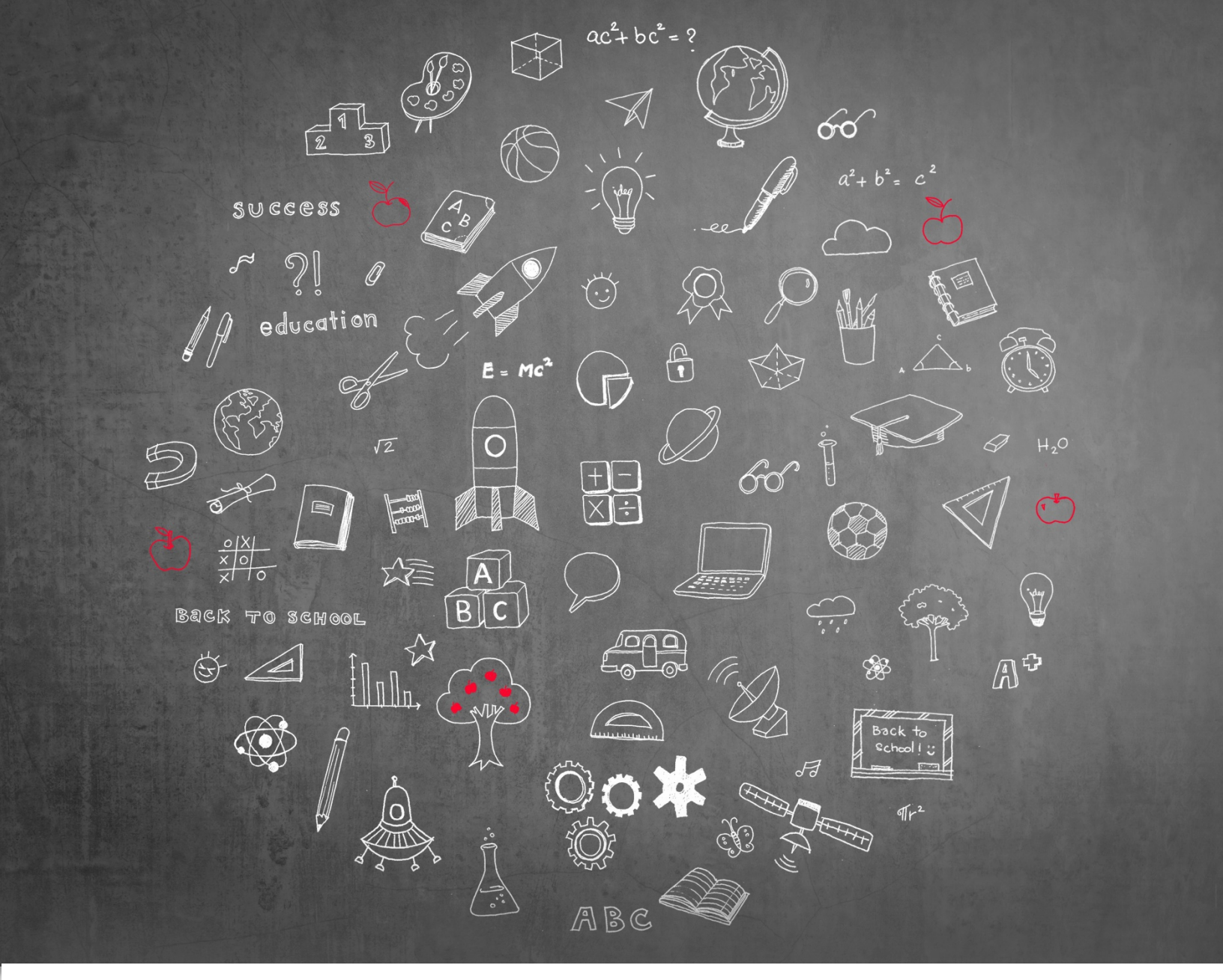

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Interdisciplinary Collaboration

Government Science and Innovation in the New Normal Discussion Paper

By: Shelby Torres, Rhonda Moore, and Jeff Kinder | November 2022

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ABOUT GSINN – CANADA NEEDS A NEW RELATIONSHIP WITH SCIENCE AND INNOVATION THAT REFLECTS OUR TIME

In December 2020, the Institute on Governance launched *Government Science and Innovation in the New Normal (GSINN),* a multi-year, collaborative research initiative designed to explore the impact of the pandemic on federally-performed science and innovation, to support medium-term planning for federal science and innovation departments and agencies, and to provide insights to help rebuild the relationship between science and society.

Throughout the pandemic, anti-vaxxers – joined by anti-maskers – have challenged scientific evidence and public health officials with a mandate to keep us safe and stop the spread of the disease. This is just one example that demonstrates society's relationship with science is under strain.

But society's relationship with science and innovation did not decline overnight. The governance model that underpins Canada's relationship with science is based on a report called *Science: The Endless Frontier* (Bush, 1945). This report outlined a basic compact in which society supports science with public funds and assures the scientific community a great deal of autonomy in exchange for the considerable but unpredictable benefits that can flow from the scientific enterprise.

Today, many of the underlying social, economic, and political assumptions in the postwar compact are outdated. This project examines the relationship between science and society and begins to imagine a new relationship, through nine specific themes:

- Equity, Diversity, and Inclusion;
- Global Research Collaboration and Infrastructure;
- Inclusive Innovation;
- Interdisciplinary Collaboration;
- Indigenous and Other Ways of Knowing;
- Mission-Driven Research and Innovation;
- Science Communications, Outreach, and Public Engagement;
- Skills and Knowledge; and,
- Trust, Integrity, and Science Ethics.

Taken together, these themes suggest elements of a new governance framework for science and innovation in Canada that embraces our current social, cultural and political realities, that recognizes the opportunities and limits of science. Perhaps most importantly, the project reinforces the role of science as part of society, and a tool ready to serve the needs of society.

Findings of the GSINN initiative were developed as a result of extensive research and engagement that included: a hindsight exercise, multiple foresight workshops, eight multisectoral roundtable discussions, and expert consultations that fed into this collection of 10 papers (one for each of the themes above and one capstone paper). Each discussion paper has been peer reviewed and explores a facet of how the relationship between government science, innovation, and society needs to be repaired in order to ensure science remains relevant in the new reality.

IOG extends its heartiest thanks to the eight federal departments and agencies that supported this work: Agriculture and Agri-Food Canada, Health Canada, Innovation, Science and Economic Development Canada, National Research Council, Natural Resources Canada, Public Health Agency of Canada, Public Services and Procurement Canada, and Transport Canada. We also wish to thank all of the individuals who participated in the workshops and roundtables whose input helped clarify and develop the project themes and findings. Finally, we want to acknowledge the following reviewers whose thoughtful feedback improved this paper: Steven Alexander, Matteo Bernabo, Lindsay Copland, Cheryl Khoury, and Curtis McKinney.

INTRODUCTION: A BRIEF HISTORY ON DISCIPLINES

The term discipline was first introduced by the Romans in recognition of the specialized knowledge required for specific professions in areas such as law and medicine (Repko et al., 2017). A major uptake in the drawing of disciplines and categorization of knowledge can be seen from the sixteenth to the eighteenth centuries. During the scientific revolution, science itself became distinctive from other branches of knowledge such as philosophy, mechanics and religion (Gieryn, 1983). Science was subsequently subdivided into fields such as botany, chemistry, and astronomy. As these areas of knowledge expanded and began to develop their own field specific methods and theories, scientists began specializing in single disciplines and sub-disciplines.

During the nineteenth and twentieth centuries, as universities became increasingly focused on research and generating new knowledge, they reinforced disciplinary boundaries (Repko et al., 2017). The academic disciplines of today largely remain the product of the categorisation of knowledge that evolved throughout the nineteenth and twentieth centuries. Natural philosophy was divided into physics, chemistry, and math, while natural history became biology. The social sciences began to follow suit and today we have disciplines such as anthropology, economics and political science. The emergence of disciplines has promoted knowledge production and resulted in major advancements of specific fields and innovative research.

INTERDISCIPLINARY AND TRANSDISCIPLINARY

More recently, academics and researchers have begun to explore the possibilities of knowledge and theory generation by transcending disciplinary boundaries through interdisciplinary and transdisciplinary research. An interdisciplinary research approach involves the interplay and reconciling of methodologies, theories, and knowledges from distinct disciplines in the pursuit of addressing new scientific questions or societal challenges (OECD, 2021). Canada's public policy responses to the COVID-19 pandemic are interdisciplinary by necessity, as will be discussed later in this paper.

Transdisciplinary research, which is necessarily interdisciplinary, goes further; it integrates knowledges from different disciplines as well as knowledge and perspectives which may be viewed as 'non-scientific', such as local and traditional knowledge, cultural norms, and social values (OECD, 2021). Transdisciplinary research aims to supplement and transform discipline-based scientific insights. The concept of transdisciplinary research has gained traction as a way to integrate the work

of academic researchers from multiple disciplines and non-academic participants to address a societal challenge involving the creation of new knowledge.

Canada's research community has highlighted the need to access knowledge and skills across disciplines to address urgent and complex challenges (CCA, 2019), and has sought federal government investment in such (Finance Canada, 2018). Since the release of the Fundamental Science Review in 2017, the Government of Canada has heard a strong and united voice across the research community about the importance of investing in the future of research, with specific demands for more investment and program supports for interdisciplinary research (Finance Canada, 2018). Challenges such as climate change, ocean protection and human health (Finance Canada, 2018) can often be "interlaced with interdependencies that have no respect for disciplinary silos" (Banerjee, 2014). For example, *Climate Science 2050: Advancing Science and Knowledge on Climate Change* (ECCC, 2020) emphasizes the need for collaboration across disciplines, as collaboration to establish a deeper understanding of the social and behavioural aspects of decarbonization will be necessary to achieve Canada's net-zero GHG emissions targets. The need for interdisciplinary and transdisciplinary work is thus pressing as we move into the future.

WHERE COLLABORATION HAPPENS

Across all levels of the Government of Canada, there are initiatives to encourage collaboration across disciplinary lines.

TRI-AGENCY INTERDISCIPLINARY PEER REVIEW COMMITTEE

While the GSINN initiative focuses primarily on government science – and so the work of the TriCouncil is beyond the scope of this project – many Canadian trained scientists and researchers received funding from at least one of the Tri-Council agencies during their postsecondary career. Thus, changes within the TriCouncil community as to how it funds and adjudicates research are significant for the government science community overall. For this reason, we note that in 2017, the Fundamental Science Review pointed to a lack of dedicated review processes for interdisciplinary research, and a lack of expertise and understanding to see the value and validity in that research within the TriCouncil. As a result, Canadian researchers conducting interdisciplinary work often encounter difficulty attracting funding from granting councils as their research does not fit cleanly into the mandate of a single council (CFSR, 2017).

To address this challenge, the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Social Sciences and Humanities Research Council (SSHRC) created the Tri-Agency Interdisciplinary Peer Review Committee (CIHR, 2022). While the committee is directed towards academic research, it increases the possibility of interdisciplinary and transdisciplinary work in Canada. The committee is composed of members with expertise in interdisciplinary research in a range of disciplines that are representative of all three Councils. Overall, the committee ensures that interdisciplinary research initiatives now have a robust review process and the expertise required to see their value.

COVID-19 RECOVERY RESPONSE

COVID-19 brought forward a number of new and complex challenges that forced governments to respond quickly, and highlighted a greater need for interdisciplinary and transdisciplinary approaches to public health research, policy and decision-making. Shortly after COVID-19 arrived in Canada, governments implemented broad and restrictive community-based lockdowns in an effort to mitigate the spread of the virus.

In the early stages of the pandemic, government research was primarily focused on treatment protocols, vaccine development, and testing (Widener, 2021). While the science community quickly mobilized and was critical in mitigating the spread of the virus, some of the public health measures – such as school closures, restrictions on gatherings and business operations – created numerous unintended consequences for many communities (PHAC, 2022) such as those facing homelessness, domestic violence, poverty, mental illness, and already marginalized communities and other hardships (Widener, 2021).

There is and will be great demand for social sciences research into decision making and risk assessment to determine Canada's path forward to prepare for and mitigate future pandemics. Canada's recovery response must consider the social determinants of health, an interdisciplinary concept which studies the different social, economic, and geographic factors that contribute to health inequities in specific populations (Widener, 2021). The concept can work in tandem with public health and medicine to understand the mental, social, economic, physical and other consequences of the pandemic (Mol & Hardon, 2020). Indeed, the federal government has launched a number of initiatives and taken steps to foster greater collaboration in Canada's pandemic recovery approach. Initiatives include but are not limited to:

- **Networks**: CanCOVID, COVID-END and National Collaborating Centres facilitate collaboration across disciplines, knowledge synthesis, translation and expertise across Canada's scientific, policy and health communities (PHAC, 2022).

- **COVID-19 Expert Panel**: A multidisciplinary (disease modelling, risk, and behavioural sciences, biomedical and clinical sciences) expert panel to advise the Chief Science Advisor of Canada on the latest scientific developments related to COVID-19 (Office of the Chief Science Advisor, 2022).

- **Grants:** Grants fund interdisciplinary research projects to catalyze Canada's Post Pandemic Recovery (Canada Research Coordinating Committee, 2022).

NRC HIGH PERFORMANCE BUILDINGS

The National Research Council of Canada's (NRC) High Performance Buildings (HPB) Program exemplifies interdisciplinary research. The program provides a whole-of-industry approach to transform existing facilities into high performance buildings that generate more energy than they consume (IOG, 2022).

Together, scientists in engineering, physics and psychology are collaborating to maximize occupant well-being while prioritizing energy efficiency in a number of areas (Stringer, 2019). An example of where collaboration across disciplines has taken place is to determine the appropriate lighting for high performance buildings. While the team focused on energy efficiency, they also considered how poor lighting affects people's moods, job-satisfaction, and overall well-being. Findings by Veitch (Stringer 2019), a psychologist and member of the team, demonstrated that many of the high-performance buildings now give employees control over light rather than fixed light levels. This change contributes to improve moods, job-satisfaction, and well-being, and reduces energy-related costs by approximately 10% per year (Stringer, 2019). The HPB Program has led to the development of new intellectual property, design guidelines, new National Energy Code for Buildings and National Building Code requirements. Program findings have enabled more than 130 government buildings to reduce their greenhouse gas emissions by 7-10% within one year.

The HPB Program team has drawn attention for emphasizing the importance of the interdisciplinary composition of their team, to which they credit the success of the HPB Program. The team members have also spoken to the need for a common language between their disciplines to enable their work (Stringer, 2019).

NEW FRONTIERS RESEARCH FUND

In 2018, the Social Sciences and Humanities Research Council (SSHRC), the Canadian Institutes of Health Research and the Natural Sciences and Engineering Research Council launched the New Frontiers in Research Fund (NFRF). NFRF was created to fund interdisciplinary and innovative

research and to promote Canada's competitiveness and expertise internationally (Government of Canada, 2022).

Each year, the NFRF funds more than a hundred research projects through social, cultural, economic, health-related and technology theme areas, up to a maximum of $250,000 per project. In 2022, current NFRF funded projects include: research on flood-resilient and climate-adaptive housing for Indigenous populations in Canada; projects to improve crop resilience to climate change; and, Black creativity in the arts, sciences, technology and business (SSHRC, 2022).

CLIMATE CHANGE

Globally, there is recognition that greater collaboration is required to mitigate and to adapt to climate change. In 2016, the United Nations Sustainable Development Report called for new working arrangements and "greater dialogue among scientists, engineers, practitioners, stakeholders, and policymakers" to address global sustainability challenges like climate change (United Nations, 2016). The report calls for knowledge sharing and approaches that span disciplines and sectors.

Canada's Pan Canadian Framework on Clean Growth and Climate Change (ECCC, 2016) echoes this need where it states the plan "recognizes that growing our economy and achieving our GHG-emissions targets will require an integrated, economy-wide approach that includes all sectors, creates jobs, and promotes innovation." The framework emphasizes that actions to advance climate change adaptation require an interdisciplinary approach. Research from the social sciences and natural sciences are integrated and applied to the framework in a number of sectors such as infrastructure, health, agriculture, and technology.

The Pan Canadian Framework also recognizes the importance of collaboration across knowledge systems. Principles of the framework aimed at working with other ways of knowing "strengthen the collaboration between our governments and Indigenous Peoples on mitigation and adaptation actions, [and are] based on recognition of rights, respect, cooperation, and partnership" and "recognize the importance of Traditional Knowledge in regard to understanding climate impacts and adaptation measures" (ECCC, 2016).

CHALLENGES

In May 2022, the Institute on Governance hosted a roundtable discussion with a handful of subject matter experts from the public and academic sectors to talk about interdisciplinary collaboration. The participants identified a number of challenges that prevent greater interdisciplinary, multidisciplinary, and transdisciplinary science and research collaboration within the federal public service.

- **Funding Structures**. Participants noted an interdependence between science and research funding and government priorities, which can reduce funding for interdisciplinary projects if they fall outside the priorities of a department, or even partially outside a department's mandate.

- **Siloed Departmental Structures.** Participants discussed how departmental boundaries, as well as the limited communication and lack of information and data sharing that flows between departments, challenge interdisciplinary collaboration. Subject matter experts from IOG's roundtable and those who participated in the Blue Economy engagement process said datasets are often withheld from specific teams, and there is an overall lack of communication about the activities of each department. Participants said these practices severely impede opportunities for collaboration, including limiting the ability of teams to build capacity, secure funding and resources to pursue interdisciplinary collaboration.

- **Cultural Biases and Barriers.** Often, specialists are less open to new bodies of knowledge or new and different ways of working and conducting research (Cooke et al., 2020). Through the Canadian education system, specialists are seldom exposed to a variety of disciplines, methods and bodies of knowledge resulting in their skepticism of methods used by other disciplines. Additionally, as natural scientists often primarily work with quantitative data, they are often skeptical of social science disciplines which rely on qualitative data or do not value quantitative data in the same way. These differences promote a culture in which interdisciplinary work – when it combines participants from the natural and social sciences as well as qualitative and quantitative data – is viewed as less rigorous or important.

- **Knowledge Hierarchies**. Participants identified that certain ways of knowing and processes are often privileged over others. Within disciplines, existing processes and worldviews are privileged over new approaches and there is a lack of acknowledgement that there is no "standard" worldview or way of knowing. Similarly, individuals with higher-ranking positions are often given the final decision and considered to be more knowledgeable than junior staff. This

results in the possibility that new or different solutions proposed by more junior staff may be overlooked. Participants felt that simply because a knowledge or person is new, this does not mean that the knowledge put forth is less valuable. Simply put, current hierarchies have made it difficult for new ways of knowing to be integrated within the federal government.

- **The Education Pipeline.** Subject matter experts noted that most researchers and scientists in the federal public service are products of the Canadian education system, which does not promote interdisciplinary studies on a large scale (discrete programs and research centres do exist), nor produce a great deal of scientists and researchers with an interdisciplinary background. Interdisciplinary education options can provide skills development and training to work effectively across or between disciplines (Newell, 2010). Interdisciplinary work draws from multiple disciplines, and so relies on generalists to ensure accurate communications between disciplinary specialists. But Canadian universities, which are largely designed according to a disciplinary approach to knowledge, do not produce science generalists to act as those interlocutors. Nor is there yet a widely adopted protocol for creating generalist positions in the public service.

CONCLUSION

In conclusion, both interdisciplinary and specialized research are crucial to the pursuit and advancement of scientific knowledge and research. While interdisciplinary research does not aim to abolish disciplines, it articulates the need for collaborative approaches to research and decision making. As the Government of Canada and Canada's research community recognize the importance of interdisciplinary work, there remains a number of barriers in both academia and the federal public service for its meaningful integration.

QUESTIONS FOR DISCUSSION

- How can federal departments and agencies work together to advance multidisciplinary, interdisciplinary, and transdisciplinary approaches to research and science?
- In what ways could scientists and researchers in the public service be taught to use an interdisciplinary approach or to work across multiple knowledge systems?

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APPENDIX A: Glossary

Culture of Science: A system of values, modes of thinking and institutional, behavioural and social standards that characterizes scientific activities. It is the lifestyle of the scientific community. Scientists are the leaders and practitioners of the forms and fashions of scientific culture, and their scientific and technical activities lay a solid foundation for the development of scientific culture (Wang, 2018).

Discipline: A branch of knowledge or learning. Practitioners of a given discipline generally share characteristic background knowledge, objects of analysis, terminology, analytic methodologies, and mechanisms for training, collaboration and knowledge exchange (OECD, 2021).

Epistemology: The study or a theory of the nature and grounds of knowledge especially with reference to its limits and validity (OECD, 2021).

Interdisciplinary: Research that involves several unrelated academic disciplines in a way that forces them to cross subject boundaries to create new knowledge and theory in achieving a common goal. Integration of natural sciences with social sciences and humanities (SSH) is particularly relevant to addressing complex societal challenges, including those related to human-environmental systems (HES), but poses substantial challenges (OECD, 2021).

Methodology: A plan for how research will proceed—how the researcher will combine the different elements of research into a plan that indicates, step by step, how the specific research project will be carried out (merges theory and methods) (Leavy, 2017).

Multidisciplinary: Research that involves several different academic disciplines working in parallel on one theme or problem, often with a common goal, yet following their individual disciplinary precepts and ways of working. Participants exchange knowledge, but do not aim to cross subject boundaries to create new, integrated knowledge and theory. This lack of integration may make it difficult to satisfactorily resolve complex societal problems.

Natural Science: Systematised knowledge of nature and the physical world, including zoology, botany, chemistry, physics, geology, etc., or any of these branches of knowledge (OECD, 2021).

Quantitative Research Methods: Characterized by deductive approaches to the research process aimed at disproving or lending credence to existing theories; involves measuring variables and testing relationships between variables in order to reveal patterns, correlations, or causal relationships; results in statistical data (generally from a large sample) (Leavy, 2017).

Qualitative Research Methods: Generally characterized by inductive approaches to knowledge building aimed at generating meaning; is used to learn about social phenomenon; robustly unpack the meanings people ascribe to activities, situations, events, people, or artifacts; or build a depth of understanding about some dimension of social life. Results in a depth of understanding (detailed information from a small sample) and is generally appropriate when the primary purpose is to explore, describe, or explain (Leavy, 2017).

Transdisciplinary: Research that integrates both academic researchers from unrelated disciplines – including natural and social sciences – and non-academic participants to achieve a common goal involving the creation of new knowledge. TDR is necessarily interdisciplinary. In drawing on non-scientific knowledge domains such as local and traditional knowledge, and cultural norms and values, it aims to supplement and transform scientific insights for the good of society.

Science: Systematised knowledge derived from observation, study, and experimentation carried out to determine the nature or principles of what is being studied; a branch of knowledge or study, especially one concerned with establishing and systematising facts, principles, and methods, as by experiments and hypotheses. Sometimes “Science” is used to denote the natural sciences, as opposed to the Social Sciences and Humanities (SSH); however, in its broadest interpretation it encompasses all disciplines of academic knowledge and both quantitative and qualitative methods (OECD, 2021).

Social Science: Systematised knowledge based on qualitative information or quantitative data about groups of people and how they live together as families, tribes, communities, races, etc., or any of several branches of knowledge, as history, economics, civics, etc., dealing with the structure of society and the activity of its members (OECD, 2021).