-access journals that charge prohibitive article-processing charges. That their research has often been funded by the government or by other public-funding bodies, which are supported by the tax payer, means that these public funds are not ultimately used for the greater common good and is hence, unethical. P. Balaram, ex-editor of *Current Science* and former-Director of the Indian Institute of Science, Bangalore believes that the funds spent on article-processing charges are better spent on research itself or on libraries. The ethical issue of publishing in a paywall journal, where the research is not even openly available to many who cannot afford the journals, is obvious. This is a sound argument therefore whenever possible, we should strive to publish in an open-access journal, one which is freely available to other researchers and to the public. As it turns out, the four journals (*Indian Journal of Medical Ethics*, *The National Medical Journal of India, Current Science,* and *Indian J Cancer*) that I am associated with are truly open access, where neither author nor reader pays. This would also satisfy principle 3 of the Hong Kong principles discussed below. This is, of course, a difficult choice as scientists are, after all, human, and factors such as prestige, readership, circulation, visibility, and the impact factor also matter.

The other profoundly unethical principle that many researchers follow — usually aided and spurred on by academic bodies and institutes In India as well as abroad — is the devotion to the impact factor (Madhan, *et al.*, 2018). The impact factor is a useful indicator of the importance of a journal, but

like most metrics and indeed, like many things in life, it has many flaws. Because the criteria used to determine the impact factor are not transparent and because these can be rigged by unscrupulous editors, it remains an imperfect metric. Certainly, it was not meant to be created for the purpose of judging a specific research paper and for awarding promotions to researchers. We are trapped in a Catch-22 situation. Researchers in India and abroad are being judged by many academic bodies based on the impact factor of the journals that they, the researchers, have published in. Besides the obvious flaw in this, is the bigger issue — the fact that most Indian journals have low impact factors. By encouraging Indian researchers to publish in the high impact journals from abroad, we are advising our researchers to publish their best research in non-Indian journals! Therefore, the impact factors of Indian journals will continue to remain low.

The principles of medical research ethics encompass more than just clinician-participant/patient interaction. Laboratory physicians also need to adopt these principles in their actions with patients and patient samples (Bhagwat and Pai, 2020; Vaz, *et al*., 2016).

The Hong Kong Principles for Assessing Researchers' Integrity

David Moher, *et al*. (2020) designed The Hong Kong Principles for assessing researchers integrity. This was done by circulating an early draft of the manuscript among the 700 attendees at the 6th World Conference on Research Integrity, followed by further discussions, and then feedback from more than 100 people.

The Principles

1. Assess researchers on responsible practices from conception to delivery, including the development of the research idea, research design, methodology, execution, and effective dissemination.
2. Value the accurate and transparent reporting of all research, regardless of the results.
3. Value the practices of open science (open research) — such as open methods, materials, and data.
4. Value a broad range of research and scholarship, such as replication, innovation, translation, synthesis, and meta-research.
5. Value a range of other contributions to responsible research and scholarly activity, such as peer review for grants and publications, mentoring, outreach, and knowledge exchange.

Code of Ethics

World Economic Forum Young Scientists Community, June 2016

The World Economic Forum Young Scientists (2016) created a code of ethics. This code was created after a workshop, which was followed by much thought and deliberations with peers and experts in various fields, such as, biology, physics, environment, technology. Although there seems to be no specific mention of medicine in this group, the lessons apply to all of us, and indeed, even to those in vastly different fields of research, such as, history and geology. It is worth reading the original article, which is freely available on the web. However, in brief, there are seven principles:

1. Engage with the public — Scientists should communicate the results of their research to the person on the street rather than stay in ivory towers only.

2. Pursue the truth — Perform research which is evidence-based and independent of bias.
3. Minimize harm — To all stakeholders including people, animals, the environment, etc.
4. Engage with decision makers — Most scientists stay in their labs and refuse to join hands with the government or with policy makers – this is wrong because engaging with decision-makers offers an opportunity to effect a change. Refusing to do so is an opportunity lost.
5. Support diversity — This is not important only from the spirit of fairness, but also because diversity in groups results in increased innovation.
6. Be a mentor — This is crucial to develop the next generation of thinkers and scientists.
7. Be accountable — Take responsibility for your actions and tread the right path for the benefit of your mentees and society.

Cost of Scientific Misconduct

The cost of scientific misconduct is huge.[1] To begin with, it damages the author as well as the institution. Jobs are lost, degrees are revoked in addition to the loss of prestige and reputation of the scientist. Institutions and journals are 'brands' and the brand takes a hit.

Misconduct hurts the profession and sets it back, often for years. Bollande, *et al.* (2016), evaluated the integrity of 33 randomized controlled trials (in orthopaedics) by the Japanese group lead by Yoshihiro Sato because there were doubts about their veracity. The flaws and obvious fraud that they were able to illustrate in these studies were responsible, in part, for 21 of the trials being ultimately retracted. However, other meta-analyses, which had already been performed using these studies before the retraction, have probably led to misleading conclusions (Kupferchmidt, 2018).

Another excellent example of how progress in science is stifled is the Wakefield affair, which has resulted in many parents refusing to get their children vaccinated — despite the clear evidence now that his data was fabricated (Tharyan, *op. cit*.). The public's trust, in science in general, gets corroded as well.

A specific cost that applies to biological and medical research is that it puts animals and/or patients at risk. One does not have to be an animal rights activist or physicians to decide that this is obviously unacceptable.

The economic loss has also to be considered. There does not seem to be any data from India on this. However, we have reports from the West, which serve as an indicator as to what the financial losses are. Stern, *et al.* (2014), have shown that the 291 papers that were retracted due to misconduct accounted for about $58 million in direct funding by the National Institutes of Health, Bethesda, USA for the period 1992 to 2012 this formed less than 1per cent of the NIH budget for this period. Each of these articles accounted for a mean of $392,582 in direct costs. Another study, by Michalek, *et al*. (2010), calculated the expense that was entailed in one particular investigation of research misconduct. Their estimate was that the direct cost of the investigation was US $ 525,000. This estimate did not include many factors that were difficult to measure.

Lawsuits and other legal costs are further economic burdens on the investigator as well as the organization. The time that the researcher and others who have been on the wrong track lose, because of the initial fraudulent research also needs to be factored in.

Finally, and most certainly not the least of the problems, is that when discovered, it shames the fraudulent researcher as well as his (and do note that it is almost always a *his* – a subject, perhaps for further research) or her family. An unexpected side-effect of the misconduct discovered by Bolland, *et al*. was that Sato committed suicide (Kupferchmidt, *op. cit*.).

Solutions to Prevent Research Misconduct

However committed and honest we are, our colleagues may not subscribe to the same principles as we do and it is possible that the collaborator may indulge in fraud — resulting in our reputation being tarnished when the fraud comes to light. The only solution is to prevent it from happening in the first place. For this, we have to make it a point to select our collaborators very carefully. We must read every reference that we are quoting so that we know for sure that there is no plagiarism. When in doubt about any aspect of the study — be it on scientific grounds or ethical issues, we need to withdraw from study and/or declare all possible conflicts of interest, financial or otherwise.

Scientific bodies and governments in India must have an ombudsman and an Office of Research Integrity, like in the West (Pai, *op. cit*.). These institutions must be filled with people of impeccable integrity — something which can be achieved with relative ease, provided the will to do so exists. Appropriate punishment must be meted out to those responsible for research misconduct; this would work both as a punishment and a way to warn others. Directors and Deans must investigate misconduct and follow-up with the appropriate action, no matter how distasteful it may be. Finally, once again, prevention is better than cure. Many who indulge in questionable practices are not even aware that some of their acts are not acceptable in the scientific world. Thus, there must be undergraduate and postgraduate education in the various fields of research ethics.

One of the simplest principles to follow in research and indeed, in life in general, is the advice that has come down through generations — Honesty is the best policy.

Ethical Clinical Research in Developing Countries

All developing countries face problems and situations that are unique to them and are considerably different from the situation in the developed world. Angell (1997) and Emanuel, *et al*. (2004), specifically reflect on ethical conduct of clinical research in the developing world.

Angell's article focuses primarily on the ethics of using placebo and was written in the context of offering placebo in HIV-trials. She denounces the research, which conveniently uses different standards for the developing world compared to the developed world, under the guise of applying "local standards of care" — even when the local standard of care is considerably less rigorous than what is considered the acceptable standard in the developed world.

Emanuel, *et al.* (*op. cit*.) point out that because of various reasons — poverty, illiteracy, sociocultural and linguistic differences, and the relatively weaker regulatory infrastructure in the developing world, the ethical framework for clinical research needs to be robust but modified to reflect the reality. Therefore, for multinational research, they present eight principles and benchmarks, which are self-explanatory:

- Collaborative partnership
- Social value
- Scientific validity
- Fair selection of study population
- Favourable risk: benefit ratio
- Independent review
- Informed consent
- Respect for recruited participants and study communities.

Is the Scientific Paper a Fraud?

Sir Peter Medawar, the Nobel prize winning genius scientist, who also wrote scintillating prose, wrote a most unusual and iconoclastic article: "Is the Scientific Paper a Fraud?" In it, he posits that the scientific paper is written in a sanitized and glamourous manner, which does not truly reflect the way science is usually done: the false starts, the near-misses, the byways, etc. Thus, the very mien in which scientific research is portrayed is misleading and hence, unethical (Medawar, 1963; Howitt and Wilson, 2014).

We may not agree with him — after all, that too is the scientific approach: the right to disagree, respectfully, with another scientist's views!

Disclaimer: The views in this article are entirely personal and may not reflect the opinions of the associations, organisations and journals that I am associated with.

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Endnote

[1] ithenticate.com. 2012. (white paper) True Costs of Research Misconduct.

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CHAPTER 8

Roles, Responsibilities, and Ethics of Research Supervisors

Parimal H. Vyas

Research supervision is a multifaceted interaction between a research supervisor and research scholar. The collaboration between the two plays an important role in influencing the excellence of supervisory practices. 'Supervision' is the process of training, guiding, counselling, coaching, mentoring, and leading the research scholar to successfully carry out research activities. The researcher aims to be recognized with the award of a doctoral research degree. Supervision is a vital element of research studies. The expectations of a research scholar and the supervisory style of the supervisor or research guide shape the quality of the supervisory process. This is most crucial in creating and building a stimulating and productive research environment.

Research supervision has two important aspects: Style of supervision and Quality of supervision. The relationship between these two is most important.

- Style of supervision is identified as the manner in which a supervisor executes the supervisory process, considering his or her understanding of the research scholar's research needs. Because such needs vary between students, there is no fixed formula for good supervisory practice.
- Quality of supervision evolves when the supervisory process is adapted to meet the specific needs of the research scholar in question.

Research supervision enables learning ethical issues in research, both internal (pertaining to aspects within the research framework) and external (aspects related to relationships with colleagues, funding agency, and authorship) (Löfström and Pyhältö, 2014).

Ethical aspects also feature in the supervisor-research scholar relationship. The manner in which the supervisor fulfils his or her responsibilities is a matter of ethics and one that has not been adequately addressed in the realm of research ethics.

Review of Literature

Bennett and Knibbs (1986) rationalized that an appropriate supervision strategy has to be based on understanding the role expectations of a research scholar and the set of needs arising from his or her individual traits.

- An intelligent knowledgeable student may look for expert help from the supervisor on research methodology.
- Another research scholar, who is self-motivated, may not like to be dependent on the research supervisor but might need critical feedback and reflection on his or her efforts and research activities.
- A long-distance research scholar, may need a lot of guidance
- An academically strong and sharp research scholar may only need the assurance from research supervisor to avoid any technical hitches in the research study.

According to several authorities (Meyer, *et al*., 2005; Case, 2008; Pyhältö, *et al*., 2011), only perfect supervision can ensure the optimum time in research degree completion, build capabilities, and ensure the research scholar's pleasure and fulfilment with the overall research practices.

A critical element in research supervision is to ensure that the research scholar addresses all relevant research ethics. Alfredo and Hart (2011) and Gray and Jordan (2012) found that research scholars essentially acquire or inherit the knowledge and procedures for ethical conduct from their supervisors. Anderson, *et al.* (1994), found in their research that if a research scholar is not comfortable with the practices of the research supervisor, and facing problems with ambiguous career projections, then the scholars get involved in ethical misconduct. Zucchero (2008), and Burr and King (2012), have asserted that proper guidance for ethical conduct is essential for imparting knowledge of ethical norms and standards. An ethical research climate in the academic community climate is also necessary. True, *et al.* (2011), have reported that research scholars who were not into academic communities are more involved in ethical misconduct. Further, according to Anderson, *et al.* (*op. cit.*), research scholars who closely collaborate with academic staff on research ventures may be behaving unethically. Therefore, the relationship between research supervisor and research scholar is a critical means of acquiring suitable procedures and codes of conduct.

Roles and Responsibilities of Research Supervisors

A research supervisor **gives direction and motivation** by bringing in clear, transparent and inspiring vision into a research scholar's participation and clear communication. Supervisors need to play different roles with their research scholars. Each role depends primarily on the prevalent situation as well as the research scholar's capacity and needs.

- *Leadership role*: is situational and helpful in dealing with the inconsistencies in supervision, and in improving flexibility and self-awareness of a research scholar (Vilkinas, 2002).
- *Managerial role*: provides clarity regarding objectives, expectations, and procedures and helps the research scholar to take up the responsibilities by focusing on autonomy, competence, and connectedness.
- *Role as a coach*: **emphasizes on dialogue with the scholar for arriving at collective solutions supported by the mechanism of** providing feedback. It is helpful in creating a positive working environment and learning opportunities to focus on the talent of the research scholar. The supervisor needs to take due care of the scholar's well-being by being accessible, empathetic, and supportive. The supervisor should support the passion, ambition, and career development of the research scholar within or outside academia.
- *Entrepreneurial role*: **supervisors are expected to vigorously encourage innovation and creativity to ensure value-driven outcome of the research activities. They** should also look for potential opportunities for mobilizing financial resources using collaborations and connectivity from funding agencies, industry, and Government sources.

As experts, There are several activities that supervisors need to do for research scholars:

- Use their professional knowledge among their colleagues and scholars to achieve a definite outcome ensure research integrity.
- Prepare suitable planning schedules for the smooth sequential execution of the research study by taking the research scholar into confidence with a specific timeframe that would enable the scholar to complete the course work and other pre-requisites and ensure participation in academic events and bringing out quality-research publications.
- Train and guide research scholars for effective coordination with various academic and administrative bodies for submitting accounting details and documents for audit, verification, approval, and reimbursement before the competent authorities of the university/institute.

- Provide academic guidance to help pursue any other academic courses to improve soft skills, writing skills computational skills, presentational skills, and analytical skills.
- Support in reviewing literature, identifying suitable research gaps, and meticulously selecting appropriate research problems, following all procedures and methods of research.
- Help the scholar understand the modus operandi for making use of library facilities as well as online electronic resources such as electronic data bases, e-reports, and other e-indexes available in the existing body of knowledge.
- Support and facilitate availability of equipment, and diverse kinds of experiential facilities for smoothly conducting research study.
- Monitor the progress of the research scholar in a timely manner by periodically holding formal review meetings and also ensuring that the scholar keeps proper records and minutes of the formal periodical supervisory meetings.
- Take care in ensuring due reporting and acknowledging each of the citations used in the review of literature.
- Be accessible and available to the research scholar at mutually convenient times to give timely feedback on the performance of the research scholar regarding conduct of the research work and progress report with corrective and supportive positive action for the improvement and timely submission of the research scholar's Ph.D. Thesis.
- Ensure the preparation of a scientific and qualitative research report with lawful adherence of concerned regulations.
- Review and forward periodical progress reports of the scholar in a timely manner and guide her/him toward desirable publication of the research work in Scopus (or) Web of Science (or) UGC Care list of quality journals and also for submitting the Ph.D. Thesis.
- Arrange an open-house seminar presentation of the research work and open defence and holding of Ph.D. Viva Voce examinations of the research scholar. Only in an exceptional case, if the progress report of the research scholar is highly undesirable and unsatisfactory, the supervisor may recommend cancelling the Ph.D. registration of the research scholar.

Kitchener (1985; 2000) outlined the key features of faculty-student relationship as characterized by authenticity, caring, mutual respect, and respect for all kinds of diversity. He has given a model of ethical principles, which includes respect for autonomy, avoiding harm (non-maleficence), benefiting others (beneficence), being just (justice), and being faithful (fidelity), as its various components. The model would be very helpful to research scholars to facilitate ethical decision making.

Research Supervisor's Code of Professional Ethics

The research supervisor must give the scholar liberty to express his/her opinion, regardless of caste, gender, economic, social, and physical attributes, and treat him or her with dignity, without any kind of malice. A supervisor is expected to inspire the research scholar to improve his/her achievements to result in holistic growth and development. It is important to inculcate inquisitiveness and scientific temperament among research scholars. Help them to develop understanding of the country's national heritage and national goals. Supervisors must avoid provoking one scholar against another, or against colleagues and/or university/college administration.

Sutherland (2013); Vekkaila *et al.* (2012) emphasize the importance of freedom for self-expression and self-determination with autonomy and privacy. In the absence of these factors, problems such as cynicism and feelings of inadequacy tend to rise in the early years of academics and careers.

Löfström and Pyhältö (2012), describe the ethical issues in supervision, which are tricky or challenging to pass through. The investigation compares the kinds of ethical questions and analyses the views of research scholars and research supervisors. The extent to which scholars and their supervisors experience similar or different ethical challenges in the supervisory relationship are addressed in framing research questions.

Goodyear, *et al.* (1992); Löfström and Pyhältö (2012, *op. cit.*), and Mahmud and Bretag (2013) have identified a variety of ethical problems that are likely to rise in the context of supervision. Ethical problems in research include incapable, ineffective, and inadequate supervision; leaving the student in a lurch midway; intervention of perception of the supervisor; using obnoxious and manipulative language; and entering into a two-fold relationship that is likely to impair professional judgment, and backing fake authorship.

Conclusion

Based on earlier research studies, it can be advocated that the quality of supervision depends on the supervisor's ability to meet the needs of a research scholar. The mutual understanding of role expectation is crucial to the success of the supervisory process. There is no perfect style or method of research supervision, it has to consider the connection between the style and quality of supervision, role expectation of the scholar and academic staff, field of research study, and various other relevant characteristics.

Research recommends that the match and association between the research scholar and his or her academic environment is important. However, there is scope for future research to explore the match between the ethical issues rooted in supervision as identified by research scholars and research supervisors.

The extent to which a research scholar depends on her or his research supervisor for guidance, inspiration, problem solving, research preparation, and communication, has a significant effect on the relationship between supervision quality and style of supervision. Finally, therefore we can state that the supervision strategy should be suitably based on an understanding of the role expectations of the individual research scholar and the needs arising from those traits, which need fine tuning with the style and strategy adopted by the research supervisor.

We can learn a lot about the supervisor/ mentor and research student/mentee relationship from our ancient *guru-shishya* model. We have excellent examples from our epics that present different shades of the supervisor-student relationship, and we may be able to cull aspects that are ideal and those that we need to be cautious about. Although we are living in a vastly different era, there are some valuable lessons that we may learn and adapt to the contemporary context. The *guru* or mentor is responsible for creating, "a learning ecology" that is rich and vibrant, and he has to adhere to all ethical principles related to the research as well as those that involve the dynamics of a relationship.

A positive meaningful relationship between a supervisor and research student not only enhances the learning process, but also has far-reaching influence on the progressive transformation of research and practice in institutes of higher education.

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CHAPTER 9

Strengthening Research Integrity in Higher Education Institutes

Debendra C. Baruah

Research in Higher Education Institutes

Research is a key component of Higher Education Institutions (HEIs). The impact of quality research of HEIs is manifold and has proved to contribute immensely towards human development. Research helps us to cure diseases, tackle issues such as climate change, and understand the world around us. The research culture of HEIs provides ample opportunities for learners to acquire new and useful knowledge, get trained and thus build a career in research. Providing research facilities at HEIs, has proved significant in attracting young and talented minds, in capacity building, and thus enhancing and enriching the pool of competent researchers. In India, promotion of research culture in HEI's has been emphasized throughout the development of the Higher Education System (HES). Aptitude towards research, combined with good quality research output, are considered major credentials for the career advancement of faculty of HEIs in India, along with engaging in teaching and other activities.

Quality Research

Generally, there is a universally accepted methodology for the entire process of research, that is, from the inception to the final output. Publishing research outcomes through various modes — manuscripts for journal, patent journals, reports, scientific meetings — has been a significant phase of research. Transparent and reproducible research, generated through universally acceptable and robust methods are desired features of quality research. Mankind's ambition of making research fundamental to the process of pushing back the frontiers of human knowledge and understanding can be fulfilled through such quality research only. Interest in research has not remained limited to academicians and industries, but has been a matter of concern to almost all sections of the society as well, including leaders, judiciary and media.

Uncertain Research Integrity

Problems with the integrity of research arise when research is anything less than, "rigorous, accurate, honest, and transparent". There may be various causes that contribute to questionable research integrity including errors, unacceptable research design, and outright fraud. Deviating from actively adhering to ethical principles, and professional standards are the root causes of reducing the certainty of research integrity. It is the responsibility of both the individual researcher and the supporting institution, to ensure quality and integrity in research.

IQAC

The National Assessment and Accreditation Council (NAAC) mandated the formation of Internal Quality Assurance Cell (IQAC), with a vision to assure quality in every aspect of the functioning of

Indian HEIs. Therefore, the IQAC is accountable and has mandated responsibility to ensure quality standard and integrity in research carried out in its institutions. Lack of transparency in scrutinizing research data by the institutions, could severely damage them. IQAC is expected to assist the respective HEIs to build the required ambience for quality research, integrated with ethical principles, honesty, trustworthiness, and with high regard for the scientific record.

Mistrust in Research

There are some unpleasant examples of unethical research practices, which perhaps could have been avoided by a robust system of ethical research ambience actively monitored by cells like the IQAC. In one such incident, an author of several reputed publications, John R. Darsee, M.D., was exposed by Harvard University, for his fabricated research data while serving as a research fellow at the Harvard School of Medicine. Suspecting the integrity of Darsee's research, Emory University, where Darsee served before working at Harvard, made extensive investigations through both internal and external committees, and revealed Darsee's use of an alarming degree of fraud through fabricated data. Faculty/ Researchers at Emory University, retracted the publication (Darsee, *et al*., 1979), with a strongly-worded apology. The letter pointed out incomplete laboratory and clinical records, compounded by the failure to sustain the results and conclusions presented in the article.

In a similar case, a research paper authored by Anil Potti, *et al*. (2006). was retracted by Duke University.[1] The reasons cited were reported failure to reproduce results supporting the validation of the lung metagene model. Incidentally, Dr. Potti was later suspended by the University in another case, which demonstrated the absence of integrity and ethics in his claim as a Rhodes Scholar. However, the crisis relating to the lack of research integrity in Duke University was settled only through judiciary intervention, as reported by the media recently. Duke University had to pay $112.5 million to the U.S. government to settle a lawsuit brought by a former employee, who alleged that the university included falsified data in applications and reports for federal grants worth nearly $200 million. Prof. Vincent E. Price, President of Duke University, admitted the devastating impact of the research fraud and reinforced the need for a focused commitment on promoting research integrity and accountability.

Lessons to be Learnt

The implications of unacceptable research integrity, which has global relevance, has been very firmly expressed in its judgement on the Duke University case by the US Department of Justice, and as stated by Matthew G.T. Martin, US Attorney for Middle District of North Carolina, "Taxpayers expect and deserve that federal grant dollars will be used efficiently and honestly. Individuals and Institutions that receive research funding from the federal government must be scrupulous in conducting research for the common good and rigorous in rooting out fraud."[2]

These disclosures are learning lessons for any HEIs aspiring to maintain research standard, besides establishing the importance of record keeping and transparency. The incidents are not limited to an individual's inner pathology and cheating tendencies. It also reveals the limitation of peer review publication process (Darsee's and Potti's publications), and thus demands robust, trustworthy systems, embodied with proper supervision and alert co-authorship.

TRAGEDIES and the Role of IQAC

Temptation, rationalization, ambition, group and authority pressure, entitlement, deception, incrementalism, embarrassment, and stupid systems ('Tragedies') have been identified as nine

drawbacks prevailed in the system supporting research (Gunsalus and Robinson, 2018). Functioning of an alert and robust IQAC in the HEI is expected to address 'tragedies' appropriately and generate the desired trust and integrity in research.

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CHAPTER 10

Academic Dishonesty and Scientific Misconduct

M.R. Yadav

Personal integrity is an important human attribute, which is significant in all spheres of life including academics and research. However, it is not an inborn quality in human beings. Personal integrity needs to be inculcated from childhood and then slowly nurtured as a child grows. And it is not only to be inculcated and nurtured but it has to be practiced constantly in daily life. When we talk about academic integrity, it is applicable equally to all the stakeholders of the academic field: students, faculty, and academics administrators. But what do we understand by academic integrity? It is a commitment to the five fundamental values, even in the face of adversity:

1. ***Honesty***: The foundation of teaching, learning, research and the whole system. Making honest efforts in all aspects of academics is the foundation of education system.
2. ***Trust***: Interpersonal faith among the academia, students and the academic administrators.
3. ***Fairness***: Fair treatment to each other is another component of integrity. Students expect fair treatment from the faculty and the administration, while faculty expects fair treatment by the students, colleagues and administration.
4. ***Respect***: The faculty must give respect to the students by taking seriously their ideas and feedback, valuing their aspirations and goals and recognizing them as responsible individuals. On similar lines students should respect the verdict of the faculty in the class and the outcome of the evaluation.
5. ***Responsibility***: Present oneself in a responsible way in all aspects of academic activities despite peer pressure, fear, loyalty or compassion.

Academic Integrity in Research

Academic Integrity means giving credit where the credit is due. While writing a research paper or making a presentation/poster or website, we must acknowledge our sources of ideas or information. We should express our ideas in our words demonstrating and sharing our personal perspectives. We must duly acknowledge others' work and contributions and give respect to the centre of learning and others involved in the system. Academic integrity and academic/scientific dishonesty are interwoven in the same way as truth and untruth. Academic dishonesty is an act of deception in which a person seeks to claim credit for the work or efforts of another person, or uses unauthorized materials or fabricated information in any academic work, including research. Research/scientific misconduct means malpractices adopted by the researchers that seriously deviate from actions that are commonly accepted within the scientific community for "proposing, recording, or reporting" research. Research misconduct basically involves three aberrations: fabrication, falsification and plagiarism.

- ***Fabrication*** means making up or cooking up data or results without performing due experiments and reporting them in presentations/publications. Fabricated results are not based on the actual authentic data.
- ***Falsification*** means the experiments are performed but the outcome of the experimentation is manipulated. It is manipulation of research materials, equipment, processes, and modifying

or omitting of data results in such a way that the research is not accurately represented in the research records.

- ***Plagiarism*** is appropriation of another person's ideas, processes, results or words without giving appropriate credit where it is due. It is presentation of someone else's research plan, manuscript, article or text or parts thereof as one's own. It is illicit presentation or use of an original research idea, plan or finding disclosed to someone in confidence under one's own name, for example, taking the research idea, text or plan from the manuscript submitted for peer reviewing process for the purpose of evaluation, or from already published work.

Plagiarism can easily be detected these days using softwares such as,"iThenticate, Turnitin or Urkund". The power of detecting plagiarism of individual software varies and depends on the 'backup data' present in them. That is why they do not give the same results. Although, plagiarism can easily be detected these days but other types of scientific dishonesty is difficult to detect/check. There lies the importance of integrating 'academic integrity' in our psyche and character. Once detected, a scientific dishonesty can destroy the life-long earned reputation of a researcher. The reputation earned over one's whole life can be destroyed by a single act of deception.

Good Scientific Practices

Researchers ought to follow some good scientific practices as are listed here:

1. Maintaining integrity, meticulousness and accuracy in conducting research and in evaluating, recording, and presenting results.
2. Collecting the data ethically.
3. Taking due account of peer researchers and giving due credit to them in publications.
4. Planning, conducting, and reporting the research according to the laid down scientific standards.
5. Determining and recording of status, rights, co-authorship liabilities and obligations of the research team in an acceptable way.
6. The sources of funding and other associations are made known to all the participants of the research team and to public.
7. Observing good administrative practices and personnel and financial management.

Poor Research Behaviours

Behaviours that must not be adopted/practiced are:

1. Falsifying or making-up research data.
2. Copying text from others' work without giving due credit to them.
3. Using other's ideas without obtaining permission or giving due credit.
4. Unauthorized use of confidential information in connection with one's own research.
5. Failing to present data that contradicts one's own previous research.
6. Overlooking other's use of flawed data or questionable interpretation of data.
7. Changing the design, methodology or results of a study in response to pressure from the funding source.
8. Ignoring major aspects of human subject requirements in human data collection.

9. Publishing the same data or results in two or more publications.
10. Inappropriately assigning authorship credit.
11. Withholding details of methodologies or results in papers or proposals.
12 .Using inadequate or inappropriate research design.
13. Dropping observations or data points from analysis based on gut feeling that they were inaccurate.
14. Inadequate record keeping of the research work.
15. Understatement of other researchers.
16. Negligence in referring to earlier findings.
17. Publishing old results as new findings.
18. Careless and misleading reporting.
19. Failure to inform the editor of related/same papers that the author has under considerations or in press.
20. Not revealing conflicts of interest that could affect the interpretation of the findings.
21. Use of selective or fraudulent data to support a hypothesis or claim.

Other Aspects of Academic Dishonesty

Apart from plagiarism and fabrication, academic dishonesty has many more connotations:

1. ***Cheating***: Use or attempted use of unauthorized materials, information or study aids, or an act of deceit by which a person attempts to misrepresent mastery of academic effort or information. This includes but is not limited to unauthorized copying, or collaboration on a test or assignment, using prohibited materials and texts, any misuse of an electronic device, or using any deceptive means to gain academic credit.
2. ***Assisting***: Helping another person commit an act of academic dishonesty. This includes but is not limited to paying or bribing someone to acquire a test or assignment, changing someone's grades or academic records or taking a test/doing an assignment for someone else by any means, including misuse of an electronic device. It is an act of creating and offering to sell part or all of an educational assignment to another person.
3. ***Tampering***: Altering or interfering with evaluation instruments or documents.
4. ***Substitution/Impersonation***: Substituting/impersonating for another student or permitting another person to substitute for oneself during an exam, course, or on other academic work.
5. ***Deception***: Providing false information to an instructor concerning a formal academic exercise, for example, giving a false excuse for missing a deadline or falsely claiming to have submitted a work.
6. ***Sabotage***: Acting to prevent others from completing their work. This includes cutting pages out of library books or willfully disrupting the experiments of others.
7. ***Duplicity***: To offer identical or substantially unchanged work in two or more courses for credit, without specific advance approval of the professors involved.
8. ***Unauthorized collaboration***: Using materials or collaborating with another person(s) during a test or other assignment without authorization.
9. ***Collusion***: Supporting malpractice by another candidate, as in allowing one's work to be copied or submitted for assessment by another.

Minor Acts of Academic Dishonesty

- Copying from another student during an exam.
- Previewing the exam from a "test file" when the teacher does not permit this and is unaware of the file.
- Presenting a paper copied from a file or purchasing and presenting it as original work.
- Faking the results of a laboratory experiment or work.
- Asking for examination content or answers from another student.
- Using material from another student's paper without credit to that student.
- Working in a group when an assignment is specifically individual work.
- "Sitting for" or taking an exam for another student.
- Memorizing questions from an exam to create a file for later use.
- Writing a laboratory report without performing the lab activity/experiment.
- Purchasing or receiving notes from a fellow student.
- Basing an "article report" on an abstract rather than reading the assigned article.
- Allowing another student to look at one's answer sheet during a quiz or exam.
- Claiming authorship or participation in a group paper or presentation when no contribution was made.
- Obtaining a paper from the Internet and submitting it as one's own work.
- Submitting a paper that has been purchased from a commercial research firm.
- Giving or receiving answers by use of signals, notes or through technological devices during an examination/quiz.

Conclusion

A single act of academic dishonesty can ruin a career. There is a Japanese proverb that says it all, "The reputation of a thousand years may be determined by the conduct of an hour." Academic honesty cannot be compromised in academic life. It must be reflected in every single act throughout the academic life span and thereafter.

CHAPTER 11

Sooner or Later Ethical Violations Get Exposed

Ramesh Ch. Deka and Ajanta Deka

In recent times, there have been many instances of ethical violations in research. We present here some examples of violations of ethical practices in executing scientific research. We deliberate on the three "cardinal sins" of scientific misconduct, FFP — Fabrication, Falsification, and Plagiarism. The duplication of research articles is also highlighted. Such unethical practices cannot be hidden for long. It is just a matter of time before such activities get uncovered.

'Ethics' refers to norms of conduct that distinguish between acceptable and unacceptable behaviour. Research ethics is the application of moral rules and professional codes of conduct to the collection, analysis, reporting and publication of information about research subjects, in particular active acceptance of subjects' right to privacy, confidentiality and informed consent.[1] In research, adherence to ethical norms is very important. While there are several reasons for this, the notable ones are promotion of aims of research and developing values that are essential for collaborative work, accountability to the public and uplifting moral and social values. We learn our first lesson on ethics at home. Religious background also helps in building strong ethics in research. Apart from the learning from family and friends, students learn research ethics from their research advisor, fellow students, other faculty members at the Institute, discussions in the laboratories, seminars, and courses dealing with ethical issues.

When a student joins a group as a researcher, he/she is expected to adhere to three sets of obligations (Kamat, 2015):

1. Honour the trust that the research mentor or the university administrators;
2. Discover or invent something new; and
3. Do something useful for the society.

However, irresponsible conduct in research can make it impossible to achieve significant outcomes. The findings of any research have to be shared in the form of paper publications or conference presentations. Publishing a research article is the culmination of months, and sometimes years, of meticulous planning, execution, and analyses of hundreds of experiments or calculations (Benos, *et al.*, 2005). In most cases, funds for research projects come from public money. Therefore, it is expected that research works will be honestly conducted and reported in the form a patent or publication in a reputed journal. There is nothing like ,"only I can do this kind of work" in science. If "I can" then it is doable by anybody else. If the research is not published, then one cannot claim that it was done. According to Whitesides (2004), "A paper is an organized description of hypotheses, data and conclusions, intended to instruct the reader. If your research does not generate papers, it might just as well not have been done." Publishing a research paper is a team effort involving authors, editors, and reviewers. People who make direct and significant intellectual contribution to the design of research, interpretation of data, explanation of results, or writing of the manuscript should be included as authors. Inclusion of honorary, guest, or gift authors is not part of the ethical practice of research publications. While choosing editors or reviewers one should be cautious not to include friends. Choosing people who will not challenge one's research in any way is also a violation of ethics as the primary purpose of the reviewing process get defeated. Critical but objective reviewers, who point

out errors in experimental design, methodology, explanation, interpretation, and citations, help in significantly improving a manuscript. A research paper should report original and significant findings that are likely to be of interest to a broad spectrum of the journal's readers. Papers that are well organized and well written with clear statements regarding how the findings relate to understanding of the subject will have high possibilities of getting accepted for publication. Papers should not be very long. They should be concise and yet complete in presenting research findings (Kamat, *op. cit*.). Research articles that report routine extensions of previous reports and those, which are poorly organized with unnecessary or poor quality illustrations are generally not accepted for publication in quality journals. Papers that violate ethical guidelines are also not publishable.

Ethical Violations

The main ethical violations that we see are (*ibid*.):

- ***Fabrication*** means making up, fabricating, data or results and reporting them in publications.
- ***Falsification*** is manipulating or falsifying research materials, equipment, data, results, etc.
- ***Plagiarism*** is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit to the person.
- ***Self-plagiarism*** is verbatim copying of one's own research is also a violation of ethics.

Ethical violation in research is a global problem. Many researchers violate the code of ethical conduct for easy publication, quick recognition, awards, greed for power, and so on. Duplication of research articles is reported to be the highest in the United States followed by Japan, Germany, China, United Kingdom, Italy, France, and Canada(Errami and Garner, 2008). Maximum duplication rate is found in the field of medicine. Researchers who manipulate their data deceive others and violate the basic values and widely accepted professional standards of science. They also fail to fulfil the three obligations already mentioned.

Case Studies

Ethical violations cannot be hidden. Sooner or later they will get exposed. There are several examples of ethical violations being reported. Some are discussed here. As a first case we take the example of Nobel Laureate in medicine, Prof. David Baltimore who published a paper in the journal *Cell* with title, "Altered repertoire of endogenous immunoglobulin gene expression in transgenic mice containing a rearranged μ heavy chain gene" (Weaver, *et al*., 1986). When Morgot O'Toole (1991), a researcher in the same laboratory, tried to reproduce their work, O'Toole could not reproduce the same results and accused the corresponding author, Dr. Imanishi-Kari of fabricating the data In 1991, Dr. Imanishi-Kari was accused of falsifying data and it was recommended that she be barred from receiving research grants for 10 years. Several books have covered the Baltimore affair.

Jacques Benveniste, who gave the term "memory of water" claimed that water molecules somehow retain a memory of the antibodies that they had previously been in contact with, so that a biological effect remains when the antibodies are no longer present. This validated the claims made for highly diluted homeopathic medicines. Other teams were subsequently unable to repeat the effect.

Jan Hendrik Schön, a German-born physicist, who was employed at Bell Laboratories, New Jersey, was working on electronic materials in which conventional semiconducting elements were replaced by crystalline organic molecules that he called molecular transistors. Schön claimed spectacular on/off behaviour, far beyond anything achieved thus far with organic materials. His findings on molecular

transistors were published in prominent scientific journals including *Science* and *Nature*. However, no research group anywhere in the world succeeded in reproducing Schön's results (Service, 2002). In May 2002, Bell Labs set up a committee to investigate the scandal. On September 25, 2002, the committee publicly released its report which contained details of 24 allegations of misconduct. Bell Labs fired Schön on the day that they received the report. Schön returned to Germany and took a job at an engineering firm. In June 2004 the University of Konstanz from where he had obtained his Ph.D., issued a press release stating that Schön's doctoral degree has been revoked due to "dishonourable conduct".

Yoshiki Sasai, a noted stem-cell scientist at the RIKEN Centre for Developmental Biology (CDB) in Kobe, Japan co-authored two controversial papers that appeared in the prestigious journal *Nature* in January, 2014. The lead author of these papers was Haruko Obokata. These papers reported a remarkably simple way of making stimulus-triggered acquisition of pluripotency (STAP) cells that could be grown into tissue anywhere in the body. However, based on allegations of irregularities in several images in the papers authored by Obokata, RIKEN launched an investigation and the two papers were retracted on July 2, 2014. The reasons cited for retraction were duplicated and mixed-up images, mislabelling, faulty descriptions and "inexplicable discrepancies in genetic background and transgene insertion sites between the donor mice and the reported."[2] Obakata's supervisor, Sasai was hospitalized for nearly a month in March 2014 due to psychological stress related to the scandal. He could not bear the humiliation and ended his life on August 5, 2014. This is one of the most tragic outcomes of the violation of research ethics.

Such glaring examples of unethical conduct are also found in Indian Science. One case in point is that of Vishwa Jit Gupta, the Indian palaeontologist from Punjab University who specialized in fossil record of the Himalayan region. He published innumerable papers on Himalayan fossils. John Talent (1989) in accusing Gupta of giving false and misleading information regarding the sites of the discovery of fossils. The most deliberate of these violations was obtaining fossils from shops, museums, and academic establishments and then claiming to have found them in the Himalaya. It took Talent nine long years to unearth this scandal. He painstakingly visited many of the places in the Himalaya where Gupta claimed to have found the fossils in order to verify facts. Subsequently, Gupta was dismissed from the post of Director of the Institute of Palaeontology at Punjab National University.

Chemistry's colossal fraud was committed by Pattium Chiranjeevi of Sri Venkateswara University (SVU), who wrote over 70 articles for journals between 2003 and 2007 only by downloading articles from the internet. The misconduct came to light when SVU conducted an investigation into Chiranjeevi's work after journal editors wrote to the university officials with evidence that the professor had plagiarized, falsified, and fabricated many manuscript submissions (Schulz, 2008). The professor claimed to have used some advanced instruments, which were not available at the university. He was also accused of duplicate submission of the same material to several journals. Chiranjeevi has since be barred from research and research supervision and from holding any administrative position in the university.

There are many such instances of violation of ethical norms in Indian Science from the recent past. About 130 papers published in peer-reviewed journals by scientists from CSIR-Indian Institute of Toxicology Research have been declared to be problematic.[3] A chief scientist from the institute is involved in forty such papers. In the Pubpeer report, about 35 papers published from CSIR-Central Drug Research Institute have images that have been manipulated and/or duplicated. The Pubpeer website also reports 37 papers with manipulated and duplicated images from CSIR-Indian Institute of Chemical Biology.

The reasons for scientific misconduct might be lack of original thinking, greed for honour, power, awards, easy recognition, and sometimes pressure from supervisor. For research integrity, the researchers should be honest, fair, trustworthy, accountable, and open in their practice. In order that scientific research succeeds in achieving its objective of detailed investigation and analysis leading to the dissemination of scientific knowledge, it is necessary that all members of the community adhere to the ethical code of conduct in research. Proper emphasis on ethics education must be the means to achieving this end. We all have to be vigilant against violation of ethical practices and report the same, should an instance occur. Nobel Laureate, Michael Levitt advised researchers to be passionate, persistent, original, kind and good (Levitt, 2014).

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CHAPTER 12

Promoting Ethics through UGC-CARE and NEP 2020

Vinod K. Jain and Gaurangi Maitra

"Knowledge is power. Information is liberating. Education is the premise of progress, in every society, every family." These wise words of Kofi Annan, (the seventh Secretary-General of the United Nations, from January 1997 to December 2006),[1] reverberate strongly as the second decade of the 21st century closes on a bewildering note of pandemics, information, and misinformation, disrupting established modes of communication, education, and livelihood. We are forced to realize that human civilization will be not be itself without ethics that determine choices, actions, and suggest difficult priorities. As John Berger says, "Without ethics man has no future. That is to say mankind without them cannot be itself. Ethics determine choices and actions and suggest difficult priorities".[2] Consequently, the reinforcement and awareness of ethics through relevant policy interventions is vital to realigning the society, and citizens in consonance with an equitable biosphere.

'Ethos' graduated to 'ethics' and came to underscore the 'ethike', the Greek term originally defined by Aristotle, meaning the science of morals. This line of development is not unique to the Greek-Latin-European evolution of the term, but present with individual variations in every human culture. Both the Indian epics, the Ramayana and the Mahabharata are in essence repositories of ethical and moral reasoning that have guided the civilizations in India for millennia. Life itself is coded into well-regulated systems that operate on the ethical premise of 'allowed' versus 'not allowed' to preserve the dynamic equilibrium that defines every citizen of the biosphere. It is therefore no wonder that ethics are the very ethos of human life and endeavour. Very early in our academic lessons we learn the value of a tick mark against a cross; teachers attaining nearly omnipotent status with a red pen that only they could wield and make or break careers. John Dewey's statement that education is just not a preparation for life but life itself[3] validates the fundamental, crucial, and indispensable coexistence of education and ethics. It would not be wrong to suggest that life is crippled if education and ethics are not given their bona fide status. Therefore, it is only natural that in India, the National Education Policy or NEP 2020, and the University Grants Commission's Consortium for Academic Research and Ethics or UGC-CARE endorse ethics as a matter of policy; the former underscores the value of ethics, while the latter has ethics embedded in its very nomenclature and objectives. In the words of Dr. K. Kasturirangan, Chairman of the NEP drafting panel, "The NEP 2020 has been crafted to realize a new system aligned with the aspirational goals of 21st century education, while remaining rooted to Indian value systems and ethos."[4]

The year 2020, with the Covid-19 leitmotif, began on a rather surprising note. A pay-to-view list claimed that predatory journals had grown from 4000 in 2017 to a humungous 13,000 journals in 2020. This dangerous trend could easily target and short-circuit virologists and epidemiologists, battling the Covid-19 pandemic and racing against time to produce a vaccine against the virus.[5] These fears are aggravated by global commercial and political exigencies demanding an accelerated vaccine release, shortcutting established safety and ethical trial norms.

Conversely, on January 2, 2020, Prof. Francis Arnold, announced the retraction of their 2019 paper on "Site –selective enzymatic C-H amidation for synthesis of diverse lactams as the results were not reproducible. What is noteworthy is her tweet, "It is painful to admit, but important to do so. I apologize to all. I was a bit busy when this was submitted and did not do my job well" (Arnold, 2019).

It must have been doubly difficult, given her hugely public profile after having won the Nobel Prize in Chemistry, in 2018. Honesty and courage won the day for research ethics and academic authenticity.

Between these two indubitable but opposing facets, ethics is the gold standard against which academics, research, and an entire education policy for a country of 1.2 billion are weighed. Thus, etching ethics into education and research through policy interventions like the UGC-CARE and NEP 2020 in India is the raison d'etre of this paper.

In the entire discourse on Academic Research and Ethics, the spotlight is most often issue based and non-holistic; consequently, missing the wood for the trees. It is apparent that this dichotomy was observed, taken note of, and decisive action taken in the form of two path-breaking initiatives UGC-CARE in 2018 and NEP 2020. Albert Einstein's statement, "Relativity applies to physics, not ethics," puts in perspective the requirement for a rigorous framework to engender and nurture ethics. Thus, landmark reforms required in the education sector have now been enshrined in NEP 2020 and mandatory mechanisms for reestablishing credibility in academic research and ethics have been put in place by the UGC-CARE initiative.

UGC-CARE

In 2018 the UGC-CARE was established to promote and benchmark research integrity and publication ethics among the Indian academia (Patwardhan, *et al.*, 2018 and Patwardhan, 2019). It was partly set up to repudiate India's unsavoury distinction of generating a high percentage of poor-quality research publications (Patwardhan, *et al.*, *op. cit.*). India was forced to take cognizance of the situation when the 15 points under the Academic Performance Indicator (API) earmarked for publication in refereed journals, lead to a wild proliferation of predatory journals (Moher, *et al.*, 2017 and Priyadarshini, 2017). The requirement of publications prior to Ph.D. submission only added fuel to fire. Consequently, the primary objective of UGC-CARE was a complete overhaul of the existing list of journals approved by its apex higher education body, the University Grants Commission (UGC). "To promote quality research, academic integrity and publication ethics in Indian universities," is stated as the first objective of the UGC-CARE. Its structure for the assessment of journals is available as a well-planned, informative, functional, responsive, and graded structure.[6]

At this juncture, it is relevant to endorse the organization of the UGC-CARE, which has designated four universities as responsible for the collection of primary information related to journals published from their allocated regions/states.[7] Tezpur University, Assam is responsible for the UGC-CARE East Zone, which includes the eight states of northeastern India, along with Bihar, Jharkhand, Odisha, and West Bengal. This cohort has special features dictated by topography, accessibility, culture, and probably the richest trove of tribes, languages, and dialects. This curation of the rich cultural and linguistic diversity as reflected in the many regional-language journals, demands special mechanisms that are being worked out, to give them equitable visibility and ensure they meet the designated UGC-CARE standards. The region is often considered a soft option for many predatory publishers seeking to circumvent accepted ethical publication norms. Issues of incorrect /false ISSN and Impact Factors, misleading addresses and credentials of publishers and editors**,** besides baseless RTIs have been successfully weeded out. UGC-CARE East Zone at Tezpur University has completed the primary data verification of a good number of journals from the East Zone. This was possible due to the seamless cooperation between the four UGC-CARE universities and UGC-CARE, Pune.

The programme has made a good beginning in restoring ethical practices and weeding out predatory journals. Since the inception of the programme,[8] workshops, meetings, reformatting of lists, and journal groups have been undertaken regularly. The interactions have helped the nascent, novel

programme to iron out glitches related to proforma, accreditation of credentials, countering unethical and commercial publications. The programme remains dynamic with the quarterly scrutiny and re-evaluation of the journal list. It is very reassuring that mechanisms for giving an even playing field to journals in Indian languages, and the Indian Knowledge Systems are being worked out. While this spirited and pro-active nature of the list is appreciable, it often creates difficulties for academicians who may have submitted papers to a journal that is subsequently removed. Workshops on Research Ethics and Integrity need to more participatory and open, for the course correction to be truly effective. Stakeholders across academia, especially librarians require to be well trained in the cross talk between the platforms or formats for print, digital, Information and Computer Technology (ICT), Open Access, and other relevant areas.

NEP 2020

The deep commitment to ethics is endorsed by the fact that it underpins the fabric of the landmark reforms in the education sector, enshrined in the National Education Policy of 2020 (NEP 2020.) The very fact that NEP 2020 was finalized taking into consideration the 2.25 lakh suggestions received after the draft was placed in the public domain is the hallmark of a truly ethical and democratic beginning. The Union Minister for Human Resource Development termed it as one of the largest consultations and discussion processes of its kind in the country. Founded on the basic tenets of access, equity, quality, affordability and accountability, NEP 2020 flags all the basic criteria required for creating a vibrant knowledge society, that India can be proud to reclaim; through a holistic, flexible, multidisciplinary approach that will shape the potential human in each citizen of India in the fast-paced 21st century world (NEP, 2020).[9]

The policy statement touches ground on the importance of ethics at least 16 times, creating the mechanisms for internalizing the difference between, "What we have a right to do and what is the right thing to do" — a deep commitment to the ethical way forward. Thus, it states, "Education must build character, enable learners to be ethical, rational, compassionate, and caring, while at the same time prepare them for gainful, fulfilling employment" (*ibid*.: 3) The policy reiterates that learning outcomes require major reforms; they must introduce the highest quality, equity, and integrity into the education system and inculcate social, ethical, and emotional abilities from childhood. It is extremely reassuring to note that, "Instilling knowledge of India and its varied social, cultural, and technological needs, its inimitable artistic, language, and knowledge traditions, and its strong ethics in India's young people" is a core tenant (*ibid*.: 4).

The principles of this policy, in its road map for developing good human beings and citizens, underscores the importance of ethical moorings and values:

- Ethics, and human and constitutional values are part of the fundamental principles on which the entire education system and individual institutions of India will be based (*ibid*.: 5).
- Socio-emotional-ethical development has been deemed central to the foundation of learning that begin with early childhood care and education (*ibid*.: 7).
- Under the section on curricular integration of essential subjects, skills, and capacities ethical and moral reasoning; and early inculcation of the importance of, "Doing what's right", helping the young to formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work (*ibid*.: 15, 17).
- While detailing India's higher education system, NEP 2020 distinctly carves out the vital importance of the ethical development of character in equipping students for holistic and

independent lives. Thus, "Value-based education will include the development of humanistic, ethical, constitutional, and universal human values of truth (*satya*), righteous conduct (*dharma*), peace (*shanti*), love (*prem*), nonviolence (*ahimsa*), scientific temper, citizenship values, and also life-skills; lessons in *seva*/service and participation in community service programmes will be considered an integral part of a holistic education" (*ibid*.: 33).

- Included under the best practices for learning, assessment, wellness, ethical inputs and outcomes have been considered vital (*ibid*.: 38).
- Given the indispensable, all-encompassing and disruptive nature of technology, ethical issues, resolution and preventing unethical practices have been considered essential for classroom, continuing and online education. This is especially relevant to ethical issues surrounding the development and deployment of AI-based technologies" (*ibid*.: 58, 59).

NEP 2020 is therefore based on an ethical, futuristic perspective and at the same time, is deep rooted in the best of the past and present, to equip young learners and their mentors for becoming global leaders of the 21st century. It is the fulfillment of a longstanding promise by our Honorable Prime Minister, Sri Narendra Modi in the Election Manifesto of 2014. NEP 2020[10] targets restoring quality in academics through critical thinking, experiential and application-based learning, flexibility in learning, focus on life skills, a multidisciplinary approach, and continuous review. It endorses universality, globalization of Indian ideas, talent identification, and transformation of India into a global knowledge economy. The requirement for quality in academics has been reinforced by the STARS Project (Strengthening Teaching-Learning and Results for States, which underscores quality-based learning outcomes, was lauded by Union Minister for Home Affairs, Shri Amit Shah, as a landmark day in the Indian Education Sector. To paraphrase Benjamin Franklin —An investment in quality academics pays the best dividends.

In the Final Analysis

The best policy decisions filter down to the individuals, who at every level constitute, make, or break a society, a country, or a civilization. Ethical behaviour is often called for at times when there is no witness, although the consequences maybe far reaching. On 1 July, 1958, a paper credited to Charles Darwin and Alfred Wallace was read out in the Linnaean Society entitled, "On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection." The former writes in his biography, "…. my plans were overthrown, for early in the summer of 1858 Mr. Wallace, who was then in the Malay Archipelago, sent me an essay, "On the Tendency of Varieties to Depart Indefinitely from the Original Type"*;* and this essay contained exactly the same theory as mine…" Shell-shocked as he was at having his life's work preempted, he did not to tear up a letter from a sick man and deny its existence. He turned to his friends Joseph Dalton Hooker and Charles Lyell for advice. "I was at first very unwilling to consent, as I thought Mr. Wallace might consider my doing so unjustifiable, for I did not then know how generous and noble was his disposition." Darwin considered his own part badly written and not fit for publication. Wallace's essay, on the other hand, was admirably expressed and quite clear. Nevertheless, their joint productions excited very little attention (Maitra and Tandon, 2009). True scientific temper and endeavour are built on the foundation of such ethical acts and on acknowledging the merit beyond oneself.

Quality, merit, ethics, authenticity, and impartiality are qualities that should ideally be synonymous with academics. They allow academics to acknowledge change and move beyond dogmatic and fanatical adherence to the past, irrespective of the knowledge or its creator. Consequently, records and repositories of knowledge are vital custodians of the past and present, and these must be synonymous with integrity and a deep commitment to ethical practices. Room for correction of genuine errors,

will promote both acceptance and increased due diligence. The UGC-CARE is a very good beginning towards protecting the high standards of academics, research, and ethics.

Finally, to validate the cardinal importance of etching ethics through UGC-CARE and NEP 2020, we look at the words of the incomparable and deeply respected Swami Vivekananda, "The work of the ethics has been, and will be in the future, not the destruction of variation and the establishment of sameness in the external world, which is impossible, for it would mean death and annihilation — but to recognize the unity in spite of all these variations, to recognize the God within, in spite of everything that frightens us, to recognize that infinite strength as the property of everyone in spite of all apparent weakness, and to recognize the eternal, infinite, essential purity of the soul in spite of everything to the contrary which appears on the surface. This we have to recognize. Taking one side alone, one half only of the position, is dangerous and liable to lead to quarrels. We must take the whole thing as it is, stand on it as our basis and work it out in every part of our lives, as individuals and as unit members of society."

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CHAPTER 13

Databases and Research Metrics

Manmohan Gupta

Introduction

It is widely acknowledged that the 21st century is being driven by innovation and knowledge creation, which are also the key drivers of the economic development for any country as already borne out by the last two decades of the 21st century. Generating, storing, and to meaningfully use the data related to research outputs are crucial ingredients for innovation and knowledge creation in any country. Data management and data mining tools, play an important role in the present context, which is related to the scholarly research activity and the related conundrums created by the exponentially rising sources of scholarly academic literature. We are particularly interested in the scholarly literature stored in many well-known and ever-increasing databases for storing scholarly literature.

After the Second World War, the world witnessed an unprecedented growth of research and academic activity, not limited to the field of science. This presented unprecedented challenges on all fronts of academic activity, from the human resource management of institutions of higher education and research to the deeper issues of ethics in the academics. In fact, this is further complicated by the fact that most academic activity has undergone transition from pursuits to professional activity. When the number of people involved in research and related activity are limited, a peer group-led approach is very practical and tangible in evaluating research output, among other parameters, of any individual and the related issue of ethics also is essentially related to the integrity of a peer group. However, things become complicated when there is exponential increase in the persons involved in such activity and there is a mind-boggling output of highly diversified research. By a rough estimate, at present more than two million scholarly documents are created every year. Storage, documentation, and accessibility of these exponentially rising number of documents is undoubtedly a gigantic problem.

With the proliferation of data, it becomes important to find quality markers for publications and journals, which are ever-increasing in number. The questions related to multidimensional research and collaborations have also opened the issues related to the quality of institutional contributions as well as that of the country. This has also complicated the matter of objectively assessing the quality and contributions of a given author, particularly in large multinational collaborations. Although there is no foolproof objective way to quantify the research contribution of an individual or an institution, one can attempt to reach as far as possible in achieving this goal.

In such a mind-boggling situation, research evaluation is continuously proving to be a tough job. With the limitations of peer reviews when the number of cases become large, one has to supplement it with other objective means. The objective here is to understand the basic features of databases and the related quality markers. We discuss the most popular databases in detail, which researchers and scholars use as well as we briefly discuss the parameters, which measure the quality of research journals as well as the scientific outputs of individuals and institutions.

Historical Introduction

It is well acknowledged that most quality research is published in peer-reviewed research journals. With the exponential proliferation of research publications and as a consequence the number of journals, it becomes important to look for quality markers for journals as well as the research outputs of the authors. Eugene Garfield took the first step in this direction by, in as early as 1955. In fact, taking a cue from the legal citations, invented in 1873 that tracked how US court cases cited earlier ones, Garfield (1955) published a paper in the journal *Science* wherein for the first time he advocated the necessity of introducing parameters to assess the quality of scientific journals. In 1960, he founded the Institute for Scientific Information (ISI, Philadelphia, PA, USA); subsequently he published the Genetics Citation Index in 1963, followed by the first official launch of Science Citation Index (SCI) in 1964 (Garfield, 1979).

Along with the creation of ISI and SCI in the early 1960s, Garfield defined the Impact Factor (IF) or the Journal Impact Factor (JIF), based on the concept of citations. Simply stated, citations are the explicit linkages between research papers that share commonality of any kind. A citation index is built around these linkages. It lists publications that have been cited and identifies the sources of the citations. Anyone conducting a literature search can find additional papers on a subject just by knowing one that has been cited. The impact factor is a measure of the frequency with which an "average article" in a journal has been cited in a particular year. For example, the Impact Factor of a journal is calculated by dividing the number of citations received in a particular year to the source items published in that journal during the preceding two years.

The concept of Journal Impact Factor (JIF) and the related issues created the research discipline of Bibliometrics, which uses mathematical and statistical methods to analyse scholarly research publications. Initially, the JIF was used as a proxy for journal quality and a collection tool for librarians. Since the 1960s, the number of scientific journals has expanded enormously and their evaluation by the JIF has become a fundamental and universal measure of a journal's quality. The JIF eventually became the gold standard for research evaluation, whereby getting one's paper accepted by a journal with a high JIF is considered a key accomplishment.

The Science Citation Index, registered remarkable expansion in the coming decades with the inclusion of Social Sciences and Humanities. Subsequently, from 1972, the ISI published Social Sciences Citation Index (SSCI) and Arts & Humanities Citation Index (AHCI) from 1978. At present in the form of Web of Science (Web of Knowledge), along with Scopus, it continues to be one of the most prestigious subscription databases. Simultaneously, several other databases were created, which have played role in developing this field. The field saw quantum leap in its development with the launch of Google Scholar in 2004 ,which brought in several other big subscription free databases.

Databases and Indexing

For any serious researcher, whether we are carrying out a research project or thesis, the first most important step is extensive search of the already existing literature in the field of interest. Laying our hands on quality research literature is a tedious task and half the job is done if we are able to find the appropriate literature. This task is enormously simplified if we can have trusted academic databases, which include the prestigious and most important journals of the field incorporating the best research papers published in the field. Therefore, database research is the first activity we as researchers undertake as part of our study, and we naturally look to established and well-known databases. Therefore, it is essential to know the kind of databases available and their limitations. Listed here are some of the well-known databases.

Databases

Summarized here are the widely used databases or those that have some unique features. We have also included a good number of the freely accessible databases. Interestingly good deal of useful information can be extracted using freely accessible bases.

Web of Science /Web of Knowledge (WoS/WoK)

Guided by the legacy of Dr. Eugene Garfield, it is the oldest and one of the most respected databases or indexes widely used ever since its creation in 1961 in the form of ISI. With the integration of Science Citation Index (SCI) with Social Sciences Citation Index (SSCI) in 1972 and Arts and Humanities Citation Index in 1978 (A&HCI), it continues to be one of the most important databases. The Institute of Scientific Information (ISI) was bought in 1992 by Thomson Scientific & Healthcare, and became known as Thomson ISI. Later Thomson Scientific itself became part of the Thomson Reuters Corporation. In 2016 Thomson Reuters sold its Intellectual Property & Science Business, which included the WoS, to Onex and Baring Asia and was available with the brand name Clarivate Analytics, and continues to be known under the same brand even now under a different owner.

In its present form, WoS represents a comprehensive platform, which allows us to track academic and scholarly literature across 254 disciplines from almost 171 million records and almost 1.9 billion cited references. It is an integrated, versatile platform, with easy access to high-quality diversified scholarly information in the sciences, social sciences, and arts and humanities, as well as search and analysis tools. Users can search the relevant information existing in international journals, open-access resources, books, patents, proceedings or web sites. It is one of the trusted global citation databases as well as one of the most powerful search engine, delivering publication and citation data, with reliability, for assessment and research.

At present, WoS is a platform for a large number of databases; the Web of Science Core Collection indexes every piece of content cover-to-cover, creating a complete and certain view of over 115 years of the high-quality research. The Web of Science Core Collection consists of six online databases:

1. *Science Citation Index Expanded (SCIE)* covers more than 8,500 notable journals encompassing 150 disciplines, covering from the year 1900 to the present day.
2. *Social Sciences Citation Index* covers more than 3,000 journals in social science disciplines, again covering from the year 1900 to the present day.
3. *Arts & Humanities Citation Index* covers more than 1,700 arts and humanities journals starting from 1975. In addition, 250 major scientific and social sciences journals are also covered.
4. *Emerging Sources Citation Index (ESCI)* covers over 5,000 journals in the sciences, social science, and humanities.
5. *Book Citation Index* covers more than 60,000 editorially selected books starting from 2005.
6. *Conference Proceedings Citation Index* covers more than 160,000 conference titles in the Sciences starting from 1990 to the present day.

Web of Science is included in the larger database Web of Knowledge, (for details visit clarivate.com), however the two databases are generally used interchangeably in the literature**.**

Scopus/Science Direct

Widely respected and used like Web of Science, launched in 2004, Scopus is also a big commercial bibliographic database that cover scholarly literature from almost any discipline. It is one of the

largest abstract and citation database of peer-reviewed literature. Scopus delivers an overview of the world's research output in the fields of science, technology, medicine, social sciences, and arts and humanities with content from over 5,000 publishers.

Besides searching for research articles, Scopus has been a data source for deriving many bibliometric indicators and related analytical tools for measuring the performance of journals, institutions and countries. Managed by the publishing company Elsevier, Scopus indexes journals from the fields of science, technology, medicine, social sciences, and arts and humanities. It provides research analysis and tracking tools covering almost 24,000 scholarly journals. It also covers "Articles-in-Press" from almost 4000 journals, with forthcoming papers in different journals including conference papers. Scopus currently has over 80 million core records, with the oldest record dating back to 1788, with almost 1.5 billion cited references.

Scopus indexes metadata from abstracts and references of thousands of publishers, including Elsevier. Scopus builds additional functionality on top of that metadata, such as citation matching, author profiles, and affiliation profiles. Scopus indexes nearly the entire Science Direct database, but without the articles' full text. It builds the profiles and metrics using that data. *Science Direct* makes available full-text scientific, technical, and health publications, primarily published by Elsevier, with functionalities so that the users can stay well informed and can work more effectively and efficiently. With over 16 million publications from over 3,800 journals and more than 40,000 e-books from Elsevier, *Science Direct* empowers and facilitates quality research.

Google Scholar

The Google Scholar, launched in 2004 by Google Inc., is the world's largest indexing and citation database of scholarly literature, covering more academic journals and other scholarly materials than similar other citation databases such as Scopus, Web of Science etc.. Its sources include peer-reviewed articles, theses, books, abstracts, and court opinions from academic publishers and professional societies, online preprint repositories, universities, subject gateways and other scholarly organizations. While Google does not publish the size of Google Scholar's database, bibliometric researchers estimate it to contains roughly 390 million documents including articles, citations, and patents making it the world's largest academic search engine. Google Scholar found 88 per cent of all these citations, many of which were not found by the other sources, and nearly all other citations found by the remaining sources (89-94 per cent).

Besides, being the world's largest search engine for academic literature, it provides a simple way to search broadly for diverse scholarly literature. Google Scholar sorts articles by full text of each article, the author, the journal in which the article appears, and how often the article has been cited in other scholarly literature, so that the most relevant results are returned on the first page. It also explores related works, citations, authors and publications, locates the complete document through the web, besides it keeps up with recent developments in any area of research. At the author level, it tracks citations to articles, see who is citing them, present graphically citations over time, and creates a public author profile.

Microsoft Academic

Developed by Microsoft Research and launched in 2014, Microsoft Academic is a large subscription-free public web search engine for academic publications and literature. Re-launched in 2016, the tool features an entirely new data structure and search engine using semantic search technologies.

It currently indexes over 220 million publications, 88 million of which are journal articles. The Academic Knowledge API (Application Programming Interfaces) offers information retrieval from the underlying databases. Microsoft Academic is the second largest overall database covering 60 per cent of all citations, including 82 per cent of Scopus citations and 86 per cent of Web of Science citations. Microsoft Academic is fully integrated with its search engine Bing of Microsoft Windows.

CiteSeer^{X}

CiteSeer^{X} (originally called CiteSeer) is a public search engine and digital library for scientific and academic papers, primarily in the fields of computer and information. CiteSeer is considered a predecessor of academic search tools such as Google Scholar and Microsoft Academic. CiteSeer usually searches and archives only documents from publicly available websites and does not crawl publisher websites. For this reason, authors whose documents are freely available are more likely to be represented in the index.

This search engine is developed and hosted by the College of Information Sciences and Technology, in the Pennsylvania State University (PSU), with support from the U.S. National Science Foundation. The earlier version of the search engine, known as CiteSeer, was developed in 1997 at the NEC Research Institute, United States. CiteSeer was the first digital library and search engine to provide automated citation indexing and citation linking. Later, a new architecture and data model was developed for the Next Generation CiteSeer, or CiteSeer^{X} , in order to meet exponential growth of scholarly literature in early years of the 21st century.

WorldWideScience (WWS)

WWS is a global academic search engine, providing access to national and international scientific databases from across the globe. It is designed to accelerate scientific discovery and progress by accelerating the sharing of scientific knowledge. Through a multilateral partnership, WorldWideScience.org enables anyone with internet access to launch a single-query search of national scientific databases and portals in more than 70 countries. One interesting feature is that it offers automatic translation, so users can have search results translated into their preferred language.

WWS implements federated searching to provide its coverage of global science and research results. Federated searching technology allows the information patron to search multiple data sources with a single query in real time. It provides simultaneous access to "deep web" scientific databases, which are typically not searchable by commercial search engines. In June 2010, WorldWideScience implemented multilingual translations capabilities. Using Microsoft's Bing Translator, Multilingual WorldWideScience offers users the ability to search across databases in ten languages and then have the results translated into their preferred language. "One to many" and "many to one" machine translations can be performed for Arabic, Chinese, English, French, German, Japanese, Korean, Portuguese, Russian, and Spanish.

Semantic Scholar

Semantic Scholar, publicly released in November 2015, is a project developed at the Allen Institute of Artificial Intelligence (Seattle, Washington, USA). It is designed to be an AI-backed search engine for academic publications, essentially topping the traditional citation analysis by intelligent analysis. It is a

new-age academic search engine, using machine learning to prioritize the searching of most important research as well as to find relevant literature. It is designed to highlight the most important and influential papers, and to identify the connections between them. In Semantic Scholar's own words, it uses influential citations, images, and key phrases to "cut through the clutter". At present it has more than 175 million scholarly documents, each of the paper hosted by it is assigned a unique identifier called the Semantic Scholar Corpus.

PubMed

PubMed, maintained by National Institutes of Health (US), is the primary resource for anyone looking for literature in medicine or biological sciences. It stores abstracts and bibliographic details of more than 30 million papers and provides full text links to the publisher sites or links to the free PDF on PubMed Central (PMC). Its web site PubMed.gov is also maintained by NIH (US).

Education Resources Information Centre (ERIC)

Provided by the US Department of Education, ERIC is the primary destination for education sciences. It is a database that specifically hosts education-related literature covering almost 1.3 million items, which are freely accessible.

Social Science Research Network (SSRN)

SSRN is a database for research from the social sciences and humanities. The database includes almost a million research papers, from 30 disciplines . Most of these are available for free, although you may need to sign up as a member (also free) to access some services.

Directory of Open Access Journals (DOAJ)

DOAJ is very special academic database since all the indexed articles can be accessed freely. It covers approximately 4.5 million items spanning a large number of disciplines. The DOAJ is one of the top general indexing databases in terms of use and reputation that journals can usually apply for relatively early in their publication life. With nearly 12,000 journal members, over 1.2 million visitors every month, and a continually updating stream of journal metadata the DOAJ is a powerful platform for searching quality literature.

Journal Storage (JSTOR)

Subscription free, JSTOR is another great resource to find research papers. It is a unique source of old academic literature. Any article published in the United States, before 1924, is available for free. It covers approximately 12 million items in different disciplines. It is provided by ITHAKA, *which* is a US not-for-profit organization with a mission to help the academic community use digital technologies to preserve the scholarly record and to advance research and teaching in sustainable ways.

IEEE Xplore

IEEE Xplore is the leading academic database in the field of engineering and computer science. It allows searching of not only journal articles but also conference papers and books. It contains

material mainly published by the Institute of Electrical and Electronics (IEEE) and other partner publishers. It provides web access to more than 5 million documents from publications in computer science, electrical engineering, electronics, and allied fields. Its documents and other materials comprise more than 300 peer-reviewed journals, more than 1,900 global conferences, more than 11,000 technical standards, almost 5,000 e-books, and over 500 online courses, with approximately 20,000 new documents being added every month. Anyone can search IEEE Xplore and find bibliographic records and abstracts for its contents, while access to full-text documents requires an individual or institutional subscription.

CORE

CORE is the world's largest research aggregator of open-access research papers from around the world. This means it works as a search engine for open-access research published by organizations from around the world, all of which is available for free. More than 200 million papers are available with fee access. It provides seamless access, through their unique Application Programming Interfaces, to content and data, thus being a very useful resource for researchers.

E-Theses Online Service (EThOS)

EThOS is a unique catalogue of electronic theses provided by the British Library, the National Library of the United Kingdom. As of March 2018, EThOS provides access to approximately480,000 doctoral theses awarded by over 140 UK higher education institutions (HEIs), with around 3000 new theses records added every month. Theses indexed by EThOS have a minimum of a thesis title, author, awarding body and date, optional additional metadata may be included such as the thesis abstract, doctoral advisor, sponsor, cross links to other databases and the full text of the thesis itself. Run by the British Library, EThOS is a database of over 500,000 doctoral theses. More than half of these are available for free, either directly via EThOS or via a link to a university website.

The Indian Citation Index (ICI)

The global citation databases such as Web of Science and Scopus cover only a handful of Indian academic journals, therefore there has always been a demand for home-grown online citation databases for better visibility of scientific literature emanating from India. This is particularly true in the case of journals from social sciences and humanities, which are not included in databases such as WoS and Scopus. The ICI, launched in October 2009 by the Knowledge Foundation and Diva Enterprises Pvt. Ltd., is a subscription-based knowledge portal, covers citation data since 2004 onwards. It is an online collection of multidisciplinary citation-cum-bibliographic databases covering about 800 multidisciplinary academic journals, published from South Asia, particularly from India.

Preprint site arXiv

One of the first and popular online preprint archive sites, arXiv (http://arXiv.org) has been very popular and in almost three decades of its existence has strongly influenced the course of research in science. The sites arXiv.org, chemArxiv.com and bioRxiv.org, cover almost all branches of science. In fact, most of the research papers in certain areas are available in the form of preprints, even before these are published, and lately many journals want the paper to be registered with arXiv, before it is processed for publication.

Indexing

Indexing is essential for journals where one attempts to publish. To be known as an acknowledged and prestigious source of quality scientific information and to stand out from among many other publications that are crowding the publishing space, research journals have to be indexed by one or more leading databases. For journal articles to be impactful, these must be discoverable, and online discovery rests almost entirely on indexing. Without proper indexing, researchers will be hard-pressed to find even the best of the scholarly articles available in the field. Journals included in an index are considered of higher quality than journals that are not. This is because journals have to go through a vetting process to be included or indexed in reputable bibliographic databases. Once a journal is indexed by a database, it is immediately available to all users of that database. Some databases index titles, some index full articles, while some others index only the abstract and/or references.

It is perhaps important to understand the various requirements of getting a journal indexed. From general search engines to discipline-specific databases and aggregators, there are numerous indexing options that journals can be indexed in, all with different benefits. Each index a journal seeks inclusion in will have its own requirements for entry and likely take time to get set up. It's important to pick a few to start with and then follow through with the necessary steps to be added to those indexes before moving on to new ones. Being included in subscription-free large scholarly search engines, Google Scholar and Microsoft Academic can be a good starting point.

Starting with general search engines, these indexes will be searching the web for content to index via computer programs commonly referred to as 'crawlers', 'spiders', or 'bots'. One can do a quick check to make sure the journal websites are showing up in search results by typing 'site' followed by the URL you want to check in the search bar. If the site shows up, it's being indexed by these databases. Many indexing requirements will essentially be standard across databases. Some of the most common index criteria include that all journals should have:

- International Standard Serial Number (ISSN).
- Digital Object Identifiers for all articles (DOIs).
- Editorial Board page with names, titles, and affiliations of the editors.
- Clearly stated time bound peer review policy and publishing schedule.
- Established copyright or IPR policy.
- At least basic article-level metadata to facilitate indexing.

In case the journal does not have all of these, then publishing in such journals is of no use. Journals can improve their indexing outcomes further by producing articles in full-text computer formats, including full-text HTML and XML. Articles in these formats are more search-engine friendly than PDFs because they are machine-readable and can be made mobile-friendly. Mobile-friendliness is now a leading content ranking factor for many search-engine indexes, including Google. Some indexing databases such as Pub Med Central actually require full-text XML files for the articles. Even if not required, putting full-text HTML or XML files into databases is advantageous as it allows for greater article usage. A common misconception about Google Scholar and Microsoft Academic is that they index all the content they have access to regardless of the content type or quality. This is not the case. Both scholarly search engines have certain quality controls in place and take steps to ensure only the academic websites are indexed.

Research Metrics

Research metrics are the Bibliometric tools used across the publishing industry as indicators of research performance, both at the journal and at the author level. Two crucial ingredients of bibliometric studies are the number of publications and the number of times those publications are cited. Citations-based Journal Impact Factor (JIF), ever since its introduction, has been one of the most important parameters for journal evaluation. For a long time, this was the only tool available for assessing the performance of research journals. At present there is a growing range of different research metrics, which are available both at journal as well as at author level, from the traditional Impact Factor to Eigen factor, *h*-index to Altmetrics, and beyond.

Based on a wealth of resources available in Science Citation Index (SCI) database, the Institute of Scientific Information (ISI) introduced a tool for ranking academic journals based on citations they received and impact they created in the scientific communities. Since 1975, SCI started publishing JIF and Immediacy Index as part of Journal Citation Reports (JCR), providing an immediate peep into the citation data. From its beginning, the SCI database included details of institution affiliation of all authors for any article published in a journal. This facilitated research collaborations, while publishing journal articles, not only in the case of writing research papers but also in the case of laboratory experimentations. In fact, ISI database laid the footprints of collaborative research and its eventual globalization of scientific research right from the beginning.

The underlying logic of all these metrics is related to the citations received by the articles published in a particular journal, both at the article level and collectively for the journal. It is presumed that the more the number of citations received by an article published, the more important it would be considered, in other words it is presumed that a quality paper is cited more often than an average paper. In case the articles published in a journal receive "on the average" higher number of citations, the more prestigious it becomes to publish in that journal. Often, while quantitatively calculating the research metrics the self-citations are taken out. Self-citation occurs when an author cites his own previous paper or a journal article cites papers already published in the same journal. There is nothing unethical in self-citations and journal self-citations. However, excessive self-citation can create doubts amongst reviewers, information analysts, and others from the research evaluation perspectives.

Journal Metrics

Impact Factor (IF) or Journal Impact Factor (JIF)

The Impact Factor (IF) is probably the most talked about metric for assessing journal performance. The Journal Impact Factor (JIF) attempts to quantify the idea of citations so as to apply it to large number of journals published across diverse range of disciplines. Designed to help librarians with the collection and management of journals in the 1960s, it has since then also become a common proxy for journal quality. After using journal statistical data in-house to compile the Science Citation Index (SCI) for many years, ISI (now Clarivate Analytics) began to publish Journal Citation Reports (JCR) in 1975 as part of the SCI and the Social Sciences Citation Index (SSCI).

JCR perhaps offers a systematic and objective means to evaluate the world's leading journals, with statistically quantifiable citation data. The JCR provides quantitative tool for ranking, evaluating, categorizing, and comparing journals. The JIF is one of these, which is a simple research metric, it's the average number of citations received in a given year by the articles published in the journal within a two-year window immediately preceding the year. The ISI introduced JIF as an important tool

for ranking academic journals analysing citations they received and the impact they created in the scientific communities.

JIF is a crucial parameter in the realm of Bibliometric analyses, which has brought revolution in the way the journals are ranked. Specifically, suppose we are considering the IF of a particular journal for the year 2019, then we have to consider all the papers (articles and reviews) published in that journal for the two preceding calendar years, that is 2017 and 2018. The WoS database is used to find all the citations in all the journals in 2019 to the papers published in that journal for the years 2017 and 2018. The Impact Factor of that Journal for 2019 is obtained by dividing the citations received to the papers published. To put it quantitatively:

***Impact Factor of a given Journal for the year 2019*:**

Number of papers published in the journal in the years 2017 and 2018	= A
Number of all the citations received by these published papers in the year 2019	= B
Impact Factor	= A/B

The number of years for which citations are chosen is arbitrary; similarly, the number of years for which the publications are considered is arbitrary; therefore, by changing the value X and Y we can get different factors. An Impact Factor of 2.0 means that, on an average, the articles published one or two year prior have been cited twice in the current year. Informed and careful use of these impact data is essential. Users may be tempted to jump to ill-formed conclusions based on Impact Factor statistics unless several caveats are considered.

Each edition of JCR contains the previous year's publication data and shows the relationship between citing and cited journals in an easily comprehensible manner. This means 2019 JCR provides analytics, including JIF, from 2018 Web of Science Data, more precisely from the Web of Science Core Collection across more than 250 disciplines. As of 2019, this database contains nearly 23,000 journals however only 12,600 of these have Impact Factors. These journals are the 9,200 indexed in the Science Citation Index Expanded (SCIE), and the 3,400 indexed in the Social Sciences Citation Index (SSCI). The other two databases of journals, Arts & Humanities Citation Index (AHCI) containing 1,800 journals, and the Emerging Sources Citation Index (ESCI) containing 8,600 journals, are not given Impact Factors. The JCR analytical works start in March of the JCR year and results are made official in June. It is updated annually. Journals that are accepted into SCIE and/or SSCI before January 1, and that remain covered in one of these collections when JCR production is started in March, are eligible to appear in the June release of the JCR data and receive a JIF.

Clarivate Analytics claims to use a single set of 28 criteria to evaluate journals, divided into 24 quality criteria designed to select for editorial rigour and best practice at the journal level, and four "impact criteria" designed to select the most influential journals in their respective fields based on citation activity as the primary indicator. Journals that satisfy quality criteria related to journal practices are sometimes unable to satisfy the four impact criteria. These are however, included in ESCI. Research journals are constantly scrutinized for their performance and if they do not come up to expectations, they are excluded . It is a two-step process: first, the Journals move to ESCI; and second, upon further clearing the IF- related criteria they move to SCIE, SSCI, or AHCI, depending on the subject area. This is a dynamic process, which allows Clarivate to include or exclude journals for assigning impact factors. For new journals, apart from getting indexed in the WoS, the first step to receiving an IF is to feature in the ESCI.

The IF is useful in clarifying the significance of citation frequencies. It eliminates some of the biases of such counts, which favour large journals over small ones, or frequently-issued journals over less-

frequently-issued ones, and of older journals over newer ones. Particularly in the latter case, such journals have a larger citable body of literature than smaller or younger journals. Perhaps the most important and recent use of JIF is in the process of academic evaluation. The impact factor can be used to provide a gross approximation of the prestige of journals in which individuals have been publishing. This is best done in conjunction with other considerations such as peer review, productivity, and subject specialty citation rates.

There have been many innovative applications of JIF, primarily providing librarians and researchers with a tool for the managing library journal collections. In market research, the IF provides quantitative evidence for editors and publishers for positioning their journals in relation to the competition, especially others in the same subject category. JIF along with other JCR data may also serve advertisers interested in evaluating the potential of a specific journal.

Limitations of JIF

The Impact Factor is an arithmetic mean and it doesn't adjust for the distribution of citations. This means that one highly-cited article can have a major positive effect on the JIF, skewing the result for the two years. Most journals have a highly-skewed citation distribution, with a handful of highly-cited articles and many low- or zero-cited articles.

The Impact Factor only considers the number of citations, not the nature or quality. An article may be highly cited for many reasons, both positive and negative. A high IF only shows that the research in a given journal is being cited. It doesn't indicate the context or the quality of the publication citing the research.

Impact Factors cannot be compared across different subject areas. Different subject areas have different citation patterns, which reflects in their IFs. Research in subject areas with typically higher IFs (cell biology or general medicine, for example) is not better or worse than research in subject areas with typically lower IFs (such as mathematics or history).

*The JCR doesn't distinguish between citations made to articles, reviews, or editorials***.** So that the IF doesn't penalize journals that publish rarely-cited content like book reviews, editorials, and news items, these content types are **not** counted in the denominator of the calculation, however, citations to this kind of content **are** still counted increasing the IF without any offset in the denominator of the equation.

Impact Factors can show significant variation year-on-year, especially in smaller journals. As IFs are average values, they vary year-on-year due to random fluctuations. This change is related to the journal size (the number of articles published per year), the smaller the journal, the larger the expected fluctuation.

Immediacy Index, Five Year Impact Factor

To supplement the IF dynamics, Clarivate brings out two other indices, which are more relevant for discipline-specific usage.

The Immediacy Index is the average number of times an article is cited in the year it is published, for example, in case we are considering Immediacy Index for the year 2019, then the publications and the citations are from 2019 only. It is similar to JIF, except the window for **both** the numerator and the denominator is restricted to the JCR data year. The **journal Immediacy Index** indicates how quickly articles in a journal are cited. A related idea, the **Aggregate Immediacy Index** indicates how quickly articles in a subject category are cited. It is a per-article average, the Immediacy Index tends to discount the advantage of large journals over small ones**.** However, frequently-issued journals may

have an advantage because an article published earlier in the year has a better chance of being cited than one published later in the year. Many publications that publish infrequently or late in the year have low Immediacy Indexes. For comparing journals specializing in cutting edge emerging areas of research, the Immediacy Index can provide a useful perspective, however, as peaking of citations usually takes several years, the Immediacy Index may not predict ultimate citation performance. It would be important to mention that it has a serious flaw, for example, for items published towards the end of the year, it would be nearly impossible for them to earn any citations before the year is out.

The Five-year Impact Factor is more useful for subject areas where it takes longer for work to be cited, or where research has more longevity. It offers more stability for smaller titles as there are a larger number of articles and citations included in the calculation. However, it still suffers from many of the same issues as the traditional Impact Factor.

Impact Per Publication (IPP)

Based on the Scopus database, IPP was introduced on the lines of JIF in 2014, and is calculated by Leiden University's Centre for Science and Technology Studies (CWTS). It is defined as the number of citations given in a specific year to publications in the past three years divided by the total number of peer-reviewed publications (papers, reviews) in the preceding three years. For example, if one is considering the IPP for the year 2019, then the publications would be from 2016 to 2018. Like the JIF, IPP does not correct for differences in citation practices between different disciplines. Previously known as Raw Impact per Publication (RIP), it has been replaced by CiteScore Index in 2016.

CiteScore

CiteScore, released by Scopus in December 2016 and calculated by CWTS, replaces the IPP metric that used to be available in Elsevier's Scopus database. CiteScore is quite similar to IPP, however its novelty is in the source items considered for its calculation. Apart from considering conference proceedings, along with journals being its source items, it includes letters, editorials, corrections, and news items, besides articles and review articles, for the calculation of citations. Since CiteScore includes larger number of sources and document types, therefore, it seems to have advantage of being more representative compared to IPP. It is currently available for journals and book series, which are indexed in Scopus. In addition to CiteScore, Scopus also publish additional rankings, such as the CiteScore percentile based on subject categories, and a monthly CiteScore tracker, for details one can visit **JournalMetric.com.**

CiteScore suffers from some of the same drawbacks as JIF, namely that it isn't comparable across disciplines and it is a mean calculated from a skewed distribution. It is perhaps instructive to compare CiteScore and JIF as both the indexes evaluate journals, of course based on different databases.

CiteScore	JIF
Uses a three-year citation window	Uses two-year window
Based on the Scopus database (number of citations and journal coverage In certain subjects is higher)	Based on Web of Science database
Includes all document types: in citation count In the numerator and publication count in the only denominator; both fully consistent	Numerator includes citations to any type of publication; denominator includes selected document types.
Covers all subjects	Only available for journals indexed in the SCIE and SSCI

Cited/Citing Half-Life

Although JIF provides an important tool in the hands of the librarians, they are always faced with decisions about collection maintenance and de-acquisition of individual journals as well as how to assess back file purchases for a journal. This is a very tricky issue and there are no easy solutions, however, the metrics, Cited Half-Life and Citing Half-Life, throw some light on this issue. 'Cited' essentially implies citations received whereas 'Citing' implies citations given, both bring out the journal's importance for archival purposes also.

In the JCRs, chronological data are provided in the Citing and Cited journal packages, but not in a form that lends itself to quick understanding of usage patterns. The Journal Half-Life Package presents these data so that chronological patterns are easily discernible. The Half-Life for a journal can help librarians decide how far back the collected issues in a journal's catalogue should extend.

Cited Half-Life looks at the citations that the articles published earlier in the journal receives (incoming citations) in the JCR data year. This metric helps us to understand the age of publications that are currently getting cited. Journals can receive citations in one JCR data year to anything that they have ever published, and the Cited Half-Life indicates how far back researchers go, when they cite articles published in that particular journal. The Cited Half-Life is the median age of a journal's articles that were cited in the JCR data year. Half of a journal's cited articles were published more recently than the Cited Half-Life. For example, a 2015 Cited Half-Life of five years of a journal implies that half of the journal papers that were cited in 2015 were published in the preceding five years including the year 2015. It need not be a whole number, for example, four-and-a-half can as well be the half-life. The half-life is always calculated from the latest year backwards**.** A citation's age is equal to the publication year of the citing item minus the publication year of the cited item. This information can help one to assess back-file purchases for a journal. Cited Half-Life is a good measure if one is interested in looking at a journal and finding out if older or newer material of the journal is receiving attention.

Citing Half-Life looks at citations given by a journal in the JCR data year. It is specifically defined as the median age of the citations produced by a journal during the JCR year. A citation's age is equal to the publication year of the citing item (i.e., JCR data year) minus the publication year of the cited item. By definition, half of a journal's outbound citations are to items published before the Citing Half-Life, and half are to items published after the Citing Half-Life. If a journal has a Citing Half-Life of four, it means the median age of citations given by it is four years—half of the citations are from items more recent than four years, and the other half are older. Citing Half-Life gives a different perspective on a journal's relationship to its peers, for example, which journals it cites most and how far back that citing relationship extends.

Newly Emerged Indicators : Eigenfactor, Article Influence, SNIP, SJR

To address some of the drawbacks of JIF and related metrics, and of CiteScore, efforts have been made to develop new generation metrics, using both WoS and Scopus databases. These metrics involve complex algorithm-based calculations involving network theory and other latest programming tools for assessing the journals using the vast mesh of citations joining vast number of scholarly documents. Essentially effort is made to include qualitative as well as quantitative aspects of citations to arrive at performance indicators for the journals. Eigenfactor and Article Influence are based on WoS data, whereas SNIP and SJR indicators are based on Scopus data.

Eigenfactor, Article Influence Scores

In 2007, the Web of Science based JCR included Eigenfactor and Article Influence Scores, two relatively complex metrics compared with JIF. These metrics were developed by Bergston Lab at Washington State University and are freely accessible at Eigenfactor.org. The Eigenfactor includes the influence of a journal based on whether it is cited within other reputable journals. A citation from a highly-cited journal is worth more than from a journal with few citations. Similarly, it incorporates the different standards for citation and different time scales on which citations occur for different subjects.

The Eigenfactor Score calculation is based on the number of times articles from the journal published in the past five years have been cited in the *JCR data* year, but it also considers which journals have contributed these citations so that highly cited journals will influence the network more than lesser cited journals. In other words, if a journal receives citations from high-ranking or highly reputed journals, Eigenfactor Score will be higher than another journal that receives most citations from average-ranking journals. Citations from one article in a journal to another article from the same journal are removed, so that Eigenfactor scores are not influenced by journal self-citation. To adjust for different areas of research , the citations are also weighted by the length of the reference list that they're from. Simply stated, the Eigenfactor calculation is the number of weighted citations in the JCR data year to articles published in a journal in the preceding five years, divided by the total number of articles published in the journal within the same five year period.

Eigenfactor score is calculated using data from WoS and JCR. The Eigenfactor approach is considered as more robust than the JIF metric, which purely counts incoming citations without considering the significance of those citations. The Eigenfactor is a measure of the journal's overall importance to the research community. The score is a measure of a journal's importance and it can be used in combination with *h*-index to evaluate the work of individual scientists. Eigenfactors also tend to be very small numbers as scores now are scaled so that the sum of all journal Eigenfactors in the JCR adds up to 100, referred to as **Normalized Eigenfactor**, which rescales the Eigenfactor score so that the average journal has a score of 1. Journals can then be compared and measured by their score relative to 1. A journal with a Normalized Eigenfactor Score of 3 suggests that it is three times as good the average journal in the *JCR. T*his score does not take the journal size into account, implying that larger journals tend to have larger Eigenfactors as they receive more citations overall.

Related to the Eigenfactor score, Article Influence (AI) score of a journal is a measure of the relative importance of each of its articles over the first five years after publication. For example, if an article published in 2010, AI measures average influence it made during 2011-2015. This is similar in its interpretation to JCR's Impact Factor. It is calculated by multiplying the Eigenfactor Score by 0.01 and dividing by the number of articles in the journal, which are normalized as a fraction of all articles in all publications in a given database. The scores are normalized so that the mean article in the entire *JCR* database has an article influence score of 1.00. A score greater than 1.00 suggests that each article in the journal has above-average influence. One can find the methods of calculation of EigenFactor and Article influence scores at eigenfactor.org.

Source Normalized Impact per Paper (SNIP)

SNIP is a key indicator as presented by CWTS Journal Indicators. Henk Moed developed the original version in 2009, which was revised in 2012. Based on the Scopus database, SNIP attempts to measure contextual citation impact by weighing citations based on the total number of citations in a subject field and corrects subject-specific characteristics, simplifying cross-discipline comparisons between

journals. It measures citations received against "citation potential" or citations expected for the subject field, using Scopus data. Essentially, the longer the reference list of a citing publication, the lower the value of a citation originating from that publication. The impact of a single citation is given higher value in subject areas where citations are less likely, and vice versa.

SNIP considers only specific content type citations (articles, reviews, and conference papers), and does not count citations from publications that Scopus classifies as "non-citing sources". These include trade journals, and many Arts and Humanities titles. Published twice a year, **SNIP** is calculated as the number of normalized citations given in the present year to publications in the preceding three years divided by the total number of publications in the preceding three years. A journal with a SNIP of 1.0 has the median (not mean) number of citations for journals in that field.

SCImago Journal and Country Rank

SCImago Journal and Country Rank, developed by SCImago Lab at Granada University, Spain, is a freely accessible web portal that includes the journals and countries scientific indicators developed from the information contained in the Scopus database. SCImago's web analytic environment facilitates analysing, monitoring and evaluating scientific journals on the one hand and national science systems on the other. The details of these rankings are available at the website SCImago.com.

Its primary indicator is called SCImago Journal Rank Indicator (SJR) that measures the scientific prestige of the average article in a journal; in fact, it expresses how central to the global scientific discussion an average article of the journal is. The SJR indicator aims to capture the effect of subject field, quality, and reputation of a journal on citations. It calculates the prestige of a journal by considering the value of the sources that cite it, rather than counting all citations equally. SJR scores are computed using network analysis of citations received by journals. The methodology accounts for number of citations as well as the source of citations, with citations from high prestige journals being worth more than those from lower prestige ones. The prestige value depends on the field, quality, and reputation of the source journals that the citing article is published in. Each citation received by a journal is assigned a weight based on the SJR of the citing journal. A citation from a journal with a high SJR value is worth more than a citation from a journal with a low SJR value.

SCImago uses the Scopus database and journal classification scheme to rank journals across subject areas and it considers only peer-reviewed articles, reviews, and conference papers. Computation of SJR is an iterative process that distributes prestige values among the journals until a steady-state solution is reached, similar to the methodology used for Google PageRankTM. Effectively, the SJR calculation is by taking average number of (weighted) citations in a given year to a journal, divided by the number of articles published in the journal in the previous three years The average SJR is now normalized to be equal to 1, which means that journals with SJRs higher than 1 are more prestigious than an average journal.

By incorporating citation behaviour in different disciplines into account, SJR can be used to make comparisons between journals in different disciplines. The effect of SJR is to flatten differences between fields i.e. citations in high cite fields (for example neuroscience, pharmacology) are worth less than a citation in a low cite fields (mathematics, humanities).

Along with journal rankings, SCImago laboratory also calculates SCImago Institution Rankings (SIR) which is a classification of academic and research-related institutions ranked by a composite indicator that combines three different sets of indicators based on research performance, innovation outputs, and societal impact measured by their web visibility.

Author Level Metrics

The citation based metrics for journals can easily be extended to the case of authors which have implications for their productivity as well as measure their impact on the scientific community. We have already emphasized the importance of citations, which can easily be extended to deduce contributions of authors at their individual or collective levels. This not only provides the first glimpse of scientist contributions but also lays the foundation of collaborations between scientists and institutions. The author-level metrics also provide a tool for assessing the research contributions, which play an important role in their career progressions. However, it needs to be emphasized that these cannot be the sole criteria as stressed by Eugene Garfield himself, it has to be supplemented by peer or other supporting review mechanisms.

h-index

h-index is perhaps the most widely-known author level index and is very extensively used as a proxy for author's academic achievements in the research domain .This index quantifies both the scientific productivity and the apparent impact created by a scientist in the scientific world. The index is based on the set of the scientist's most cited papers and the number of citations that these have received in other people's publications as well as through self-citations. The index can also be applied to the productivity and impact of a group of scientists, such as a department, university, or country**.**

In 2005, Jorge E. Hirsch, a physicist at University of California at San Diego, USA, first suggested this index and it is sometimes called the *Hirsch index* or *Hirsch number*. (Hirsch, 2005). *h*-index is calculated by number (*h*) of an author's articles, which have been cited at least same number (*h*) of times. For example, if an author has published 20 papers or more and 20 of these have each been cited 20 times or more, then the author will have an *h*-index of 20 or $h = 20$.

The *h*-index seems to give better qualitative information than the total number of research publications as well as the total number of citations received. Merely knowing the number of publications does not reveal how well these articles have been received by other researchers. Similarly, the total number of citations can be inordinately influenced by a small number of highly-cited few articles, in which case it may not be a true reflection of one's productivity, or a large number of poorly-cited papers, in which case the quality of work may not be up to the mark.

The main advantage of the *h*-index is that it is neither skewed upwards by a small number of highly-cited papers nor skewed downwards by a long tail of poorly-cited work. A high *h*-index indicates that the research work is receiving adequate attention in the literature as well as shows the consistency and the contemporary nature of the research of a particular author. From July 2011 onwards, Google has provided an automatically calculated *h*-index within their own Google Scholar profile.

The Limitations

Before using h-index as the marker for research quality and output for an author, several observations have to be kept mind in its interpretation:

Results can be inconsistent: Although the basic calculation of the *h*-index is clearly defined, it can be calculated using different databases or time-frames, giving different results. Normally, the larger the database, the higher the *h*-index calculated from it. Therefore, an *h*-index taken from Google Scholar will nearly always be higher than one from Web of Science, Scopus, etc.

***Results can be skewed by self-citations*:** Although some self-citation is legitimate, authors can profusely cite their own work to improve their *h*-index. This is particularly true in the case of large collaborations involving hundreds of authors. Such collaborations churn out large number of publications, which surely includes, in a natural manner, self-citations. It is natural that all authors in these collaborations would have large *h*-index, which actually reflects the contribution of the collaboration and not of the individual authors.

***Results aren't comparable across disciplines*:** Citations depend on a particular subject and the sub-category or work area. The *h*-index varies widely by subject. A mediocre *h*-index in the life sciences will still be higher than a very good *h*-index in the social sciences. Comparison across disciplines is fraught with dangers, and at best be avoided. We can't benchmark *h*-indices because they are rarely calculated consistently for large populations of researchers using the same method.

***Results can't be compared between researchers*:** The *h*-index of a researcher with a long publication history including review articles cannot be fairly compared with a post-doctoral researcher in the same field, nor with a senior researcher from another field. Researchers who have published several review articles will normally have much higher citation counts than other researchers.

Unable to capture an unusual original work: In the final analysis, the *h*-index would miss such a work, which many times come to the mainstream research after a gap. Further, the index does not distinguish between who is citing and where. For example, few citations by acknowledge leaders of the field are more important than large numbers general citations. Similarly, few citations in quality journals are far better than large number of citations by all and sundry working in the field.

There are several related metrics that are derived from *h*-index. For example, H-core relates to the set of top cited *h*-articles from a journal, whereas *h*-median represents median of citation counts in a journal's *h*-core. One can restrict the citation window to the preceding five years to check the output of an author in those five years. The corresponding H-index is referred to as *h*5, similarly we can define *h*5-core and *h*5-median, corresponding to articles published in the five years.

Leo Egghe's *g*-index

In 2006, Leo Egghe suggested another important author level index, the *g*-index (Egghe, 2006). The index is calculated based on the distribution of citations received by a given author's publications. Suppose the research papers are arranged in decreasing order of the number of citations that these have received, then the *g*-index is the unique largest number such that the top *g*-articles have received together at least g^2 citations. It can be equivalently defined as the largest number *g* of highly cited articles for which the average number of citations is at least *g*. Effectively, the g-index by design jacks up the low-cited papers by the highly-cited papers.

Comparing h-index and g-index

In the case of *h*-index, once a paper has sufficient number of citations to get included in the *h*-index, additional citations to the same article are not that important, essentially implying the papers that have much higher citations than the *h*-index do not matter for that particular value. In other words *h*-index defines essentially a quality threshold of the publications. The ***g*-index,** in contrast, weighs highly-cited papers more heavily. The *g*-index value will always be equal to or greater than the *h*-index value.

Other Author-level Metrices

Several other author level metrics are talked about.

i10: One such metric is *i*10, which gives the number of publications with citations equal or greater than 10. It is a good index to check that an author has produced good number of publications with reasonable quality and is noticed by his or her peer group. Depending upon different disciplines and sub-disciplines one can make it '*i-n*' where '*n*' can be some number.

hc-index: If someone published a few highly-cited papers decades ago but presently is inactive, then the *h*-index may be higher than an established researcher who continues to steadily publish, or a promising new researcher who is just beginning to gain recognition. The ***hc*-index** (contemporary *h*-index) weighs-in newer articles more heavily than older articles, to take into account the loss of their research value over time. This allows a somewhat clearer picture of more recent levels of productivity and impact.

m-index: This takes into account the lengths of careers of researchers while comparing citations, as one who has been publishing for decades will certainly have higher *h*-index compared with a relatively younger researcher.

Altmetrics (Alt-metrics, Article-level Metrics, Alternative Metrics)

In the twenty-first century driven by the Internet, researchers are very keen to maintain their online profiles through social networking, transnational forums and peer-to-peer collaborations. Citation-based metrics have long been the accepted measure of scholarly productivity and quality, however, increasingly authors and scholars are using basket of tools, usually referred to as Altmetrics. These new generation tools essentially capture a holistic picture of how one's research influences the creation and dissemination of knowledge as well as how it is perceived by society at large.

Altmetrics assess broad spectrum online societal activity around any scholarly publications. These new tools can be used by individual researchers, departments, institutions, publications, and more. In addition to citations, these newer metrics include impact measures such as media coverage and social media, Wikipedia and other quasi-scholarly platforms, news sources, and policy documents. Specifically, it can include tweets, comments, shares or links, readers, subscribers, watchers or followers, downloads, clicks or views, saves, bookmarks. and favourites. It can also include mentions in mainstream media, in public policy documents, reviews, comments, ratings, or recommendations, adaptations, or derivative works. There are several such metrics with the ever-expanding list.

Altmetric Attention Score (Altmetric.com)

The Altmetric Attention Score is presented within a colourful donut. Each colour indicates a different source of online attention, ranging from traditional media outlets to social media, blogs, academic forums, patents, policy documents, multimedia platforms, and so on. A strong Altmetric Score will feature both a high number in the centre, and a wide range of colours in the donut.

Plum Analytics (plumanalytics.com)

Captures metrics for all types of scholarship and categorizes according to usage, captures, mentions, social media, and citations. Specific products for institutions, institutional repositories, research departments/groups, research funders.

Impactstory (impactstory.org)

Tracks and ranks all research outputs via data from citations, social media, data and code repositories and other sources. Links to users' ORCID profiles and is freely available to Twitter users.

Research Gate Score (explore.researchgate.net)

The academic social networking site, Research Gate, calculates a score based on peer evaluations of users' contributions. Contributions can include publications and data, among others. The RG score is weighted by the RG score of whoever is evaluating one's work.

Altmetrics have several uses for authors, institutions, publishers, librarians, and managers, to name a few. Altmetrics can help researchers understand how their outputs are being shared and discussed via social media and online, and may supplement the information gained from traditional indicators. It allows the use of several personalized tools for increasing visibility in social media and interaction with online academic communities based on research interests. Apart from giving information at the article level, unlike citations that take time, Altmetrics can quickly provide response to a particular research work in scholarly as well as other forums. Altmetrics also provides a holistic picture of the response to one's work including its relevance to societal needs as well as policy-planning tasks for improving governance. Researchers can complement their search of literature by instantly visualizing a paper's online attention, also easily find out new scholarly articles in different disciplines.

Publishers can showcase research impact to authors and readers in a beautiful new way as well as monitor, search, and measure all of the conversations about journal's articles, as well as those published by the competitors. For Librarians and Repository Managers these tools can easily add value to the libraries and institutional repositories. Altmetrics can track article level metrics for the institution's research outputs, and present to faculty, staff, and students a richer picture of their online research impact.

Limitations

Before making use of the Altmetric 'scores', one should keep in mind several observations. There are many different Altmetric providers available and it can be hard to determine which are the most relevant ones. Like any indicator, there's a potential for manipulations of scores. Also, Altmetrics may indicate popularity with the public, which need not necessarily indicate quality research, therefore it may not find favour with many institutions. In many subjects or disciplines it may not be considered important, however in many areas it may be very relevant, particularly in the case of Social Sciences and Humanities.

Unique ID for Research Contributors/Authors

When searching online databases by an author's particular name, generally, results may show more than expected number of bibliographic records of papers of the author, including contributions by different persons with similar names or somewhat similar names. Having a unique identifier for an author or a contributor of a scholarly publication can easily remove this ambiguity. Presently, two online systems are available to the researchers' communities for obtaining a unique identity of an author or a research contributor: Researcher ID and Open Researcher and Contributor ID (ORCID), available at ResearcherID.com and ORCID.org websites, respectively. Creating a UID also facilitates creating online profiles as well as groups for discussion based on particular research interests.

Conclusion

With the proliferation of research in general and scientific research in particular, storing and the ability to use the data related to research outputs in a meaningful manner has become a challenging task to manage. By a rough estimate, at present more than two million scholarly documents are created every year, indicating the enormity of the problem.

- The first step was taken by Eugene Garfield in the 1960s when he created Institute of Scientific Information (ISI) and defined the citations-based Journal Impact Factor (JIF) as a tool for evaluating journals, thus laying the foundation of Bibliometrics or Scientometrics. This has led to creation of academic databases as well as research evaluation metrics. At present there are large number of databases, both with and without subscriptions, as well as good number of research evaluation metrics at the journal and the author level.
- Web of Science (WoS), In its present form as maintained by Clarivate Analytics, is the oldest, as well the most respected platform, which allows one to track scholarly literature across 254 disciplines from almost 171 million records and almost 1.9 billion cited references.
- Scopus, maintained by Elsevier, another universally accepted subscription database, currently has over 80 million core records, with the oldest record dating back to 1788 with almost 1.5 billion cited references.
- Google Scholar is perhaps the most important subscription-free database, estimated to contain roughly 390 million documents including articles, citations and patents making it the world's largest academic search engine.
- Microsoft Academics is another subscription-free large database, currently indexes over 220 million publications, 88 million of which are journal articles. There are many more databases, some of these are disciplines specific or are for targeted audience.

For journal articles to be impactful, they have to be discoverable, and online discovery rests almost entirely on indexing. Journals included in an index are considered to be of higher quality than journals that are not as these have to go through a vetting process to be included or indexed in reputed bibliographic databases. Based on the citations, there are several research evaluation metrics for both journals and authors.

WoS-based Journal Impact Factor is the most popular parameter used for evaluating journals. Simply stated, it is the average number of citations received in a given year by the articles published in the journal within a two-year window immediately preceding the year. Besides JIF, several metrics have come up based on the WoS, for example, Immediacy Index, Five-year Impact Factor, Cited/Citing Half-Life, throwing light on the various aspects of citations. Recently, similar to JIF, Scopus based IPP and its replacement CiteScore have also become popular in the literature.

In order to address some of the drawbacks of JIF and related metrics, efforts have been made to develop new-generation metrics, both using WoS and Scopus databases. These metrics involve complex algorithm-based calculations for assessing the quality of journals using the vast mesh of citations. Eigenfactor and Article Influence are based on WoS data, whereas SNIP and SJR indicators are based on Scopus data. The Eigenfactor Score calculation is based on the number of times articles from the journal published in the past five years have been cited in the *JCR data* year, but it also considers which journals have contributed these citations so that highly cited journals will influence the network more than lesser cited journals, with self-citations not being considered. Related to the Eigenfactor score, the Article Influence (AI) score of a journal is a measure of the relative importance of each of its articles over the first five years after publication.

Based on Scopus database, SNIP attempts to measures contextual citation impact by weighing citations based on the total number of citations in a subject field and corrects subject-specific characteristics, simplifying cross-discipline comparisons between journals. Similarly, SCImago Journal Rank Indicator (SJR) measures the scientific prestige of the average article in a journal. Both SNIP and SJR use three years window for taking into account the published papers in the Scopus database.

The citation-based metrics for journals can easily be extended to authors. *h*-index is the most widely known author-level index and is a very widely used criterion as a proxy for author's academic achievements in the research domain. The index is defined as the number (*h*) of author's research papers, which have been cited at least the same number (*h*) of times. Along with the *h*-index, there are indices such as *i*10, *g*-index, among others, which have become popular.

In recent times, authors and scholars are increasingly using a basket of tools, usually referred to as Altmetrics, which supposedly captures a holistic picture of how one's research is perceived by society at large. These new tools can be used by individual researchers, departments, institutions, and publishers. In addition to citations, Altmetrics can include tweets, comments, shares or links, readers, subscribers, followers, downloads, clicks or views, saves, bookmarks, and favourites. The Altmetric Attention Score is presented within a colourful donut, each colour indicates a different source of online attention. These metrics have also led to the creation of unique research identities, facilitated by the websites ResearcherID.com and ORCID.org.

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CHAPTER 14

Impact Factor of Journal as per Journal Citation Report and Metrics

Pulok K. Mukherjee

Impact Factor (IF) and Its Importance

The evaluation of the quality of research is important for various professional societies, individual scientists, scholarly institutions, and funding organizations. Metrics have become a fact of life in many, if not all fields of research and scholarship. The quality of a scientific contribution is primarily estimated from the long-term impact that it has in science. The latter can be inferred from the citations in scientific articles that a contribution receives. These principles have been applied in the evaluation of scientific journals. The Impact Factor of a journal (IF), first conceived in 1955 by Eugene Garfield, the founder of the Institute for Scientific Information (ISI), has been extensively used in the past decades as an index of quality of scientific journals and is based on citation analysis. Although the IF has been widely regarded as the best instrument for the evaluation of the quality of scientific journals, it has not been spared from criticism. For a specific journal, the IF is the number of citations for publications over the previous two years divided by the number of total citable publications in these years (the citation window). Therefore, a journal's impact factor is based on two elements: the numerator, which is the number of citations in the current year to any items published in a journal in the previous two years, and the denominator, which is the number of substantive articles (source items) published in the same two years. Although this simplicity works to an advantage of this method, complications arise when answers to questions such as, "What is included in the citation window?" or "What makes a good journal impact factor?" are ambiguous. The advantages of the IF include promoting the author while giving the readers a visualization of the magnitude of review. The disadvantages include reflecting the journal's quality more than the author's work, the fact that it cannot be compared across different research disciplines, and the struggles it faces in the world of open access.

It is one thing to use impact factors to compare journals and quite another to use them to compare authors. Journal impact factors generally involve relatively large populations of articles and citations. Individual authors, on average, produce much smaller numbers of articles. The impact factor could just as easily be based on the preceding year's articles alone, which would give an even greater weight to rapidly-changing fields. A less current impact factor could take into account longer periods. Alternatively, one could go beyond two years for the source items in the denominator, but then the measure would be less current.

All citation studies should be normalized to take into account variables such as field, or discipline, and citation practices. Citation density and half-life are also important variables. The citation density (mean number of references cited per article) would be significantly lower for a mathematics article than for a life sciences article. There is a widespread but mistaken belief that the size of the scientific community that a journal serves affects the journal's impact. This assumption overlooks the fact that the larger the author and article pool for citing, the larger the number of published articles to share those citations. Many articles in large fields are not well cited, whereas those in small fields may have

unusual impact. Therefore, the key determinants in impact are not the number of authors or articles in the field but, rather, the mean number of citations per article (density) and the half-life or immediacy of citations to a given journal. The time required to review manuscripts may also affect impact. If reviewing and publication are delayed, references to articles that are no longer current may not be included in the impact calculation. Even the appearance of articles on the same subject in the same issue of a journal may have an effect.

For greater precision, it is preferable to conduct item-by-item journal audits so that any differences in impact for these different types of editorial items can be taken into account. For a small number of journals a bias may be introduced by including in the numerator these extra citations to items that are not part of the denominator of source articles. Clearly, if the denominator is smaller than the actual number of published items, it will increase the journal's impact factor. This in turn may alter the rankings. However, most journals primarily publish substantive research or review articles. Therefore, statistical discrepancies are rare. The *JCR* data (Journal Citation Report data) have come under some criticism for this reason among others.

Different metrics for determination of Impact factor of a journal has been represented in Figure 1. Although IF has its constraints, until there are better proposed alternative methods, it remains one of the most effective methods for assessing scholarly activity. Main points of consideration regarding methodological aspects in the calculation of this index include the lack of assessment of the quality of citations, the inclusion of self-citations, the poor comparability between different scientific fields, and the analysis of mainly English-language publications. In fact, many researchers have proposed different approaches in the evaluation of the quality of scientific journals. The common point in most of these approaches is the assessment of the quality of citations received by a journal. The quality of citations can be estimated analysing the networks of scientific papers with sophisticated mathematical algorithms.

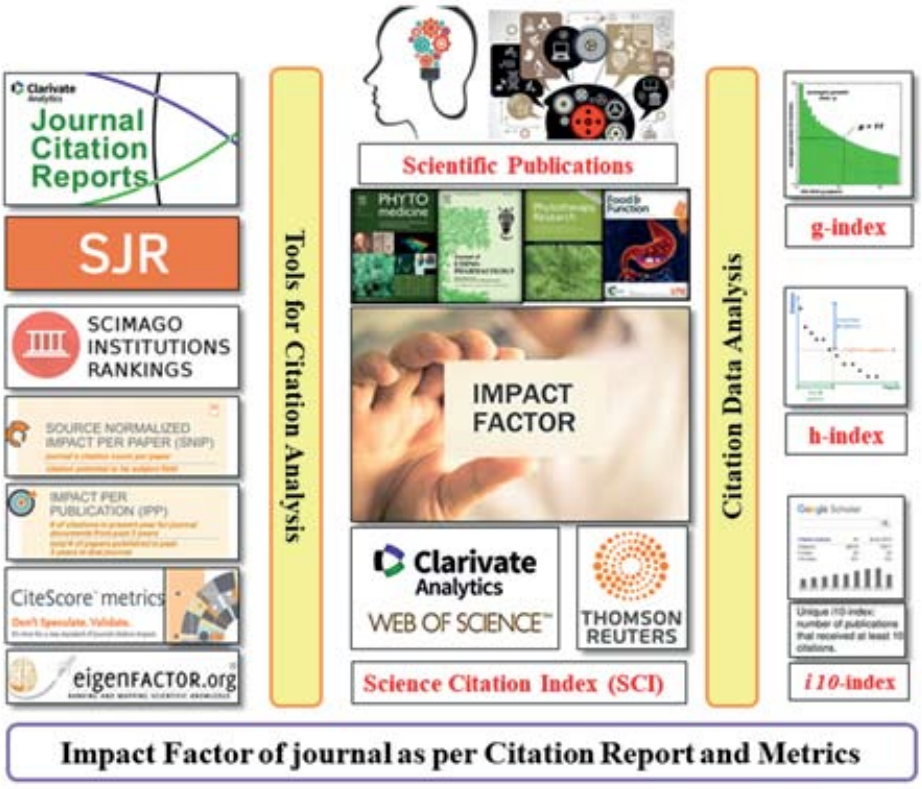

Figure 1. Impact Factor as per Citation Report and Metrics

Journal Citation Reports (JCR)

A group of researchers at the University of Washington developed a similar algorithm for the evaluation of the influence of scientific journals included in the Thompson Scientific Journal Citation Reports (JCR) dataset.

Journal and Country Rank (SCImago)

Alternatives to the IF have been emerging, such as the SCImago Journal and Country Rank. The Page Rank algorithm, used in the evaluation of web pages by the popular Google search engines, has been proposed as an appropriate model for the evaluation of the quality of citations in scientific journals. Furthermore, another research group from Spanish Universities developed an indicator, named the SCImago Journal Rank (SJR) indicator, for the assessment of the quality of scientific journals, applying the Page Rank algorithm on the Scopus database. The SCImago journal rank indicator is a novel instrument for the evaluation of scientific journals that may challenge the established premiership of the journal IF in ranking scientific journals. It provides unrestricted (open) access, is based on a larger source journal database, and focuses on the quality of citations that a journal receives by other journals, rather than the absolute number. However, the sophisticated methodology used in the calculation of the SJR indicator needs to be adequately validated, and certain characteristics may need to be reconsidered before definitive conclusions for its applicability could be drawn. It appears, though, that the election of one index or the other would be mostly a matter of whether the popularity or the quality of a journal is considered as the primary criterion for the evaluation of scientific journals.

Source Normalized Impact per Paper (SNIP)

Another metric known as Source Normalized Impact per Paper (SNIP) is a sophisticated metric that intrinsically accounts for field-specific differences in citation practices. It does so by comparing each journal's citations per publication with the citation potential of its field, defined as the set of publications citing that journal. SNIP therefore measures contextual citation impact and enables direct comparison of journals in different subject fields, since the value of a single citation is greater for journals in fields where citations are less likely, and vice versa. SNIP is calculated annually from Scopus data and is freely available alongside CiteScore and SJR.

Impact Per Publication (IPP)

The impact per publication is calculated as the number of citations given in the present year to publications in the past three years divided by the total number of publications in the past three years. IPP is fairly similar to the well-known journal IF. Like the IF, IPP does not correct for differences in citation practices between scientific fields. IPP was previously known as RIP (Raw Impact per Publication). IPP and SNIP are provided with stability intervals. A stability interval reflects the stability or reliability of an indicator. If for a particular source IPP and SNIP have a wide stability interval, the indicators have a low reliability for this source. This, for instance, means that the indicators are likely to fluctuate quite significantly over time.

CiteScore

CiteScore metrics are a suite of indicators calculated from data in Scopus, the world's leading abstract and citation database of peer-reviewed literature. CiteScore itself is an average of the sum of the

citations received in a given year to publications published in the previous three years divided by the sum of publications in the same previous three years. CiteScore is calculated for the current year on a monthly basis until it is fixed as a permanent value in May the following year, permitting a real-time view on how the metric builds as citations accrue. Once fixed, the other CiteScore metrics are also computed and contextualize this score with rankings and other indicators to allow comparison.

Metrics: *g*-index, *h*-index, *i*10-index

g-index

The *g*-index was proposed by Leo Egghe; *g*-index is calculated this way: "[Given a set of articles] ranked in decreasing order of the number of citations that they received, the *g*-index is the (unique) largest number such that the top *g* articles received (together) at least *g*^2 citations." It accounts for the performance of author's top articles and helps to make more apparent the difference between authors' respective impacts. The inflated values of *g*-index help to give credit to lowly-cited or non-cited papers while giving credit for highly-cited papers.

h-index

Another author-level metric, the *h*-index (and some of its numerous variants) has come to be applied to higher-order aggregations of research publications, including journals. A composite of productivity and citation impact, *h*-index is defined as the greatest number of publications *h* for which the count of lifetime citations is greater than or equal to *h*. Being bound at the upper limit only by total productivity, *h*-index favours older and more productive authors and journals. As *h*-index can only ever rise, it is also insensitive to recent changes in performance. Finally, the ease of increasing *h*-index does not scale linearly: an author with an *h*-index of 2 needs only publish a third paper and have all three of them cited at least three times to rise to an *h*-index of 3; an author with an *h*-index of 44 must publish a 45th paper and have it and all the others attain 45 citations each before progressing to an *h*-index of 45. *h*-index is therefore of limited usefulness to distinguish between authors, since most have single-digit *h*-indexes.

i10-index

The *i*10-index is the newest in the line of journal metrics and was introduced by Google Scholar in 2011.[1] It is a simple and straightforward indexing measure found by tallying a journal's total number of published papers with at least 10 citations.

Research metrics are sometimes controversial, especially when in popular use they become proxies for multidimensional concepts such as research quality or impact. Each metric may offer a different emphasis based on its underlying data source, method of calculation, or context of use. In this context, use of multiple complementary metrics can help to provide a more complete picture and reflect different aspects of research productivity and impact in the final assessment.

Endnote

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CHAPTER 15

Predatory Journals: Causes and Consequences

Shubhada Nagarkar

Introduction

Predatory publications have been extensively debated in literature over the last decade and global efforts are underway to educate new researchers about predatory publishers. Jeffrey Beall was the first one to report such publishers on his blog, making it clear that they had exploited the Open Access (OA) publishing model and had attracted gullible researchers and faculty members to publish their research in their journals (Beall, 2012). Scholars, desperate to meet publication norms for career promotions and other academic purposes, unknowingly fall prey to these publishers. The "pay and publish" model that bypasses the peer review process, and accepts and publishes research papers has been made easier by predatory publishers. Therefore, several substandard papers are flooding research literature across disciplines, and are proving immensely harmful to society. By adopting conscious, calculated and frequent changes in their practices, predatory publishers have made it difficult for unwary authors to differentiate predatory journals from respectable/standard journals (Beall, 2016).

Here we provide a clear overview of the meaning, origin, and characteristics of predatory journals. Different types and examples of predatory journals are listed; the reasons for their existence are addressed; and the implications they have produced are pointed out. A checklist for the identification of predatory publications is presented and a reference is made to the efforts of the global campaign against predatory journals.

The Academic Journal

Researchers worldwide are engaged in discovering new knowledge and reaffirming the results of previous endeavours. Research ventures are disseminated through academic journals ,which reveal the author's credentials, methods of investigation, observations, and outcomes of the research; mapping the progress of any discipline. Academic journals have a long tradition of publishing (first published in 1665), in print format by universities and learned societies, surviving on individual or institutional subscriptions.[1] The stringent editorial practices with the strong editorial board and peer review systems rendered these journals authentic and therefore trusted among researchers (Smith, 1999; Cope and Phillips, 2014; Weiner, 2001).

Advances in Information and Communication Technology (ICT) transited the print journal to the electronic format (through the World Wide Web), significantly impacting academic publishing by giving free online access, that is, Open Access (OA) (Harnad, 2010). Although new pricing models for print only, print and online (hybrid) (Green OA), and online-only (Gold OA) journals were brokered. The standard publishing practices were not diluted (Björk and Solomon, 2015).

For Green OA, the researcher is required to wait for the embargo or moving wall period (usually 12 to 24 months) to be over, prior to archiving his or her published paper in any repository. Alternatively, researchers have the option to publish their papers online through preprint archives (arXiv, bioRxiv and engrXiv etc.),with an online peer review process.

Commercial publishers started a new business model of publishing, in which they charged extra fees — Article Processing Charges (APCs), for allowing immediate access to the research papers, referred to as Gold OA, in which the publishers drew up their individual OA policies for APCs, to cover the cost of review, manuscript preparation, and server space. Gold OA journals survive solely on revenue generated by APCs (Harnad, 2010).

Predatory Journals

The "Publish or Perish" policy for career advancement played a major role in prompting some publishers to take advantage of bringing out the "Pay and Publish" model; which Beall labelled as "Predatory Publishing". His most damaging indictment of OA was against its destruction of the traditional model of publishing, where there was no monetary exchange between the scholar and the publisher. According to him, the OA arrived with the intention of making the scholarly publications accessible to all, beyond paywalls; but it was unscrupulously exploited by the predatory publishers (Beall, 2012, *op. cit*.). The subsequent rise of predatory publications became an unacceptable fallout.

Definitions of Predatory Journals

- **Jeffrey Beall:** Early definitions by Beall describe predatory publishers as outlets "which publish counterfeit journals to exploit the open-access model in which the author pays" and publishers that were "dishonest and lack transparency" (*ibid.*).
- **Committee on Publication Ethics (COPE)**: "Predatory publishing is generally defined as for-profit open-access journal publication of scholarly articles without the benefit of peer review by experts in the field or the usual editorial oversight of the journals in question."[2]
- **A. Grudniewicz, *et al.*:** "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).

Number of Predatory Journals

It is very difficult to enumerate the exact number of predatory journals, but Cabell's blacklist of predatory journals in 2018 listed 13,900 journals.[3] Predatory journals are more in number from developing countries (Seethapathy, *et al.*, 2016) but few studies indicate some publishers from developed countries are also involved in predatory publications (Bohannon, 2013; Linacre, *et al.*, 2019).

Characteristics of Predatory Journals

Predatory journals, which override standard publishing practices, can be identified with the following characteristics (Beall, 2016, *op. cit*.).

Basic Information about the Journal

- Titles and websites of the standard journals are hijacked.
- Use of misleading words such as 'International', 'Global', 'World journal' 'Äsian', 'American', in the titles, while the journals lack the international scope and editorial board.

- Journal titles simultaneously combine two or more subjects or disciplines, which may not necessarily be specific to the journal.
- No contact details of publisher and editor are provided.
- False locations of the offices of the publisher and editor/s are given.
- Lack of information on the editorial board members.
- Lack of information about the frequency of periodicals/Journals/Serials.
- Fraudulent or improper use of ISSNs and logos of standard publishers.
- Many editors are unaware of the inclusion of their names on editorial boards.

Contents of the Journals

Articles in such journals are characterized by:

- Low quality
- Several typographical mistakes
- Plagiarised work
- Out of sync with the aims and scope of the journal
- Multidisciplinary — not committed to any single discipline.

Lack of Standard Publishing Practices

- The peer review process is absent.
- Spam emails inviting articles are sent to authors.
- Attracting academicians to serve as editorial board members/peer reviewers only for convenience or value addition.
- Articles are accepted only after the payment of submission charges.
- High acceptance rate.
- Lack of publication ethics, peer review, and retraction policy.
- Article submission guidelines are not given.
- Very quick turnaround time for acceptance and publication of articles.

False Impact Factor and Indexing Databases

- False, non-existent, misrepresented Impact Factor [4] (IF)is generated.
- Unscientific methodology for calculating the IF.
- The IF is purchased by publishers from fraudulent companies like Universal Impact Factor (UIF), Global Impact Factor (GIF), etc. (More than 20 such companies exist to date).
- Journals are included in sub-standard indexing databases[5] on a payment basis (for example, Index Copernicus).
- False claims of indexation of journals in world-recognized databases.

Types of Predatory Publications

A perusal of extant literature allows categorization of the various types of predatory journals:

- ***Shoddy/sham journals***: Journals having all characteristics and unethical features mentioned above (Klyce and Feller, 2017).
- ***Hijacked journals*:** They are difficult to recognize as they mimic the standard publications in name, logo, and website (Dadkhah and Borchardt, 2016). They look as good as the standard legitimate journals.
- ***Cloned journals*:** They are online dubious versions of print only authentic journals. Here the names and ISSN (if any) are the same (Asim and Sorooshian, 2019).
- ***Crony publishing*:** Institutional publications in which editorial board members and a majority of the authors are from the same institutes, across a majority of the issues of the periodical. Editorial misconduct by editors and their associate reviewers (groups of friends from either the same or different institutions are on board of reviewers).

Consequences of Predatory Journals

As discussed earlier, anyone can publish on any topic in predatory journals. There are no efforts to check the quality of research by predatory publishers as they are interested in APCs alone. Research in the biomedical field often leads to improved therapies, new medicines, new surgeries and improved patient safety. Therefore, if the research results are published without scrutiny, doctors and individuals may use false information. Journalists or media people may mislead people if they publish information, without ascertaining journal credentials (predatory or legitimate).Therefore, information published in predatory journals, without any "peer review", threatens the society at large with uncharted pitfalls.[6]

Other Implications of Predatory Journals

- ***Corruption in Science and Other Disciplines***: A recent study shows that predatory journals contaminate the scientific archive as mainstream journal articles do cite journals that have been published in predatory journals. Others, not being aware that these papers have not really been peer-reviewed, may take them as being validated by experts in the area. This could lead to a real negative impact on the credibility of science and disciplines.[7]
- ***Influence on Key Sectors such as Human Health***: Misleading information can influence behaviour and cause damage to human health. There are no mechanisms to authenticate the information, test veracity of claims and avoid findings that can be potentially harmful to patients and others (Hansoti, *et al*., 2016).
- ***Damage to the Career of Researchers*:** Publishing in predatory journals reflects poorly on the researchers and harms their CVs. Experts assessing the researchers, whether for job interviews or job promotions, will weigh and favourably assess quality against quantity. The papers published in predatory journals are unlikely to be cited, which ultimately affects the researcher's metrics such as h-index and makes his/her research integrity and credentials questionable.[8]
- ***Damage to the Institution's Reputation***: Publishing in predatory journals by the researchers affiliated to the institutions causes collateral damage to the profile of the institution. Moreover, the institutions will not squander precious funds on predatory publications; with the added danger of exposure to negative external scrutiny which would certainly tarnish their image.[8]

- ***Loss of Money***: By publishing in predatory journals, many researchers lose money because either their articles are not published at all, even after paying the exorbitant APCs or even though they are published, they are not peer-reviewed and archived (Moher, *et al*., 2017).
- ***Waste of Time and Efforts***: Time invested in research and in writing papers is precious, and results in a compounded loss of time and effort if the work is published by mistake in a predatory journal (Van Noorden, 2020; Moher, *et al. op. cit*.). Predatory journals waste the time of academics and researchers which could otherwise be spent for presenting, reviewing, and serving as editors for established journals (Cress, *et al*., 2019).

Checklist to Identify Predatory Journals

- ***ISSN***: Although the ISSN is not an indicator of any quality, it should be verified by researchers from the ISSN-providing agencies or from some secondary source.
- ***Publisher address / Editor address***: Addresses can be verified from secondary sources Such as Google Map, or similar online searches.
- ***Impact Factor***: Verify IF with Journal Citation Report by Clarivate Analytics.
- ***Indexing database***: Check authenticity of the database (contact details, journal inclusion criteria, etc.). Google scholar, aggregators, library catalogues are not indexing databases.
- ***Credibility of editor/s*:** Credibility can be checked with publications of editors-in-chief and editorial board members in respectable journals.
- ***Publication in a short duration of time***: Always check dates of submission and acceptance of papers.
- ***Journal back volumes***: Availability of the archives can be checked.
- ***Annual listing of reviewers*:** Does the journal publish a list of reviewers in the Annual Issue/ number? [optional feature]

Reasons for Publications in Predatory Journals

Apart from mandatory publications for career advancement becoming a major cause of the growth of predatory journals, there are a number of other reasons as well (Demir, 2018).

- Fear of job loss and the "publish-or-perish" pressure.
- Failure to publish in journals indexed in world recognized databases.
- Rejection by standard/respectable journals due to inadequate research skills .
- Competition among colleagues; desire to score higher and gain respect.
- Lack of awareness among researchers and new faculty members.

Battle against Predatory Journals

After taking strict cognizance of the unethical practices in publishing, the battle against predatory journals was initiated by Jeffrey Beall who worked as the Scholarly Communications Librarian and Associate Professor at Auraria Library University of Colorado Denver. He started a blog "List of Potential Predatory Journals and Publishers" in 2008, which was closed down in 2017 due to the controversies it evoked.

Kscien Organization for Scientific Research[9] Kurdistan has recruited a special committee consisting of 23 young researchers, to prepare the Kscien list of predatory journals. They are working to keep the

list up-to-date on a daily basis to expose current tactics of the predators and guide authors. Research is ongoing to provide more stringent criteria and objective evidence to overcome Beall's critics. Kscien's list[10] could help to fill the gap left by Beall's list (Kakamad, *et al*., 2020).

The Centre for Journalology,[11] an independent journalology centre, has been set up by the Ottawa Hospital, Research Institute, Canada. A group of experts conduct research and provide outreach on a wide range of journalology topics under the leadership of Dr. David Moher. The goal is to help enhance reporting quality of research in order to increase the value of biomedical research. The team is actively studying predatory journals to develop a one-stop shop of educational resources and tools related to predatory journals. Further, they aim to determine if and how work published in predatory journals goes on to be cited; and develop a digital journal authenticator tool that will provide users with information about the operations of any given journal. A number of publications related to predatory journals have been published by this group.

Cabell's Scholarly Analytics (Commercial Initiative)

Cabell's Scholarly Analytics, USA, publishes two products, *Journalytics* and *Predatory Reports* to universities and academic institutes. They have curated list of over 11,000 academic journals spanning 18 disciplines. Curation is based on 60 behavioural indicators, which keep the research community aware of predatory journals. Products by Cabells are accessible on subscription basis, and more information is available online.[12]

Indian Initiatives

Publication in predatory journals is on the rise in India and is being debated internationally. Efforts were made to find out number of predatory journals published in India (Seethapathy, *et al.*, *op. cit*.; Patwardhan, *et al*., 2018). The University Grants Commission (UGC), Delhi, a statutory body of the Government of India for Higher Education[13] established the Consortium for Academic and Research Ethics (CARE) in 2018 to combat predatory journals. The main objective of UGC-CARE[14] is to develop, manage, and update the UGC-CARE Reference List of quality journals (Patwardhan, 2019). Moreover, the quality mandate of UGC also implies that publications in predatory journals should not be accepted by any Higher Educational Institution (HEI) for any academic purpose (promotion, direct recruitment, supervisory role). Creating awareness about ethics in research and publications is on the UGC radar. In this direction UGC has made a two-credit course on "Research and Publication Ethics" compulsory for all Ph.D. students, to be completed in the first year of registration of a doctoral program. UGC also published a guidance document, "Good Academic Research Practices (GARP)" which offers recommendations for institutions to inculcate the culture of research integrity in particular institutions (Patwardhan, *et al.*, 2020).

Tips for Selecting Credible Journals

- ***Think.check.submit***[15]: This international, cross-sector initiative (members from COPE, DOAJ, OASPA, ISSN, etc.) helps researchers identify trusted journals and publishers for their research.
- ***Journal finder***: Many publishers provide help to researchers to find and select the appropriate journal relevant to their topic of research. For example Journal Finder by Elsevier,[16] Springer Journal Suggester,[17] Wiley Journal Finder.[18]

Worldwide Initiatives for Research and Publication Ethics

There are organizations worldwide which have set standards for publication ethics, research assessment, research metrics, and integrity of research. The prominent ones are:

- Committee on Publication Ethics (COPE), UK.[19]
- San Francisco declaration on research assessment (DORA).[20]
- Leiden manifesto for research metrics.[21]
- The metric tide.[22]
- The Hong Kong principles for assessing researchers: Fostering research integrity.[23]
- World Association of Medical Editors (WAME).[24]

Conclusion

Predatory journals exist solely for profit without any commitment to publication ethics or quality of research. They not only damage the reputation of individual researchers or institutions, but more dangerously, they contaminate scientific and other disciplines. Thus, the authenticity and credibility of research is at stake. The number of predatory publications with changing modalities is on the rise, which makes it very difficult to recognize them. The paper mills,[25] producing extremely convincing pseudoscientific texts, are proving a new challenge. This approach also makes it possible to have predatory preprint servers, which renders the predatory publishing scene more serious (Moore, 2020).

Therefore, it is important that every individual researcher takes serious cognizance of all the pitfalls of publishing in predatory journals and remains worthy of the ethical ethos that is the foundation of true scientific and academic endeavour.

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Endnotes

[1] https://royalsocietypublishing.org/journal/rstl.

[2] https://publicationethics.org/resources/discussion-documents/predatory-publishing.

[3] https://blog.cabells.com/tag/predatory-journals/.

[4] Journal Citation Report (JCR) published by Clarivate Analytics, lists the authentic Impact Factors of journals. Impact factor is based on two elements : the numerator, which is the number of citations in the current year to any items published in a journal in the previous two years, and the denominator, which is the number of substantive articles (source items) published in the same two years (https://www.cmaj.ca/content/161/8/979). Impact factor is one the measures which is being used for all academic assessment of individual faculty members.

[5] Standard Indexing databases list high quality, legitimate journals in a particular discipline. Such databases have stringent criteria for inclusion of journals and are updated at regular intervals. Web of Science, SCOPUS, PubMed, PsycInfo, Biological Abstracts, Chemical Abstracts, ERIC, AGRICOLA, etc.

[6] https://healthydebate.ca/2020/07/topic/dangers-of-predatory-publishing.

[7]https://scholarlykitchen.sspnet.org/2019/10/28/citation-contamination-references-to-predatory-journals-in-the-legitimate-scientific-literature/.

[8] https://predatory-publishing.com/will-publishing-in-predatory-journals-harm-your-cv/.

[9] http://kscien.org/.

[10] http://kscien.org/predatory.php.

[11] http://www.ohri.ca/journalology/.[12] https://www2.cabells.com.

[13] https:/ugc.ac.in/.

[14] http://ugccare.unipune.ac.in.

[15] https://thinkchecksubmit.org.

[16] https://journalfinder.elsevier.com/.

[17] https://journalsuggester.springer.com/.

[18] https://journalfinder.wiley.com/.

[19]http://publicationethics.org.

[20] https://sfdora.org/.

[21] https://www.leidenmanifesto.org/.

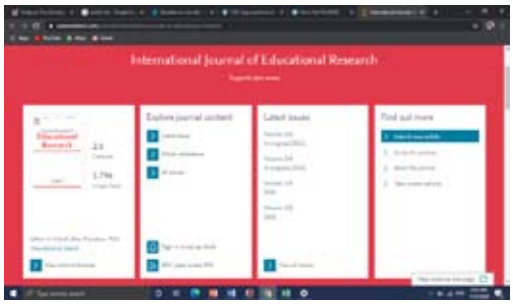
[22] https://responsiblemetrics.org/the-metric-tide/.

[23] https://osf.io/m9abx/.

[24] http://wame.org/.

[25] Paper mills: set-ups that essentially make money by "writing" bogus papers for bogus researchers – in the thousands, are coming up, producing amazingly convincing pseudoscientific texts (they even pass the Turing test). They cannot be detected using criteria for plagiarism, because – seemingly – they contain none (Moore, 2020, Sing. 2020).

Annexure: Examples of Different Types of Predatory Journals



Credible journal having international word in title

Name: *International Journal of Educational Research*
ISSN: 0883-0355
Publisher: Elsevier
Starting Year:1976
Language: English
Website:https://www.sciencedirect.com/journal/international-journal-of-educational-research

Predatory journal having international word in title

Name: *International Education and Research Journal*
ISSN: 2454-9916
Publisher: M/S. The Author's Journals
Starting Year: 2015
Language: English
Website: http://ierj.in/

Credible Journal (No Impact Factor)

Name: Wulfenia
ISSN: 1561-882X
Publisher: Regional Museum of Carinthia
Starting Year: 2012
Language: German
Website:https://landesmuseum.ktn.gv.at/wulfenia

Predatory Journal (False Impact Factor)

Name: WulfeniaJournal
ISSN: 1561-882X
Publisher: Landesmuseum Karnten, Museumgasse 2, Klagenfurt
Starting Year: 2017
Language: English
Website:http://www.multidisciplinarywulfenia.org/contact/index.html

Credible Journal

Name: *Jökull Research Journal*
ISSN: 0449-0576
Publisher: Iceland Glaciological Society
Starting Year: 1951
Language: Icelandic and English
Website: http://jokulljournal.is/

Hijacked Journal

Name: *Jökull Journal*
ISSN: 0449-0576
Publisher: NA
Starting Year: NA
Language: Icelandic, German and English
Website: http://www.jokulljournal.com

Credible Print Journal (Marathi)

Name: *MuktShabd*
ISSN: 2347-3150
Publisher: Mukta Shabd
Starting Year: 2010
Language: Marathi
Website : NA

Cloned online version

Name: *MuktShabd Journal*
ISSN: 2347-3150
Publisher: NA
Starting Year: 2020
Language: English & Hindi
Website:http://shabdbooks.com/

Credible journal

Name: *Journal of Shanghai Jiaotong University (Science)*
ISSN: 1007-1172
Publisher: Shanghai Jiao Tong University
Starting Year: 1996
Language: English
Website: https://www.springer.com/journal/12204

Cloned journal

Name: *Journal of Shanghai Jiaotong University*
ISSN: 1007-1172
Publisher: NA
Starting Year: 2005
Language: English
Website:https://shjtdxxb-e.cn/

CHAPTER 16

Mentoring for Enrichment of Core Academic Values

Shridhar R. Gadre

Introduction

The concept of mentoring has been existing for several centuries, although the word seems to have acquired its present meaning since the 18th century. It is supposed that the word 'mentor' itself originated from Greek mythology. Three important explanations for the word 'mentor' have been taken from three well-known sources (Merriam-Webster Dictionary, MacMillan Dictionary, and Encyclopaedia Britannica).

Merriam-Webster Dictionary gives the historical origin and the present definition of the word. "We acquired 'mentor' from the literature of ancient Greece. In Homer's epic *The Odyssey*, Odysseus was away from home fighting and journeying for 20 years. During that time, Telemachus, the son he left as a babe in arms, grew up under the supervision of Mentor, an old and trusted friend. When the goddess Athena decided it was time to complete the education of young Telemachus, she visited him disguised as Mentor and they set out together to learn about his father. Today, we use the word *mentor* for anyone who is a positive, guiding influence in another (usually younger) person's life."[2]

MacMillan Dictionary states, "The noun *mentor* dates from 1750 and came into English from French. ….In the first hundred years, or so of its use in English, *mentor* was written with a capital letter, marking its status as an eponym."[3]

The concept of mentoring is given in some more detail in Allen's entry in Encyclopaedia Britannica, which states: "Mentoring, professional relationship between two individuals, usually a senior and a junior employee in an organization, in which the senior employee teaches the junior employee about his job, introduces the junior employee to contacts, orients him to the industry and organization, and addresses social and personal issues that may arise on the job. The mentoring relationship is different from other organizational relationships (e.g., supervisor-subordinate) in that the mentoring parties may not formally work together, the issues addressed may include non-work matters, and the bond between mentor and protégé is usually closer and stronger than that of other organizational relationships."[4]

Vast literature is available on mentoring, in more recent times in the form of books as well as review articles (see Additional Readings). Here we are focusing on a few select aspects of mentoring in higher education. Of immense importance is to understand how mentoring of young students was done in ancient India and how the graduation addresses given to them brought out the core values. Although it is an Indian thought, it seems to have been forgotten and may be relevant even in modern times. This is followed by highlighting academic mentoring in more recent times, mainly from the 19th through to the 21st centuries, with several illustrative examples. Finally, we offer some practical suggestions for starting a mentoring programme for Ph.D. students and young faculty. These are only some preliminary thoughts for bringing value addition to our education system through a mentoring programme.

Mentoring in Ancient India

The early education system in India was based on young students living at a *gurukula* or *vihara* for a period of 8 to 10 years (Altekar, 1944). This education system made it essential for the *shishya* (student) to live in the same premises as his guru or teacher. Apart from imbibing religious knowledge, the students got trained in several other fields such as grammar, philosophy, martial arts, music, and painting. The guru was supposed to teach everything he knew to the student, without holding back any specialized knowledge. One of the most significant features of this system was that the student was staying away from his home, at the home of the teacher. Living under the guardianship of the guru and his family was helpful to tone down the pampered children and to inculcate a sense of discipline and compatibility. Students came from different social and economic classes and yet were under the influence of the family of the teacher, treated as equals. This way of life made the students self-reliant, resourceful, and well-trained to live in the world. Therefore, the guru was more than a teacher of a subject, represented a parent, and was also the role model, a friend, philosopher, and guide for the students. He was regarded in high reverence. For more details of the *gurukula* or *vihara* system, such as the admission procedure, fee structure/waivers, and the strengths and limitations of the system, we again refer to Altekar (*op. cit.*).

There was a lot to learn from the teacher, since books did not exist. All the knowledge was transmitted orally. A similar structure existed in the *guru-shishya parampara* (tradition) that existed in ancient times and still exists in some music or arts education systems in India. The guru was supposed to be very knowledgeable in his subject area. He was to continue his studies throughout his life. However, merely a deep scholarship was not an adequate qualification for a guru. He was expected to also have fluent delivery, readiness of wit, empathize with and understand his students, and can spontaneously explain the most difficult texts.

The relationship between the teacher and the student was that of a father and son according to both the Hindu and Buddhist traditions. Apart from taking care of the education, the teacher was supposed to watch the conduct of his student, take care of his health, food, and so on. If a student was sick, the guru was supposed to take care of him as he would take care of his son. This is how the mentor-protégé relationship was at its best in the *gurukula* and *vihara* system.

On the downside, the Hindu *gurukula* system admitted only students of the higher castes. Apparently, women were admitted during the very early ages. However, this tradition broke at some stage in history. In the Buddhist system, on the other hand, students of all castes as well as women were trained. Altekar gives a detailed discussion of the shortcomings of the system (*ibid*. Chapter XI). He also describes the mentoring system followed in ancient knowledge centres for higher education, such as Nalanda and Takshashila. The alumni of these famous institutions included eminent Kautilya, Chandragupta Maurya, Aryabhata, and Nagarjuna, to name a few, who no doubt, achieved eminence due to the excellent mentoring they must have received.

The core values inculcated in the medical students trained in the *gurukula* system are clearly reflected in the words of advice given to them on their graduation, given in the *Charaka Samhita* (Chapter 8). A few select statements have been freely translated into English and given here. For this purpose, I have used the original Sanskrit text and its translations as provided by Altekar (*ibid*.) and Acharya Yadavji Trikamji (2009).

- You should make a continuous and dedicated attempt to promote the health of your patients all the time. Do not neglect your patient even if your life is in danger.
- Do not entertain any evil thought about the wealth or wives of others. Your attire and appearance should be modest, not fancy. Your speech should be gentle, virtuous, assuring, upright and concise.

- Taking into consideration the facts about the place and the time, you should make continuous and deliberate efforts to enhance your knowledge and excellence of instruments.
- Do not give medicine to the patients if you are sure that their disease is certainly incurable, also to those who are about to die or to women if their relatives are not present. Do not accept any fees from ladies without the permission of their husbands or relatives.
- When you enter a patient's room, focus all your attention on the patient, his/her expression, movements, and medicines, and not on anything else. You must treat all information about the patient and his/her family as strictly confidential.
- If there is a danger of the patient or his/her relatives receiving a shock, you should not divulge about the impending death of the patient, even if you are aware of it. Do not boast of your knowledge even though you are knowledgeable.

An excerpt from what may be described as a graduation address to Graduates in Taittiriya Upanishad (11th Anuvak; 1-4) is paraphrased here (Swami Sharvananda,1921):

- Speak the truth. Carry out your duty ethically. Do not neglect your daily studies.
- Do not swerve from the truth. Do not swerve from duty.
- Reckon your mother as a veritable god. Reckon your father as a veritable god.
- Reckon your teacher as a veritable god. Reckon your guest as a veritable god.
- Do not neglect what is useful. Do not miss opportunities to achieve prosperity.
- Do not neglect the daily duties of teaching and learning.
- Emulate only good deeds of ours, not others. Follow only good characters of ours, not others.
- Whatever is to be given as a donation, should be given gracefully, with joy, with modesty, with fear and with kindness.
- Thus, conduct yourself. This is the commandment. This is the teaching. This should be observed and verily this should be observed.

These graduation addresses reflect many core values, and with some modifications, are valid even in modern times. Apart from basic guidelines about ethical and professional behaviour, they emphasize the effort that needs to be made for continuous engagement in teaching and learning and also for the enhancement of knowledge. How the efforts were made to inculcate these core values in the ancient Indian education systems is available in documents about them (Altekar, *op. cit.*).

Mentoring in Recent Times

After an insight to mentoring in ancient India, it is useful for us to have a glimpse at mentoring in more recent times, especially over the last two centuries.

Several books, review articles and research papers are available on the subject of mentoring in the last two centuries (see Additional Readings). Here we can view the topic through examples, experiences, and thoughts on mentoring of many eminent personalities during the 20th and 21st centuries.

Thoughts of Rabindranath Tagore

The great Indian poet, philosopher, and artist, Rabindranath Tagore, a Nobel laureate in literature, stressed that the best education can only be imparted by the teacher. Rabindranath Tagore thought

that the teacher should become the role model for his/her students. In his opinion, the teacher should never be strict. Instead, a teacher should always be a mentor as well as a guide for the students.

Tagore also stressed the need for continuous learning by the teacher. In his own words, "A teacher can never truly teach unless he is still learning himself. A lamp can never light another lamp unless it continues to burn its own flame. The teacher, who has come to an end of his subject, who has no living traffic with his knowledge, but merely repeats his lessons to his students, can only load their minds; he cannot quicken them." (Prasad, 2006). In the early 20th century, Tagore's thinking on education was a combination of the ancient Indian system and the modern scientific attitude (for example, towards the education of girls, co-education and so on). With this rare combination as the motivation, he started a new model educational institution, Shantiniketan, on December 22, 1901.

Mentoring Experiences of Nobel Laureates

It is normally found that behind every Nobel laureate, there is a mentor! A short summary (See the Table in the Appendix), presents some case studies of Nobel laureates in sciences and economics, listing out their respective mentors, who helped them choose the right path. It is indeed instructive to go through their individual mentoring experiences and observations from their review articles, Nobel Lectures or Memoires. A citation from the Nobel laureate Hans Krebs is given here as an example:

"Association with a leading teacher almost automatically brings about a close association with outstanding contemporaries of the pupil because great teachers tend to attract good people. Students at all levels learn as much from their fellow students as from their seniors" (Krebs, 1967). Nobel laureate Venkataraman Ramakrishnan, cited two experiences about his getting mentored at the MRC Laboratory of Molecular Biology. After joining the laboratory, it took him several days to realize that the regular breaks from laboratory work, to have meals or coffee or tea are important. These breaks allowed scientists to get together informally, at the canteen on the top floor, and talk and share ideas. He noted that the human mind could remain fully focused for a couple of hours at a time. The tea/coffee/lunch breaks indeed re-energized the scientists.

The other lesson he learnt is given here in his own words: "Even very famous scientists would ask questions at seminars that were often trivial to people in the field. It reinforced in me the feeling that ignorance is not something to be ashamed of, and that no question is too stupid to ask if you want to know the answer" (Ramakrishnan, 2009).

Mentoring Experience of Narayana Murthy

In 2018, Professor H. V. Sahasrabuddhe's (HVS) 75th birthday was celebrated in Pune, with Mr. Narayana Murthy, then the CEO of Infosys, being the chief guest. In 1969, when Murthy faced the dilemma of choosing between a high paying job *versus* learning the "cutting edge" technology, HVS had advised the undecided Murthy to prefer learning over salary.

Murthy said that while he was studying for M. Tech. in Computer Science at IIT-Kanpur, his batch-mates, including himself, were offered jobs in 1969 by companies such as Telco, Tisco, HMT and Air India. When Murthy met Professor Krishnayya of IIM, Ahmedabad (IIMA), and got a job offer, the latter told him about the modern, time-sharing mini-computer that he was going to install and that IIMA would be the third business school to do so after Harvard and Stanford. Murthy was advised by some of his hostel friends to talk to somebody of their generation. He told HVS (who had completed his Ph. D. in 1968) that the only catch was that the job offered by Krishnayya paid only Rs. 800. HVS

replied, "If I were you, I will focus on learning." It was a nudge in the right direction. Taking this job at a salary of Rs. 800 a month was the best decision of Murthy's life.[5] Murthy's mentors at the crucial juncture were his friends at the hostel and HVS!

Krishnayya was the person who influenced Murthy the most. He taught the team how important it was to aspire and the team members used to work 20 hours a day. The team designed and implemented a basic interpreter for ECIL. During his stay at IIMA, Murthy learnt that it is not the theory but application of the theory to solve problems, which makes a difference to society. Murthy acknowledges that the decision to join Krishnayya, coupled with his training at IIMA and the opportunity to develop an operating system for an airport in Paris indeed helped him in setting up Infosys.

Two Main Shortcomings of the Indian Higher Education System

An article by Narayana Murthy, published by IIMA, about 11 years ago, captured the Indian science scenario quite aptly in the following words: "In addition to new funding mechanisms, India must improve its recruiting process and the mentoring of young faculty. In the past, Indian Institutes and Universities had significant amount of inbreeding, with former students returning to their prior establishments as faculty members, in sometimes less than fully-open searches. While this practice is diminishing, Institutes/Universities must continue to improve their searching/hiring strategies to bring in the best candidates. Besides, newly hired faculty must learn the necessary skills to become successful, such as choosing good research problems and managing their laboratories" (Vale and Dell, 2009).

Unfortunately, not many concrete steps have been taken in the last 11 years to alleviate these problems. Few simple steps need to be taken for initiating a well-planned mentorship programme for Ph. D. students as well as young assistant professors. It is meant for execution in colleges and universities in India, which account for large manpower in academics in the country.

Suggestions for a Future Mentoring Programme in India

A new mentoring programme in colleges and universities in India must be initiated. As mentioned earlier, many books exist on various aspects of mentoring and detailed research works exploring many new facets of the subject. Apart from face-to-face mentoring, another possibility, viz. *E-mentoring* has emerged with the advent of the Internet and mobile phones, wherein the interaction between *mentors* and protégés can happen in two ways. It can be synchronous, for example, while interacting via a video/audio call, chat, or an online lecture. The communication can also be asynchronous, such as a pre-recorded video lecture, the use of emails or forums where there may be some time lag, say minutes to hours, between sending and receiving messages. UGC's publication on Good Academic Research Practices (GARP) presents a detailed and critical discussion of the advantages and limitations of E-mentoring.[6]

It will be worthwhile to embark upon mentoring programmes for Ph.D. students, and young faculty recruited during the last two or three years in all academic institutions governed by UGC and AICTE, for example, in colleges and universities. Mentoring programmes for students in several IITs already exist, although the performance analysis of these programmes is not publicly available. Numerous studies on mentoring have been globally reported for the past 50 or more years. Some important observations from these studies suggest a pragmatic approach for going further.

In a study published several years ago (Berg and Ferber, 1983), it was reported that students and faculty seem to relate more 'comfortably' with persons of the same gender, but with a small pool of

women faculty, women students were at a clear disadvantage in finding mentors. This situation seems to have changed as far as the college and university scenario in India is concerned. Probably now we have a sufficient senior women faculty who can serve as mentors, although in some disciplines their number may not be adequate even today.

A detailed survey-based study (Sands, *et al.*, 1991), revealed that only about a third of graduate students and assistant professors were mentored by a colleague at the university in which the study was conducted. The largest proportion of mentors described by male and female protégés in this study were full professors. Another noteworthy observation was that mentoring between faculty seemed to be a voluntary arrangement. Departments rarely assigned mentoring relationships. The article also pointed out that mentoring of young faculty by senior faculty of the same department faced some problems. The protégés found themselves in an unequal and vulnerable position in relation to the persons who, sometime in the future, may be making decisions about their promotion, etc. This is indeed a valid point and needs to be addressed in the suggestions for future mentoring programmes.

The essential qualities of a mentor: A mentor should be an established person in his profession; possess core values, and be able to spare his/her time for this noble cause. The mentor has to be inclusive and interested in continual learning. Unfortunately, there is no instrument to measure these qualities and therefore objectivity in choosing mentors is a crucial part of the mentorship programme for the Ph.D. students and young faculty. This commitment should be for at least two years. Preliminary suggestions for formulating the guidelines of a nationwide mentorship programme under the auspices of the UGC and AICTE are given below.

1. The programme will be open to all the Ph.D. students during the first two years after registration as well as to the recently recruited young assistant professors working in Indian colleges and universities. Participation will be voluntary and with the approval of the research supervisor and the head of the concerned department as applicable. A protégé will have two mentors: an alumnus mentor and a faculty mentor. He/she will receive mentoring for two years after being admitted to the programme, typically for one session of two hours every month from each mentor.
2. The alumni mentors will be selected from the senior, distinguished alumni of the concerned department. Most college and university departments, which are active in research, have produced many Ph. Ds who have reached top positions in academia, industry, or other walks of life. Many of them retain a sense of attachment to their *alma mater* and are willing to spare their time for it. However, we have not made any systematic attempt to seek their contribution for furthering the standards of our academic departments in colleges and universities in India. Each department needs to compile a list of the distinguished, senior alumni who are physically active and are willing to spare two hours of their valuable time every month for mentoring one or two protégés assigned to them. The desirous alumni should be requested to submit a statement of interest with a one-page CV and all contact details.
3. Active and retired faculty members from a college/university should be similarly selected. In this way, a central pool of academic mentors can be made after careful selection, based on academic experience and research achievements, keeping the criterion of inclusiveness in mind.
4. The lists and CVs of the selected mentors can then be made available to the Ph.D. students and young faculty. They will select one or two mentors each from the two lists with the advice of their Ph.D. supervisor and a senior professor or the head of the department (HOD) respectively. The mentor will select two or three protégés from the list and work with them for the next two years. There will not be more than three protégés working with a mentor at any time.

5. The mentors will make efforts to enhance the core academic value of their protégés, conduct group discussions, facilitate short presentations by the protégés, etc. They may advise their protégés regarding writing research projects, enhancing their language skills, and sensitize them about plagiarism, predatory journals, and conferences, among other important aspects. UGC has taken some very concrete steps in this direction in the last three years (UGC-CARE[7] and UGC-GARP[8]). Another significant step is the association of a mentor with the colleges supported by the UGC Scheme for Trans-disciplinary Research for India's Developing Economy, the STRIDE programme. The Indian Academy of Sciences (IASc),[9] Bengaluru and the Indian National Science Academy (INSA),[10] New Delhi have also published excellent documents on scientific and ethical values. Mentors may use these guidelines while imparting training. Mentors may also be able to provide emotional support to the newly admitted Ph.D. students and newly recruited young faculty. A one-page report of each monthly session may be electronically uploaded (on a website constructed for this purpose by the department) by the protégés and vetted by the respective mentor.
6. The monthly face-to-face interaction of the protégés with their mentors will go a long way in nurturing their academic values. In such interaction, non-verbal communication also plays a very important role. Such face-to-face interactions could be effectively supplemented and complemented by interaction through email, SMS, and social media. One or two such short interactions per week would add value to the mentorship programme. Excessive interactions would make the protégés overtly dependent on the mentors. The mentors may also recommend additional lectures available for viewing and listening for further information.
7. An added advantage of having alumni mentors is that they will be able to interact also with the existing faculty of a department and with the supervisors of the protégés. If mutually agreed, their services could be used by a department for other academic purposes. The alumni have been left out from our educational system for too long. We have been thinking about them mostly as a financial resource. It would be a good idea to let our Ph.D. students and young faculty reap the benefit of the knowledge and wisdom of the alumni as well as senior faculty mentors.
8. Such mentorship programmes may be run with minimal finances, for example, by providing local travel allowance and a small sitting fee only to the alumni mentors. Mentoring ensures mutual benefits. For the mentor, it is a great gain that he/she comes in contact with active, young minds and gathers the valuable experience of mentoring.

Conclusion

While a short account of the mentoring system in ancient India through the *gurukula* and *vihara* has been given here, the advice to the medical graduates given in *Charak Samhita*, in particular, as well as the one to general graduates in *Taittiriya Upanishad*, reflect the core academic values even in modern times. It is not surprising that the former shows many similarities with the core values reflected in the Hippocratic oath[11] and also its modern version.[12] Of course, some changes are required in the core values discussed in the ancient literature to reflect the social changes that have taken place during the last 2000 to 2500 years.

The case studies covering eminent mentors and their protégés highlight the important role the mentors have played in shaping the lives and careers of the protégés. With this background, future mentoring programmes for Ph.D. students and young faculty have been suggested. These are based on some guidelines available from the literature studies or experience. Such a program cannot be made compulsory. Making it compulsory and associating it with the indices such as academic performance index (API) would result in losing its value.

In India, the teacher-training programmes have been running through refresher or orientation courses for the past 30 or more years. Coupling them with API has made them highly ineffective. The steady effort of an academic mentoring programme, spread over two or more years for every young faculty as well as Ph.D. student, if implemented with sincerity, will prove to be very fruitful.

Dedication

This article is dedicated to the memory of my two mentors: Professor P.T. Narasimhan (Indian Institute of Technology, Kanpur, my Ph.D. supervisor) and Professor Robert G. Parr (University of North Carolina at Chapel Hill, U.S.A., my post-doctoral supervisor). They were immensely instrumental in inculcating core academic values in several doctoral and postdoctoral students like me.

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Appendix

Table: Some famous mentors and the respective protégés in physics, chemistry, computer science, biology and economics.

Mentor	Protégé
Andy Van Dam (1938–), professor of computer science, who invented the hypertext system	Famous American professor of computer science and author of the "Last Lecture: Achieving Your Childhood Dream", Randy Pausch (1960–2008)
Eminent physicist, J. J. Thomson (1856–1940), Nobel laureate in physics	New Zealand physicist and father of nuclear physics, Ernest Rutherford (1871–1937), Nobel laureate in physics. In turn, Rutherford mentored the future Nobel laureates Niels Bohr, James Chadwick and Francis Aston, among others.
Harold Johnston (1920–2012), chemistry professor, Stanford University and University of California, Berkeley	Dudley R. Herschbach (1932–), professor of chemistry, Harvard University, Nobel laureate in chemistry, 1986
Hartog Jacob Hamburger (1859–1924), a physiology Professor at the University of Groningen	Albert Szent Gyorgi (1893–1986), Nobel laureate in physiology and medicine, 1937
Sydney Brenner (1927–2019), British researcher and the Nobel laureate in physiology and medicine, 2002	H. Robert Horvitz (1947–), MIT professor and Nobel laureate in physiology and medicine, 2002
Richard Stone (1913–1991), Economics Nobel laureate, 1984	Angus Deaton (1945–), Economics Nobel laureate, 2015

Overview of CARE

Archana Thakur

The first and foremost requirement in quality education is educational or academic integrity along with the culture of value orientation and ethical practises in all around activities performed within any institution of higher education. The ancient Universities of Takshashila and Nalanda, which were global centres of higher education in India were known for their quality education. They followed the model of interactive residential education where the initial step was building a bond between the teacher and the student, that is, *guru and shishya*, through series of dialogues for inculcating universal values and for character building. The Indian education system has evolved through multiple phases from the ashram-based *gurukul* to the university-based *kulaguru* system. Rediscovering virtues and learning from the glorious past of the Indian education system can help us to pave the way towards a bright future. In the words of Swami Vivekananda, "We want that education by which character is formed, strength of mind is increased, the intellect is expanded, and by which one can stand on one's feet."

The increased incidence of compromised publication ethics and academic integrity is a growing problem, contaminating all domains of research. Unethical practises are leading to an increased number of dubious journals across the globe. In India, the percentage of research articles published in predatory journals his high. Unethical practices leading to the "pay and publish trash" culture need to be foiled straightaway. Research and innovation involves rigorous scientific efforts in the quest of new knowledge contributing to the global standards in publications. Plagiarism should be stopped from scientific research in order to safeguard ethics and integrity. Dr. Sarvepalli Radhakrishnan, one of the greatest philosophers of recent times stated that to help students to earn a living is one of the functions of education but education according to Indian tradition is not merely a means of earning or living it; is initiation into the spiritual life, a training of the human soul in pursuit of truth, and the practice of virtue. He also said, "All education is, on the one side, a search for truth, on the other side it is pursuit of social betterment."

Background

A Standing Committee was constituted by the University Grants Commission (UGC) for the purpose of identifying journals in different domains of knowledge and prepare a list of UGC-approved journals. The Standing Committee developed filtering criteria for the inclusion of journals in the UGC-approved list of journals. After careful analysis as per the criteria, the list of journals, approved by UGC, was uploaded on the UGC website for stakeholders. It was agreed to upload all the Journals listed in the Web of Science, Scopus, and Indian Citation Index on the UGC website.

Predatory Journals to be Removed as and When Identified

The Committee observed that a number of sources of predatory journals were identified. It was recommended that these sources of predatory journals be used as an indicator of predatory journals, however, every journal, except for those covered by Web of Science or Scopus, should go through the filter defined by the Standing Committee for inclusion in the UGC-approved list of journals. The Committee authorized UGC to remove journal titles found predatory/-questionable in the UGC-approved List of Journals as soon as they were identified, based on the filtering criteria identified by the Standing Committee. It was also resolved that every journal, except those that are covered by Web

of Science or Scopus, to go through the filter defined by the Standing Committee for inclusion in the UGC-approved list of journals.

With a view to redefine and consider issues related to the UGC-approved list of journals and as a part of the "Quality Mandate" of the UGC, emphasizing the importance of promoting high-quality research and the creation of new knowledge by faculty members, the Commission in its 536th meeting held on November 14, 2018, dissolved the Standing Committee for "UGC-approved list of Journals" and approved the constitution of the Consortium for Academic and Research Ethics (CARE) for the preparation of a new list of credible quality journals for disciplines such as, Social Science, Humanities Languages, Arts, Culture, and Indian Knowledge System. The main tasks of CARE are :

- To promote the quality research by the faculty members and creating credible research.
- To promote academic and research integrity as well as publication ethics.
- To promote high quality publications in reputed journals that would help in achieving higher global ranks and overall improvement of the quality of research and education.
- To develop an approach and methodology for the identification of good quality journals.
- To prevent publications in dubious/sub-standard journals, which reflect adversely and tarnish the image of research work and thus lead to long-term academic damage.
- To create and maintain a "CARE Reference List of Quality Journals" for various academic evaluations.

CARE Members

UGC-CARE comprises Statutory Councils/Academies/Government bodies in Social Sciences, Humanities, Arts and Fine Arts, Science, Medical, Agriculture, Engineering and the Association of Indian Universities (henceforth referred to as CARE members) and Regional Universities identified by the UGC (henceforth referred to as CARE Universities).

CARE Councils

CARE councils includes relevant Government Statutory Councils and Academic Bodies from multiple disciplines.

CARE Universities

- Jawaharlal Nehru University (JNU), New Delhi (Northern Region)
- The Maharaja Sayajirao (MS) University of Baroda, Vadodara (Western Region)
- University of Hyderabad, Hyderabad (Southern Region)
- Tezpur University, Tezpur, Assam (Eastern Region)

UGC Cell for Journal Analysis

Savitribai Phule Pune University (SPPU) has been entrusted the responsibility of journal analysis and the UGC has established a "Cell for Journals Analysis" at SPPU, Pune (UGC cell, SPPU). INFLIBNET Centre, Gandhinagar, will serve as supporting agency. UGC Cell at SPPU shall function under the supervision of CARE Empowered Committee (CARE-EC).

CARE List

Research journals from all disciplines indexed in Scopus (Source list) or Web of Science (Arts and Humanities Citation Index Source Publication, Science Citation Index Expanded Source Publication, Social Science Citation Index Source Publication) are globally accepted as quality journals and considered for all academic purposes. The CARE List, therefore, includes journals indexed in Scopus and/or Web of Science. Apart from these, a list of journals especially from disciplines of Arts, Humanities, Languages, Culture and Indian Knowledge Systems is prepared. EC-CARE, established by UGC, monitors the process to create and maintain the CARE List.

UGC-CARE comprises following two groups:

UGC-CARE List Group I

Journals found qualified through UGC-CARE protocols

UGC-CARE List Group II

Journals indexed in globally recognized databases

Process For the Submission of New Journal Title/s

1) *Universities and Colleges*

Only teaching faculty from universities can recommend the journals following the prescribed submission process. Recommendations of journal title/s shall be routed through universities and colleges as follows:

- ***Universities***: The Internal Quality Assurance Cell (IQAC) of the University may recommend journal title/s to the respective regional UGC-CARE University.
- ***Affiliated colleges***: College IQAC cell may recommend journal title/s if found suitable to the parent university's IQAC cell. The Parent university IQAC cell may forward the recommended journal title/s if found suitable to respective regional UGC-CARE University.

2) *Individuals*

Anyone can recommend a journal title/s to a UGC-CARE University through the IQAC cell of the nearest college or university only by following the prescribed submission process with the recommendation of the teaching faculty.

3) *Publishers*

Publishers can submit journal title/s through the IQAC Cell of an affiliated college/ IQAC cell of the university by following the prescribed submission process with the recommendation of the teaching faculty.

Procedures to be Followed By UGC-CARE Universities/Council Members

1. Each UGC-CARE University should follow the procedure given below to add journal title/s received from universities/colleges/individuals/publishers from its region.

- Evaluate the journal as per UGC-CARE protocol Part II: Primary Criteria.
- If found suitable submit the necessary information through CARE portal.

2. Each UGC-CARE Council member should follow the procedure given below to add journal title/s.
    - UGC-CARE Council member should validate the academic quality of journal title/s and must state reasons for the recommendation.
    - If found suitable, members shall submit the basic information about the journal title/s on the UGC-CARE portal.

Procedure for the Selection and Addition/Inclusion of Journal Title/s

Every title submitted by UGC-CARE Council members and UGC-CARE Universities, will be analysed by the UGC Cell at SPPU, as per the protocols for journal analysis approved by the Empowered Committee of UGC-CARE. A stringent methodology is adopted for analysing new titles. It consists of three parts:

- UGC-CARE Protocol Part I: Basic Information
- UGC-CARE Protocol Part II: Primary Criteria
- UGC-CARE Protocol Part III: Secondary Criteria

UGC-CARE Protocol Part I : Basic Information

Part I of the analysis protocol is designed to obtain basic information about the journal (given below) from universities/colleges/individuals or publishers:

1. Journal title
2. Journal broad discipline and focus subject
3. Name of publisher
4. Country of origin and registered address
5. Journal language/s
6. Publishing frequency
7. Editor name, editorial office address, phone, email, and website
8. Current status (date of last publication) (print/ online/ both)
9. ISSN/ eISSN
10. Other registrations/ memberships such as RNI/ COPE/ UGC-CARE

Parts II and III of the protocols are to be used for internal analysis and assessment purposes, which include due diligence, verification process, and critical appraisal using the sequential algorithmic elimination process and weightage-based metrics on a scale of 10.

Updating of the UGC-CARE List

The UGC-CARE List is dynamic. It is updated quarterly, on the first of January, April, July, and October (or on the next working day if there is a public holiday on these dates) every year.

The link for the CARE website is: https://ugccare.unipune.ac.in.

COMMITTEE ON PUBLICATION ETHICS (COPE)

Guidelines on Good Publication Practice

Why the Guidelines were Developed

1. The Committee on Publication Ethics (COPE) was founded in 1997 to address breaches of research and publication ethics. This is a voluntary body providing a discussion forum and advice for scientific editors, aimed to find practical ways of dealing with the issues, and to developing good practice.
2. We thought it essential to attempt to define best practice in the ethics of scientific publishing. These guidelines should be useful for authors, editors, editorial board members, readers, owners of journals, and publishers.
3. Intellectual honesty must be actively encouraged in all medical and scientific courses of study and used to inform publication ethics and prevent misconduct. It is with that in mind that these guidelines have been produced.
4. Details of other guidelines on the ethics of research and published codes of conduct are listed in the Appendix.

How the Guidelines were Developed

The guidelines were developed from a preliminary version drafted by individual members of the committee, which was then submitted to extensive consultation. They address: study design and ethical approval, data analysis, authorship, conflict of interests, the peer review process, redundant publication, plagiarism, duties of editors, media relations, advertising, and how to deal with misconduct.

Purpose of the Guidelines

These guidelines are intended to be advisory rather than prescriptive, and to evolve over time. We hope that they will be disseminated widely, endorsed by editors, and refined by those who use them.

Study Design and Ethical Approval

Definition

Good research should be well justified, well planned, appropriately designed, and ethically approved. To conduct research to a lower standard may constitute misconduct.

Action

1. Laboratory and clinical research must be driven by protocol; pilot studies need a written rationale.
2. Research protocols have to seek answers to specific questions, rather than just collect data.
3. All contributors and collaborators, and if appropriate, the participants, must carefully agree on the protocols.

4. The final protocol should form part of the research record.
5. The precise roles of the contributors and collaborators, and matters of authorship and publication, should be agreed upon at the earliest.
6. Statistical issues should be considered early in study design, including power calculations, to ensure that there are neither too few nor too many participants.
7. Formal and documented ethical approval from an appropriately constituted research ethics committee is required for all studies involving people, medical records, and anonymized human tissues.
8. Using human tissues in research has to conform to the highest ethical standards, such as those recommended by the Nuffield Council on Bioethics.
9. Always seek fully-informed consent. It may not always be possible, however, and in such circumstances, an appropriately constituted research ethics committee must decide if this form of research is ethically acceptable. [please confirm, instead of saying 'this']
10. When participants are unable to give fully-informed consent, research should follow international guidelines, such as those of the Council for International Organizations of Medical Sciences (CIOMS).
11. Experiments with animals require full compliance with local, national, ethical, and regulatory principles, and local licensing arrangements. International standards vary.
12. Formal supervision, usually the responsibility of the principal investigator, is essential for all research projects: this must include quality control, and the frequent review and long-term retention (may be up to 15 years) of all records and primary outputs.

Data Analysis

Definition

Data must be appropriately analysed, but inappropriate analysis does not necessarily amount to misconduct. Fabrication and falsification of data do constitute misconduct.

Action

1. All sources and methods used to obtain and analyse data, including any electronic pre-processing, must be fully disclosed; detailed explanations should be provided for any exclusions.
2. Methods of analysis must be explained in detail, and referenced, if they are not in common use.
3. The post-hoc analysis of subgroups is acceptable, but it must be disclosed. Failure to disclose that the analysis was post-hoc is not acceptable.
4. The discussion section of a paper should mention any issues of bias which have been considered and explain how they have been dealt with in the design and interpretation of the study.

Authorship

Definition

There is no universally agreed definition of authorship, although attempts have been made (see Appendix). As a minimum, authors have to take responsibility for a particular section of the study.

Action

1. Authorship has to balance the intellectual contributions to the concept, design, analysis, and writing of the study against collecting data and other routine work. If there is no task that can reasonably be attributed to a particular individual, then that individual should not be credited with authorship.
2. To avoid disputes over attributing academic credit, it is helpful to decide early in the planning of a research project who will be credited as authors, as contributors, and who will be acknowledged.
3. All authors must take public responsibility for the content of their paper. The multidisciplinary nature of much research can make this difficult, but this can be resolved by disclosing individual contributions.
4. In the light of current uncertainties, it is advisable to carefully read the "Advice to Authors" of the target journal.

Conflicts of Interest

Definition

Conflicts of interest comprise those, which may not be fully apparent, and which may influence the judgement of authors, reviewers, and editors.

They have been described as those which, when revealed later, would make a reasonable reader feel misled or deceived.

They may be personal, commercial, political, academic, or financial.

'Financial' interests may include employment, research funding, stock or share ownership, payment for lectures or travel, consultancies and company support for staff.

Action

1. Researchers, authors, and reviewers must declare such interests, where relevant, to the editors.
2. Editors should also disclose relevant conflicts of interest to their readers. If in doubt, disclose. Sometimes editors may need to withdraw from the review and selection process for the relevant submission.

Peer Review

Definition

Peer reviewers are external experts whom the editors choose, to provide written opinions, with the aim of improving the study.

The working methods vary from journal to journal, but some use open procedures in which the name of the reviewer is disclosed, together with the full or 'edited' report.

Action

1. Authors' suggestions as to who might act as reviewers are often useful, but editors are not obliged to use those suggested.

2. Expert reviewers must maintain confidentiality in assessing a manuscript, and this extends to reviewers' colleagues who may be asked (with the editor's permission) to give opinions on specific sections.
3. The submitted manuscript must not be retained or copied.
4. Reviewers and editors must not make any use of the data, arguments, or interpretations, unless they have the authors' permission.
5. Reviewers need to provide speedy, accurate, courteous, unbiased, and justifiable reports.
6. If reviewers suspect misconduct, they should write, in confidence, to the editor.
7. Journals should publish accurate descriptions of their peer review, selection, and appeals processes.
8. Journals should also provide regular audits of their acceptance rates and publication times.

Redundant Publication

Definition

Redundant publication occurs when two or more papers, without full cross reference, share the same hypothesis, data, discussion points, or conclusions.

Action

1. Published studies do not need to be repeated unless further confirmation is required.
2. Previous publication of an abstract during the proceedings of meetings does not preclude subsequent submission for publication, but full disclosure should be made at the time of submitting a paper.
3. Re-publication of a paper in another language is acceptable, provided there is full and prominent disclosure of its original source at the time of submission.
4. At the time of submission, authors should disclose details of related papers, even if in a different language, and similar papers in press.

Plagiarism

Definition

Plagiarism ranges from the unreferenced use of others' published and unpublished ideas, including research grant applications, to submitting under 'new' authorship of a complete paper, sometimes in a different language.

It may occur at any stage of planning, research, writing, or publication: it applies to both print and electronic versions.

Action

1. All sources should be disclosed, and if large amounts of other people's written or illustrative material are to be used, permission has to be taken.

Duties of Editors

Definition

Editors are the stewards of journals. They usually take over their journal from the previous editor(s) and always want to hand over the journal in good shape.

Most editors provide direction for the journal and build a strong management team.

They must consider and balance the interests of many constituents, including readers, authors, staff, owners, editorial board members, advertisers, and the media.

Actions

1. Editors' decisions to accept or reject a paper for publication should be based only on the paper's importance, originality, and clarity, and the study's relevance to the merit of the journal.
2. Studies that challenge works previously published in the journal should be given an especially sympathetic hearing.
3. Studies reporting negative results must not be excluded unless reviewed properly.
4. All original studies should be peer reviewed before publication, considering all possible bias due to related or conflicting interests.
5. Editors must treat all submitted papers as confidential.
6. When a published paper is subsequently found to contain major flaws, the editors must accept responsibility and ensure correcting the record prominently and promptly.

Media Relations

Definition

Medical research findings are of increasing interest to the print and broadcast media.

Journalists may attend scientific meetings at which preliminary research findings are presented, leading to their premature publication in the mass media.

Action

1. Authors approached by the media should give as balanced an account of their work as possible, ensuring that they point out where evidence ends, and speculation begins.
2. Simultaneous publication in the mass media and a peer-reviewed journal is advised, as this usually means that enough evidence and data have been provided to satisfy informed and critical readers.
3. Where this is not possible, authors should help journalists to produce accurate reports, but refrain from supplying additional data.
4. Authors must make all efforts to ensure that they inform all patients, who have helped with the research, of the results before the mass media, especially if there are clinical implications.
5. Organizers of scientific meetings must advise authors if journalists are attending the meetings.
6. It may be helpful to authors to be advised of any media policies operated by the journal in which their work is to be published.

Advertising

Definition

Many scientific journals and meetings derive significant income from advertising. Reprints are also lucrative.

Action

1. Editorial decisions must not be influenced by advertising revenue or reprint potential: editorial and advertising administration must be clearly separated.
2. Advertisements that mislead must be refused, and editors must be willing to publish criticisms, according to the same criteria used for material in the rest of the journal.
3. Reprints should be published as the original paper appears in the journal unless a correction is to be added.

Dealing with Misconduct

Principles

1. The general principle confirming misconduct is the intention to make others believe or regard that which is untrue, as true.
2. Examining misconduct must therefore focus, not only on the particular act or omission, but also on the intention of the researcher, author, editor, reviewer, or publisher involved.
3. Deception may be deliberate, by reckless disregard of possible consequences, or by negligence. It is implicit, therefore, that "best practice" requires complete honesty, with full disclosure.
4. Codes of practice may raise awareness but can never be exhaustive.

Investigating Misconduct

1. Editors should not simply reject papers that raise questions of misconduct. They are ethically obliged to pursue the case. However, knowing how to investigate and respond to possible cases of misconduct is difficult.
2. COPE is always willing to advise, but for legal reasons, can only advise on anonymized cases.
3. It is for the editor to decide what action to take.

Serious Misconduct

1. Editors must take all allegations and suspicions of misconduct seriously, but they must recognize that they do not usually have either the legal legitimacy or the means to conduct investigations into serious cases.
2. The editor must decide when to alert the employers of the accused author (s).
3. Some evidence is required, but if employers have a process for investigating accusations — as they are increasingly required to do — then editors do not need to assemble a complete case. Indeed, it may be ethically unsound for editors to do so because such action usually means consulting experts, so spreading abroad serious questions about the author (s).

4. If editors are presented with convincing evidence — perhaps by reviewers — of serious misconduct, they should immediately pass this on to the employers, notifying the author(s) that they are doing so.
5. If accusations of serious misconduct are not accompanied by convincing evidence, then editors should confidentially seek expert advice.
6. If the experts raise serious questions about the research, then they should notify the employers.
7. If the experts find no evidence of misconduct, the editorial processes should proceed in the normal way.
8. In the case of medical journals or papers, if presented with convincing evidence of serious misconduct, where there is no employer to whom this can be referred, and if the author(s) are registered doctors, cases can be referred to the General Medical Council.
9. If, however, there is no organization with the legitimacy and the means to investigate, then the editor may decide that the case is sufficiently important to warrant publishing something in the journal. Legal advice will then be essential.
10. If editors are convinced that an employer has not conducted an adequate investigation of a serious accusation, they may feel that publication of a notice in the journal is warranted. Legal advice will be essential.
11. Authors should be given the opportunity to respond to accusations of serious misconduct.

Less Serious Misconduct

1. Editors may judge that it is not necessary to involve employers in less serious cases of misconduct, such as redundant publication, deception over authorship, or failure to declare conflict of interest. Sometimes the evidence may speak for itself, although it may be wise to appoint an independent expert.
2. Editors should remember that accusations of even minor misconduct may have serious implications for the author(s), and it may then be necessary to ask the employers to investigate.
3. Authors should be given the opportunity to respond to any charge of minor misconduct.
4. If convinced of wrongdoing, editors may wish to adopt some of the sanctions outlined below.

Sanctions

Sanctions may be applied separately or combined. The following are ranked in approximate order of severity:

1. A letter of explanation (and education) to the authors, where there appears to be a genuine misunderstanding of principles.
2. A letter of reprimand and warning as to future conduct.
3. A formal letter to the relevant head of institution or funding body.
4. Publication of a notice of redundant publication or plagiarism.
5. An editorial giving full details of the misconduct.
6. Refusal to accept future submissions from the individual, unit, or institution responsible for the misconduct, for a stated period.
7. Formal withdrawal or retraction of the paper from the scientific literature, informing other editors and the indexing authorities.
8. Reporting the case to the General Medical Council, or other such authority or organization which can investigate and act with due process.

Appendix

The Association of the British Pharmaceutical Industry (APBI). 1989. *Facilities for Non-patient Volunteer Studies*. London.

The Association of the British Pharmaceutical Industry (ABPI).1990. *Guidelines for Medical Experiments in Non-patient Human Volunteers*. London.

ABPI fact sheets and guidance notes: Clinical trials and compensation guidelines, January 1991.

Guidelines for phase IV clinical trials, September 1993.

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Relationship between the medical profession and the pharmaceutical industry, June 1994.

Good clinical trial practice, November 1995.

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GLOSSARY

Altmetrics: Stands for "alternative metrics". The "alternative" part references traditional measurements of academic success such as citation counts, journal prestige (impact factor), and author H-index.

Authorship: Defines the role of a creator; whose intention is to circulate original ideas and intellectual works. In scholarly publishing, in particular, the role of the author carries significant responsibility, legal rights, and privileges. Authorship provides credit for an individual's contributions to a study and carries accountability.

> ***Improper Author Contribution or Attribution:*** All listed authors must have made a significant scientific contribution to the research in the manuscript and approved all its claims.

***Types of Authorship*:** Inappropriate types of authorship include:

> ***Anonymous Authorship*.** Authorship should be transparent and it requires public accountability, it is not appropriate to use pseudonyms or to publish scientific reports anonymously.
>
> ***Authorship for Sale.*** Some instances have been reported in which non-authors have attempted to buy authorship from an author of a paper, often after the paper has been invited for revision or provisionally accepted.
>
> ***Deceased or Incapacitated Authors.*** Pertains to cases in which a co-author dies or is incapacitated during the writing, submission, or peer-review process, co-authors should obtain disclosure and copyright documentation from a familial or legal proxy.
>
> ***Ghost Authorship*.** Ghost authors participate in the research, data analysis, and/or writing of a manuscript but are not named or disclosed in the author by-line or acknowledgments.
>
> ***Group Authorship.*** Group authorship may be appropriate when a group of researchers has collaborated on a project, such as a multi-centre trial, a consensus document, or an expert panel.
>
> ***Guest Authorship*:** Guest authorship has been defined as authorship based solely on an expectation that inclusion of a particular name will improve the chances that the study will be published or increase the perceived status of the publication. The 'guest' author makes no discernible contributions to the study, so this person meets none of the criteria for authorship.
>
> ***Honorary or Gift Authorship.*** Honorary or gift authorship has been defined as authorship based solely on a tenuous affiliation with a study. A salient example would be 'authorship; based on one's position as the head of a department in which the study took place.

Bibliometrics: The use of statistical methods to study the bibliographic data to analyse the impact of research outputs using quantitative measures. It is the quantitative method of citation and content analysis for scholarly journals, books and researchers.

Citations: In-text citations are similar to references, but occur in the body of the text with direct quotes and paraphrases to identify the author/publication for the material used or cited.

Citation Analysis: The process whereby the impact or 'quality' of an article is assessed by counting the number of times other authors mention it in their work. Citation analysis involves counting the number of times an article is cited by other works to measure the impact of a publication or author.

Clone Journal: A counterfeit mirror of an authentic journal that exploit the title and ISSN of

legitimate journals. In contrast to predatory journals, clone journals are more likely to accept papers from authors, since they have developed as the mirror image of reputable journals, including their domain name. Usually, they receive massive attention through claiming that they have earned high impact factors from reputable indexing agencies such as Web of Science and Scopus.

Database: Organized collections of computerized information or data such as periodical articles, books, graphics, and multimedia that can be searched to retrieve information.

Fabrication: Data fabrication means the researcher did not actually do the study, but made up data.

Falsification: Data falsification means the researcher did the experiment, but then changed some of the data. Both of these practices make people distrust scientists.

Hijacked Journals: Duplicate or fake websites of legitimate ones utilizing the title, ISSN and other information of the reputable journal. They are often created by a malicious third party for the purpose of fraudulently offering academicians the opportunity to rapidly publish their research online for a fee.

Impact Factor (IF): is a measure of the frequency with which the average article in a journal has been cited in a particular year. It is used to measure the importance or rank of a journal by calculating the times it's articles are cited.

Index: A listing of names, places, and specific topics in alphabetical order, with page numbers associated with each topic, at the end of a book.

> ***Citation index:*** Citation indexing, CI, is a kind of bibliographical data base, an index of citations between publications, allowing the user to easily establish which later documents cite which earlier documents C I consists of the charting of the text details of each such references. It makes links between books and articles that were written in the past and articles that make reference to ("cite") these older publications.
>
> ***g-Index*:** An index for quantifying scientific productivity based on publication record. The index is calculated based on the distribution of citations received by a given researcher's publications. The *g*-index gives more weight to highly-cited articles.
>
> ***h-index: is an index to quantify an individual's research output. The h*-index is an index that attempts to measure** both the productivity and citation impact of the publications of a scientist or scholar. **The index is based on the set of the researcher's most cited papers and the number of citations that they have received in other people's publications.**

Journal Citation Report: provides ranking for journals in the areas of science, technology, and social sciences. For every journal covered, the following information is collected or calculated: Citation and article counts, Impact Factor, Immediacy index, cited half-life, citing half-life, source data listing, citing journal listing, cited journal listing, subject categories, Publisher information.

Moving Wall: The time period between the last issue of an academic journal available in a given online database and the most recently published print issue of a journal. A moving wall is a set period of time (usually three to five years) between a journal issue's publication date and its availability as archival content.

> **Multiple Submission:** Submission of the same manuscript to more than one journal at the same time. Doing this wastes the time of editors and peer reviewers and can damage the reputation of journals if published in more than one.

***OpenAccess* (OA):** refers to freely available, digital, online information. *Open Access* scholarly literature is free of charge and often carries less restrictive copyright and licensing barriers than traditionally published works, for both the users and the authors.

Gold Open Access: is where an author publishes the article in an online open access journal. Gold open access has the key advantage of making publications freely accessible right from the moment they are first published, which means they can be used immediately.

Green Open Access: is where an author publishes the article in any journal and then self-archives a copy in a freely accessible institutional or specialist online archive known as a repository, or on a website. Green open access does not offer the same legal framework for content licensing.

Plagiarism: Using another person's original work, without giving reasonable and appropriate credit to or acknowledging the author or source, whether such work is made up of code, formulas, ideas, language, research, strategies, writing or other form(s).

Self-Plagiarism: the reuse of one's own words, ideas, or artistic expression (as in an essay) from pre-existing material especially without acknowledgment of the earlier use. Self-plagiarism refers to the re-submission of work as if it were original.

Predatory Journals: 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.

Processing Charge: Also known as a publication fee, is a fee which is sometimes charged to authors to make a work available in either an open access journal or hybrid journal. This fee may be paid by the author, the author's institution, or the research funder.

Publication Ethics: Ethical standards for publication to ensure high-quality scientific publications, public trust in scientific findings, and that people receive credit for their ideas.

Redundant Publications: Publishing many very similar manuscripts based on the same experiment. It can make readers less likely to pay attention to a researcher's manuscripts.

Referencing: A list of the resources that a researcher uses when writing an assignment or doing research. These resources may include books, journals, conference papers, theses, film, videos, and other such material.

Research Integrity: may be defined as active adherence to the ethical principles and professional stadards essential for the responsible practice of research.By active adherence we mean adoption of the principles and practices as a personal credo, not simply accepting them as impositions by rule-makers. By ethical principles we mean honesty, the golden rule, trustworthiness, and high regard for the scientific record.

Scientometrics: Concerned with the quantitative features and characteristics of science and scientific research. The field of study, which concerns itself with measuring and analysing scientific literature. Scientometrics is a sub-field of bibliometrics. The branch of information science concerned with the application of bibliometrics to the study of the spread of scientific ideas; the bibliometric analysis of science.

सत्यमेव जयते

Government of India
Ministry of Education
Department of Higher Education

ज्ञान-विज्ञान विमुक्तये

University Grants Commission
Ministry of Education
New Delhi

Designed by **Professor Him Chatterjee,** Department of Visual Arts, Himachal Pradesh University, Shimla

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.