



EDITORIAL

Monodisciplinary-plus researchers: What and why?

A brief historical perspective and current trends

Oxford English Dictionary defines ‘Science’ as knowledge about the structure and behavior of the natural and physical world, based on facts that you can prove, for example, by experiments. Cambridge Dictionary defines ‘Science’ as knowledge from the careful study of the structure and behavior of the physical world, especially by watching, measuring and doing experiments, and the development of theories to describe the results of these activities. Merriam Dictionary defines ‘Science’ as knowledge about or study of the natural world based on facts learned through experiments and observation. In a broader sense, it is defined as the state of knowing, i.e., knowledge as distinguished from ignorance or misunderstanding. As per the Collins Dictionary, ‘Science’ is defined as the study of the nature and behavior of natural things and the knowledge that we obtain about them. Wikipedia definition of ‘Science’ is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the world.

Going by the aforementioned definitions, the earliest roots of science could be traced to historical civilizations. Broadly speaking, scientist or researcher is a person learned in science, more specifically, a person who systematically gathers and uses research and evidence to make hypotheses and test them to gain and share understanding and knowledge. In other words, researchers conduct scientific investigations or scientific research to advance knowledge in an area of interest.

Likes of Albert Einstein and Stephen Hawking consider the Sixteenth-century scholar Galileo Galilei as the “father of modern science.” More importantly, it is to be emphasized that Galileo was a polymath with expert knowledge in diverse fields, including astronomy, physics, mathematics, engineering and natural philosophy. As per the definition, polymath is an individual whose knowledge spans a substantial number of subjects, known to draw on complex bodies of knowledge to solve specific problems.

A greatest painter in the history of art, Leonardo da Vinci was a polymath too. He fused diverse knowledge to create masterpieces of art, which are perennially appreciated. ‘Mona Lisa’ and ‘The Last Supper’ are

notable and iconic examples. He was curious about everything and all sorts of different disciplines and was many things: a painter, an architect, an engineer, a thinker and a scientist. He chose to proactively interact with diverse domain experts and specialists who were mathematicians, architects, playwrights, engineers and poets. He spent a lifetime absorbing the best of art, science, optics and the universe, which shaped his mind, abilities and personality. He was a lively character, creative and inquisitive just for curiosity’s sake, not simply because it’s useful.

Since the periods of the aforementioned polymaths, the scientific research ecosystem has scaled up worldwide in terms of research investments, number of researchers and publications in peer-reviewed journals. It is to be noted that the worldwide growth is exponential only in the recent fifty years. According to Clarivate Analytics, more than fifty-two million scientific papers were published in archival journals since 1970.^[1] The statistics division of the United Nations Department of Economic and Social Affairs estimated that the worldwide investments in research reached more than two trillion PPP dollars in 2018, which is higher than 1.4 trillion dollars in 2010.^[2] In other words, the proportion of global GDP invested in research increased from 1.61% in 2010 to 1.73% in 2018. Total number of researchers per million inhabitants worldwide jumped from 1,022 in 2010 to 1,235 in 2018. This underscores the emphasis placed by the countries on scientific research in advancing respective economies, securing competitive advantage and solving societal challenges. The rapid development and deployment of vaccines and medicines, healthcare solutions, personal protective equipment and digital technologies to protect citizens against the COVID-19 pandemic are excellent examples of science-based innovations in current times. COVID-19 caused five million deaths when compared to estimated 75–200 million deaths caused by the fourteenth century The Black Death and 50 million deaths caused by Spanish Flu in 1918.

Clarivate Analytics, via its adsorbed former entities Thomson Reuters Intellectual Property and Science and Web of Science, has been identifying the highly cited researchers in the world annually.^[3] The list compiles the world’s most influential researchers of the past decade, demonstrated by the production of multiple highly

cited papers that rank in the top 1% by citations for field and year in Web of Science. According to Clarivate Analytics, researchers are selected for their ‘exceptional performance’ in one or more of 21 fields or across several fields. A total of 6,389 researchers are named as Highly Cited Researchers in 2020. Among them, about 3,896 researchers (~60% of the total 6,389) are in specific fields and 2,493 researchers (~40% of the total 6,389) are identified for their cross-field performance. Even though the practice of identifying highly cited researchers has been there for some time, only since 2018 the Clarivate Analytics started identifying the researchers with cross-field impact. The analysis indicates that influential researchers are comfortable with multiple disciplines and the cross-field research pursuit is important.

The seventeen Sustainable Development Goals (SDGs), also known as 2030 Agenda for Sustainable Development, adopted by the United Nations Member States in 2015 provide a shared blueprint for peace and prosperity for people and the planet, now and into the future.^[4] The SDGs focus on important issues such as human health, sanitation, food, water, energy, transport, urbanization, production, education, oceans and climate. The 2030 Agenda is a call for all sectors of society, globally. Universities play an important role in progressing on 17 SDGs. UNESCO, partnered with the University of Bergen, established the Global Independent Expert Group on the Universities and the 2030 Agenda (EGU2030). The EGU2030 is supported by the International Science Council (ISC) and the International Association of Universities (IAU). The EGU2030 group is convened to propose guidelines and actions for how universities can facilitate knowledge development as well as new research and education strategies that can generate the needed deep-going social, economic and environmental transformations.^[5] The EGU2030 report to be unveiled at the III World Conference on Higher Education in Barcelona in May 2022 emphasizes the need for moving toward more inter- and transdisciplinary approaches to education and research.^[6] Single disciplines working in isolation will not alone be able to address complex planetary and societal challenges. The report stressed that the foundation for the inter- and transdisciplinarity will still be strong and discipline-based research and education, but that Universities must create arenas and incentives where disciplines can provide more holistic perspective on drivers and solutions.

In the literature, a number of key terms – multidisciplinary, interdisciplinary and transdisciplinary – have been used to describe the varying degrees of interaction and integration involved in the beyond-discipline collaborations. However, there remains some ambiguity surrounding how these terms are used and understood. It is not the remit of EGU2030 team to provide clear-cut definitions, but the EGU2030 report expresses the team’s

understanding of these terms and – importantly – their differences as follows.

Multidisciplinarity brings together knowledge from different disciplines to address a given issue. The process of knowledge production and power relations between disciplines is mostly left unaffected in multidisciplinary collaborations. Each discipline works in a self-contained manner without the aim to transform the disciplines themselves. Compared to inter- and transdisciplinary collaboration, integration – both on an epistemic and social level – is not an objective of multidisciplinary.

Interdisciplinarity describes a mode of knowledge production that focuses on coordination and interaction between different disciplines as a means to both advance knowledge and action. In contrast to multidisciplinary, there is an attempt to integrate scientific practices, including information, data, concepts and theories from more than one discipline. However, the term has been used to describe a range of ambitions, from cooperation that leaves disciplinary boundaries mostly untouched to collaborative work through which disciplines themselves are transformed.

Transdisciplinarity was introduced as an explicit addition to interdisciplinarity to describe collaborations that go beyond coordinating interactions between different disciplines and aim at transcending them, therefore moving beyond disciplinary boundaries. In addition, transdisciplinarity rests on the premise that researchers alone cannot solve these problems and that therefore academic boundaries also need to be transgressed through incorporation of extra-academic actors and knowledge into processes of problem definition, knowledge production and use. Transdisciplinary collaborations thus aim for both conceptual integration of different disciplines as well as a transgression of academic boundaries, which is not necessarily a part of interdisciplinary modes of producing knowledge, to include other forms of knowledge. Transdisciplinarity points to disintegration of boundaries and the development of something entirely different. It is to be noted that despite these crucial differences, there are also commonalities in interdisciplinarity and transdisciplinarity.

Let us consider the example of standards development. Sustainability standards are voluntary guidelines used by producers, manufacturers, traders, retailers and service providers to demonstrate their commitment to good environmental, social, ethical and safety practices. Sustainability standards are accompanied by a verification process – often referred to as ‘certification’ – to evaluate that an enterprise complies with a standard, as well as a traceability process for certified products to be sold along the supply chain, often resulting in a consumer-facing label. There are over 400 such standards across the world and they continue to grow. There are about 457 ecolabels in 199 countries and 25 industry sectors. The World Trade Organization (WTO) and

international standardization requirements advocate an open and transparent process and the principle of consensus on the development of national and international standards. This calls for appreciation of topics and knowledge beyond one's own area.

Ground realities

Massification of scientific research over the past five decades unintendedly led to strong disciplinary boundaries and ubiquitous monodisciplinary experts. Research massification resulted in intense competition for precious, limited and often sporadic research funds. Competitive research funds are given out to researchers upon a stringent peer review process. As the name suggests, peers are those who are domain experts or deeply familiar with the proposed research topic in the grant proposal. The peer review process gives significant importance to the track record of individual researcher often evidenced by publications, prior research works and standing or reputation among other researchers in the same domain. In other words, unintendedly, the processes of current research ecosystem perpetuate monodisciplinary culture.

The universities around the world too have been internally structured, organized and incentivised along specialized disciplines, so as to train employment market-ready graduates. Recruitment of faculty members is mostly based on disciplinary boundaries. Criteria and metrics of promotion and tenure, incentives as well as rewards and recognition of faculty members are largely based on monodisciplinary considerations. Over the decades, these discipline-based frameworks and key performance indicators to managing academic units fed on themselves and led to self-serving sub-cultures and rigid academic processes. This situation is further accentuated by the introduction of subject rankings of universities by ranking organizations in recent years. Unfortunately, the well-accepted adage, i.e., you get what you measure, has become true in the scientific research world too. As such, the current system, while advancing innovative ideas and solutions, remains structurally ill-equipped to facilitate beyond monodisciplinary culture of research and learning.

Another dimension highlighted by the EGU2030 report is scientific publishing. Competition for publishing has been exacerbated by the perceived need for academics all around the world to publish in a limited number of prestigious journals, reinforced by evaluation and promotion criteria. Specialized disciplinary outlets and pay walls provide barriers and there is little diversification of ways of sharing knowledge. Hence, the metrics used to gauge research impact and relevance should be reconsidered.

The EGU2030 report points out that the scientific reductionism has provided new insights and major scientific achievements, but also created scientific 'silos' in

structure and thinking. The much-needed progress on 17 SDGs requires holistic perspectives across disciplines. This poses major challenges not only for the structure of education and research within universities, but also for financing agencies. The transit toward inter- and trans-disciplinary research and teaching requires profound cultural and structural changes in the traditional ways in which many universities are structured. Changing structures within universities is often a slow process, but since the SDGs requires actions now, it is crucial that such incentives are implemented as soon as possible. A trend toward universities support of more collaborative, trans-disciplinary and relevant research is already moving forward. Yet, it is fair to say that this transformation is still very much in its infancy.

Monodisciplinary-plus researchers

From the aforementioned information and discussion, one could deduce that there is an expectation on the part of every researcher to be aware of knowledge beyond his/her own monodisciplinary pursuit. In other words, a monodisciplinary-plus researcher connects dots of knowledge within and beyond own area. Evidence from the influential as well as highly cited researchers indicate that monodisciplinary-plus approach enables researchers to be relevant and impactful. Moving forward, universities as well as research funding agencies are well advised to demonstrate their alignment, commitment and actions to engender the much-needed transformation in respective research ecosystem. Therefore, it is timely and important for the universities and institutions to encourage and to facilitate monodisciplinary-plus research culture. They must update respective recruitment, promotion and tenure, rewarding and recognition policies and celebrate henceforth needed monodisciplinary-plus culture. These transitions will enable universities to play their part in progressing on the 17 UN SDGs or 2030 Agenda. Individual researchers will be better off by embracing monodisciplinary-plus approach which involves proactive appreciation and connecting with knowledge beyond own silos. In this respect, every researcher needs to reformat respective cognitive and memory bias and get comfortable with monodisciplinary-plus mindset, if not a polymath!

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