Interdisciplinary Research-Need of the Hour

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Abstract- The past few years have seen a steady growth in interdisciplinary research as the boundaries between scientific fields slowly begin to blur. Today, interdisciplinary research is being seen as the most effective way of tackling intricate socio-economic problems and is now being considered the best way to develop new knowledge streams. An interdisciplinary approach to research involves the integration of knowledge from two or more academic disciplines into one activity. Seemingly unrelated fields can have much to offer to each other in terms of new information, data, techniques, tools, perspectives, concepts, and/or theories. It allows us to study the same problem or concept from different disciplinary perspectives and help us understand it better or in a more holistic way. A single discipline cannot adequately understand or address many real-world problems. Interdisciplinary research allows researchers to approach these problems from multiple angles, which can lead to a more comprehensive understanding of complex phenomena. By working collaboratively and pooling their knowledge and skills, researchers can achieve fresh insights, creative solutions, and innovative breakthroughs that would not have been possible through conventional, discipline-specific approaches. There are a number of complex problems that requires integrating knowledge and methods from multiple disciplines such as climate change, medical research as new diseases are emerging, digital humanities and social issues etc. which draw insights from sociology, psychology, atmospheric science, ecology, economics, and social sciences. Interdisciplinary research in these areas has led to a better understanding of their impacts and the development of strategies to mitigate its effects.

Keywords: Interdisciplinary, Collaborations, Integration of Knowledge, Holistic approach, Critical solutions.

INTRODUCTION AND REVIEW OF LITERATURE

An interdisciplinary approach to research involves the integration of knowledge from two or more academic disciplines into one activity. Seemingly unrelated fields can have much to offer to each other in terms of new information, data, techniques, tools, perspectives, concepts, or theories. Thus, addressing a problem by bringing knowledge of different fields together may allow us to study the same problem or concept from different disciplinary perspectives and help us understand it better or in a more holistic way. It Lead us to novel solutions and advance science and give rise to useful technologies that did not exist before. This approach is not new to science. Some of the most spectacular, path breaking scientific discoveries have been made by scientists going beyond the boundaries of their specialised area of expertise. Scientists or students of science trying to understand a complex system, phenomenon, or concept from the perspective offered by a single discipline or subject are like the blind men trying to know the elephant. Finding solutions to complex problems an interdisciplinary approach is not only useful in arriving at simple, everyday decisions, but also in making more complex and once-in-a-lifetime decisions. Often, simple everyday decisions require a knowledge of various fields. More complex decisions also benefit from an interdisciplinary approach.

The core principles of IDR are based on three "C's" that is collaboration, cooperation, and communication, among disciplines in various stages of the research process (Klein 2014, Kapila & Moher, 1995). There are three degrees of interdisciplinary approach: (a) Application degree, such as the application of nuclear physics in medicine, to introduce new therapy for cancer treatment; (b) Epistemological degree, such as the application of formal logic in the study of general law, to help to generate some interesting relation with the epistemology of law; (c) Generation of new disciplines degree example, application of mathematics to physics, to generate mathematical physics, or application of mathematical methods in meteorology study or stock market processes,

generating another perspective; application of particle physics to astrophysics, for generating quantum cosmology.
Interdisciplinary research is increasingly recognized as one of the solutions to today's challenging scientific and societal issues. Many studies have aimed to explore the relationship between the interdisciplinarity of research and the attention they receive from the scientific community as well as society. There is a positive correlation between the interdisciplinary of scientific publications and the attention they receive from policy documents in almost all fields. As science and technology continue to advance and many complex research issues need to be tackled, research beyond disciplinary boundaries is becoming increasingly important.

The modes of research beyond disciplinary boundaries primarily may include three types: multidisciplinary, transdisciplinary, and interdisciplinary. Multidisciplinary draws on knowledge from different disciplines but stays within their boundaries. Transdisciplinary integrates the natural, social, and health sciences in a humanities context and transcends their traditional boundaries. Interdisciplinary analyzes, synthesizes, and harmonizes links between disciplines into a coordinated and coherent whole (Choi & Pak, 2006). The National Academies (2004) defined that "Interdisciplinary research (IDR) is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice"

Interdisciplinary research is increasingly recognized as the solution to today's challenging scientific and societal problems (Carayol & Thuc Uyen Nguyen Thi, 2005; Frodeman & Mitcham, 2007). In recent decades, governments and public funding agencies have increasingly called on scientists in universities and public research organizations to demonstrate both the scientific and societal impacts of publicly funded research (Bornmann, 2013; Bozeman & Sarewitz, 2011; Salter et al., 2017).

Given the significant importance of interdisciplinary research, it is crucial to consider the attention it receives from policy documents. Receiving attention from policy documents implies that the research has the potential to influence policy formulation and implementation, in other words, the transformation of scientific research into policy outcomes (Bornmann et al., 2016). The attention research receives from policy documents facilitates the transformation of scientific knowledge into concrete actions, thereby influencing policy-making and decision-making mechanisms. The transformation of scientific knowledge into concrete actions, which combines scientific research with societal needs, not only achieves the societal impact and value of science but also better utilizes research outcomes to drive societal and economic development, promote technological innovation, and advance society (OECD,2015).

OBJECTIVE

- To understand interdisciplinary research (IDR), and its importance.
- Study the key steps of interdisciplinary research.
- Study about Fields of Interdisciplinary research.

The goal of interdisciplinary research is to create a more holistic understanding of complex phenomena and to generate innovative solutions to real-world problems. However, IDR has many challenges, in terms of integrating different theories of different disciplines. So, it is very important to study and follow the systematic steps and characteristics of IDR for successful integration.

Steps and Characteristics of Interdisciplinary Research

Identification of research problem: Identify the research problem and formulate the common goal or objective In the first step, it is essential to define the research question with consideration of the problem, generated issues, methodology to be used in consultation with all team members. This will help to build a systematic framework, that agrees to the common problems and to formulate the project target goals.

Developing IDR proposal: In this step it is important to state the reasons for using IDR and the role of other disciplines, describe ways of integrating the other involved disciplines with a summary of the involved researchers skills, state a clear plan for the involvement of stakeholders, state the expected benefits and roles and contribution of the stakeholders and mention the budget and additional expenditure needed during research.

Team formation: The selection of team members should be based on consideration of individual characteristics, their expertise, and attitude that support interdisciplinary teamwork. The team should be composed of an appropriate skill mix, assigning the right roles to the right persons, each member understanding and respecting their roles and should be trained and rewarded.

Review of IDR: The IDR proposal should be sent to review to a competent reviewer. While reviewing, the reviewer should examine the nature of the research project and how it is interdisciplinary, for example in terms of methodology that enables to address new issues or disciplines, in terms of technical or policy relevance, the strategies to be used for issues on shared research vision and identity.

Selection of a competent leader: A strong team leader with the willingness and ability to coordinate and collaborate with different disciplines, regional, national, and international networks should be selected. The leader should have leadership skills with IDR vision and interest in a wide range of subjects, listen to new methods and other disciplines data, ability to organize the functioning of the team as well as allocating the responsibilities appropriate to the team members with due consideration of their expertise.

Team Management: The success of an interdisciplinary team requires effective management. Some functions of a leader for management include effective communication, effective relationships building, teamwork, and networking mechanisms, with the ability to negotiate with stakeholders of various disciplines and work across the disciplines boundaries and issues; and facilitate the development of a team identity so all the researchers work collectively in unity rather than individually.

Funding agency : Research funder's role in IDR include formulating IDR research question, introducing and developing a research plan and design, availability of research funds or grants; designing the organizational structure of IDR program, such as location, selecting a leader, research evaluation and accountability; integration of research results for capacity development to facilitate long term impacts; play an enterprising and dynamic role to create a congenial and inclusive IDR future academic environment; and finally guaranteeing the availability of funding to future interdisciplinary research, to facilitate sustainability of interdisciplinary research. (University of Leicester, 2016).

Selection of collaborators : For collaborators selection, personality factors should be considered more than discipline, including having a broad outlook, appreciation of all languages, research methods, and cultures of different disciplines, ability to identify and analyze strategies. The collaborator should be accountable to the opinion of fellow interdisciplinary researchers and participate regularly in a follow-up meeting, can adjust and adapt in teamwork, take responsibility for achieving practical results, tolerate and assimilate different disciplines.

Data Collection and analysis : IDR data should be collected according to the listed objectives and it should be organized on a scheduled timetable with the inclusion of all participants from all disciplines. The collected data then should be analyzed with due consultation and discussion of the different aspects of the listed research problem since the IDR process aims at integrating the results of various disciplinary participants (Vajaradul, 2016).

Resolving problems in IDR management: If there arises any disagreement among team members, it should be discussed openly to bring a consensus and settle it (Kapila & Moher, 1995). At the same time, the leader needs to negotiate with collaborators by sharing the common vision to bring awareness of the objectives and target goals of the research project amongst the team members and attempt to resolve transparently.

Periodic meetings, discussions, and follow-ups: Meetings should be regularly scheduled at least once a week for interaction, sharing information, and to inform the project's status in terms of the progress report and tentative time for completion. The meeting will provide the opportunity for interaction, communication, and discussion for a research plan, methodologies or forma, status, progress, tentative time for completion of the research, discussion to solve any disagreement or troubleshooting, advantages and disadvantages of the existing research methodologies techniques along with application and steps for integrating data by writing and integrating participant disciplines.

Evaluation: Evaluation of interdisciplinary research is very important. It can be done by peer-reviewing, presentation of research proposals, evaluating manuscripts for publication, or end-of-research impact evaluation, etc.

Integration and publication: Successful integration of IDR needs to have a common language, goal, adaptability, and respect for each discipline along with the ability to interact and collaborate with researchers from other disciplines, such as learning new from other disciplines and learning the art of integrating other disciplinary knowledge. During the report writing stage of the interdisciplinary research, it is essential to integrate the result from various research components. Further, there needs integration and synthesis of different theories of both the researchers and the stakeholders.

Capacity Development: Capacity can be developed by establishing institutions that encourage interaction and linkages between various disciplines and ultimately to build capacity for leadership in integrated research. Further, the capacity of IDR scientists can be developed through providing training of different methodological backgrounds and the application of various IDR tools. Local and national-level capacity can be developed by inviting researchers to participate from the beginning of the research process to develop closer relationships between researcher and policymaker and finally to integrate the research findings in designing public policy.

Promote and design IDR for policy and practice : It can be promoted through publicity, advertisement, or call for IDR approaches to solve common problems of the society, aided by the availability of facilities for partnership, collaboration, and networking among institutions and researchers. At the same time, there should be a change in policies and practices of Universities, including hiring, recruitment of faculty members who have IDR background or interests.

FIELDS OF INTERDISCIPLINARY RESEARCH

Climate change mitigation research: Climate change is a complex problem that requires integrating knowledge and methods from multiple disciplines, including atmospheric science, ecology, economics, and social sciences. Interdisciplinary research in this area has led to a better understanding of the impacts of climate change and the development of strategies to mitigate its effects.

Large-scale project like the construction of a dam: Decisions about its design will require knowledge of geography, geology, hydrology, engineering, architecture, and economics. Predictions of the dam's impact on people and ecology will require a study of the local biodiversity, as well as the socioeconomic conditions, agricultural and water needs of human populations at the dam site (environmental science).

Industrial Development: Planning an industrial development or demarcating sanctuaries or protected areas for wildlife etc., are impossible without an interdisciplinary approach as they will affect both biotic and abiotic factors of the concerned area. These require the knowledge of Anthropology, Biodiversity, and Architecture etc. Innovative solutions and technologies and new approaches to problem solving can be framed by conducting IDR.

Medical research: Medical research often involves integrating knowledge and methods from multiple disciplines, including biology, chemistry, and physics. Interdisciplinary research in this area has led to new treatments and therapies for diseases and a better understanding of the underlying mechanisms of disease. Fighting a large-scale disease outbreak, like malaria, requires a team of scientists, doctors, chemists, administrators, public health workers, and state officials work together. Entomologists study the behaviour of mosquitoes (vectors of the malarial parasite) to come up with measures to control them. Based on this information, public health workers and state officials help raise awareness about the disease and measures to mitigate its spread. Parasitologists study the parasite to determine the species causing the outbreak and its effects on infected people. These studies help physicians diagnose the infection and arrive at an appropriate treatment plan (e.g., combinations of drugs), with the help of chemists and pharmacologists, that is targeted at the species causing the local outbreak. Accordingly Government frames the policies to sensitize the masses and control the spread of diseases.

Digital humanities: (DH) is an interdisciplinary field that combines traditional humanities research with digital technologies. Multidisciplinary research in this area has led to new methods for analyzing and interpreting cultural artifacts and insights into how technology transforms humanities.

Social sciences: Many social problems are complex and require interdisciplinary research to understand and address issues. Social issues in India are in plenty and they need to be addressed systematically to achieve social justice and economic justice to all the citizens of India. Some of these issues are gender discrimination, health, poverty, caste, migration, increasing youth suicides, drug abuse etc. Multidisciplinary research in this area has led to a better understanding of the root causes of social issues and the development strategies for addressing them. For example, research on poverty and inequality may draw on insights from economics, sociology, psychology, and other fields.

Biomimetics: Humans have always looked at nature for inspiration to solve problems such as maneuvering in air, staying underwater, surviving in low oxygen environments for extended duration, and so on. Today, such studies are classified as 'biomimetics'- an applied field that focuses on the development of new technologies and products inspired by nature. Application of this science needs the knowledge of architecture, morphology, biochemistry, chemistry and physics etc.

BENEFITS OF INTERDISCIPLINARY RESEARCH

There is an increasing importance of IDR which can be seen in the research contexts, especially in the sustainability issue of environmental science, taking into account the close relationships between natural and social science. There is an increasing importance of the application of interdisciplinary research (IDR) in all kinds of disciplines over the past two decades as it helps to improve a researcher's career and also enables them to compete successfully in the job market. It encourages researchers to expand their knowledge beyond their field, which leads to a series of positive outcomes, such as:

Effective problem-solving: Interdisciplinary research brings together diverse perspectives and knowledge from different fields, which can lead to more creative and effective problem-solving strategies.

Innovative research outcomes: By combining different approaches, interdisciplinary research can lead to more comprehensive and innovative research outcomes, as researchers can draw on a broader range of theories, methods, and data.

Improved understanding of complex phenomena: A single discipline cannot adequately understand or address many real-world problems. Holistic view of complex issues is important for resolving them and framing the policies. Interdisciplinary research allows researchers to approach these problems from multiple angles, which can lead to a more comprehensive understanding of complex phenomena.

Encourage collaboration: Interdisciplinary research encourages collaboration among researchers from different disciplines, which can help break down disciplinary barriers and facilitate sharing of knowledge and ideas.

Exchange of knowledge: Interdisciplinary research enables active knowledge and concept sharing between academicians and researchers across different disciplines. By working in collaboration and pooling their knowledge and skills, researchers can achieve fresh insights, creative solutions, and innovative breakthroughs that would not have been possible through conventional, discipline-specific approaches.

Address complex global challenges: Interdisciplinary research can help to address real-world problems that require a multidisciplinary approach. For instance, the looming threat that climate change poses to our world needs to be addressed by experts across different domains, including environmental sciences, geology, economics, and politics. This interdisciplinary approach is critical to address the impact of climate change and to mitigate its adverse effects on natural resources, agricultural production, and life on our planet.

Leads to the creation of new scientific fields: Researchers can assist in identifying global issues and developing new scientific disciplines by collaborating with teams made up of experts in a variety of subject areas. Interdisciplinary research and collaborating with scholars in other subjects can inspire the development of completely new fields of inquiry that explore previously uncharted territory. For instance, the discipline of bioinformatics integrates computer science and biology to provide innovative, new methods for studying biological data.

CONCLUSION

Interdisciplinary research continues to be crucial in tackling challenging scientific issues and developing a fresh approach to problems encountered in the real world. IDR is a synthesis of two or more disciplines with aims to discover something new or develop a better outlook, where the contributions of the various disciplines are integrated to provide holistic or systemic outcomes. Nowadays, human society is facing complex problems in every field. So, we need collaboration, discussion and sharing with other disciplinary participants, studying together, using combined techniques and procedures to obtain the common objectives. These interdisciplinary studies have produced ground-breaking findings that could revolutionize socio-economic development, transform industries, and advance our knowledge of complex systems.

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