

Challenges and Opportunities of Multi-Disciplinary, Inter-Disciplinary and Trans-Disciplinary Research



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Abstract Disciplinary approaches have advanced the frontiers of knowledge in the various disciplines. Multi-disciplinary methods have enhanced understanding of observed phenomena from multiple perspectives. Inter-disciplinary approaches integrate disciplines and allow a more holistic understanding of phenomena. Trans-disciplinary approaches engage stakeholders in interdisciplinary teams and integrate practical considerations and impacts in developing and applying knowledge. Increasingly, advancing scientific knowledge demands a combination of approaches to address complex issues involving technical and societal concerns. Integrating ideas, expertise, and practices offer many opportunities and have proven highly effective and successful in various fields, especially concerning enhancing fundamental understanding and developing innovative solutions to complex problems. However, adopting this approach may be hampered by different technical, institutional, personal, communication, practical, and educational challenges. In this article, an assessment of the challenges and opportunities associated with implementing multi-disciplinary, inter-disciplinary, and trans-disciplinary research approaches are presented and discussed within the context of the University of Sharjah.

Keywords Research · Research paradigm · Disciplinary research · Multi-disciplinary research · Inter-disciplinary research · Trans-disciplinary research

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1 Introduction

Research is pivotal for making evidence-based decisions, understanding societal issues, as well as sustaining growth and development. Using disciplinary oriented approaches have advanced knowledge and professional insight for strengthening professional practices in society's various fields and sectors. More so, disciplinary research guided by different research paradigms has been established to propel specific agendas and goals in various professional domains. For instance, natural sciences and engineering mostly adopt positivism, drawing on natural laws as a research paradigm driving data collection and analysis by using quantitative, observational and experimental processes [1, 2]. Simultaneously, humanities and arts mostly employ interpretivism to recognize subjective thoughts and social context peculiarities using qualitative approaches, including interviews, focus group discussions, and ethnography to explore issues. Cohen et al. [3] explained that researchers adopting the interpretive paradigm offer the chance to see issues from the participants' views other than those of the researchers.

The body of theoretical and applied knowledge in the various disciplines continues to expand with research and development. However, knowledge worthy of exploration exists in between disciplinary fields. Such in-between knowledge may best be approached by multi-disciplinary or inter-disciplinary researchers, which opens doors for exploring knowledge not usually accessible through disciplinary research, enhances understanding, consolidates knowledge, induces creativity, and dissolves boundaries. The need to better understand complex phenomena demands synergy between and among various disciplinary areas. Hence, multi-, inter-, and trans-disciplinary research with a blend of ideas from different fields and disciplines emerged. With the emergence of this approach, the mixed methods movement among researchers agreed that methods (objective and subjective) and ideas from different fields could be tapped to understand complex issues [4]. Researchers subscribing to these research approaches recognize the need for combining efforts, specialized disciplinary knowledge, and diverse research methods to explore issues and develop new ideas.

Despite gaining currency and considered beneficial, inter-disciplinary approaches are not without some challenges [5–7]. Therefore, this chapter discusses the opportunities and challenges of the multi-, inter- and trans-disciplinary research approaches drawing on the experience of the University of Sharjah (UoS). In the next section, we present the conceptual discourse, followed by the opportunities and challenges of the methods using UoS as a case study. In the last section, we present the conclusion, state the implications for practice, and share a framework for enhancing the adoption of multi-, inter and trans-disciplinary research.

2 Conceptual Discourse

The following conceptual discourse covers previously published discussions and conclusions in the literature regarding the key concepts related to this study. Namely research paradigm, multi-disciplinary research, inter-disciplinary research, and trans-disciplinary research.

2.1 *Definition and Types of Research Paradigm*

The research paradigm concept has been extensively discussed in the literature, with its definition, importance, and features clarified. In Kivunja et al. [8], it is explained that a paradigm represents the principles used by researchers selecting the appropriate methods for conducting their studies. Researchers sometimes encounter challenges in their research due to the lack of knowledge of paradigm types and their implications [9]. Thus, it is essential to understand and explicitly clarify the paradigm followed in research proposals and projects to determine the strategies for collecting and analyzing data.

As Lincoln and Guba [10] contended, a paradigm is characterized by four main elements – epistemology, ontology, methodology, and axiology. In terms of types, many have been proposed in the literature. For instance, paradigms were initially grouped into three main categories: (1) positivist, (2) interpretivist/constructivist, and (3) critical/transformational paradigms [11]. Researchers then proposed a fourth paradigm type combining the three components mentioned earlier: (4) the pragmatic paradigm [12].

The positivist paradigm is known as the scientific method of investigation [8]. This type of research is based on logic, hypothesis formulation, testing, and various mathematical operations to derive conclusions. The interpretivist/constructivist paradigm is mainly based on understanding the subjective world of human experience, which emphasizes on comprehending the subject's viewpoint under observations rather than the observer's perspective [10]. A theory is then generated based on the data from the conducted work. The critical/transformational paradigm involves research work undertaken to promote social justice and address economic, social, and political issues related to marginalized and underprivileged individuals [8]. The pragmatic paradigm was proposed in order to establish a paradigm that involves a combination of all these methods aiming at understanding human behavior and complex issues in a pragmatic way [8].





| | | | |
|--|---|---|---|
| <p>❑ Disciplinary Approaches - advance the frontiers of knowledge in the various disciplines</p> |  | <p>From the point of view of one discipline</p> | <p>✓ Separate research output</p> |
| <p>❑ Multidisciplinary Approaches - enhance understanding of observed phenomena from various perspectives.</p> |  | <p>From the point of view of multiple disciplines separately</p> | <p>✓ Separate research output</p> |
| <p>❑ Interdisciplinary Approaches - integrate disciplines and allow a more holistic understanding of phenomena.</p> |  | <p>From the point of view of multiple disciplines collaboratively blended</p> | <p>✓ Integrated research output</p> |
| <p>❑ Transdisciplinary Approaches - engage stakeholders and allow integration of practical considerations in developing and applying knowledge.</p> |  | <ul style="list-style-type: none"> ✓ Academics ✓ Investors ✓ Decision/policy makers ✓ Community | <ul style="list-style-type: none"> ✓ Integrated research output ✓ Policies, decisions ✓ Products ✓ Solutions |

Fig. 1 Illustration of the disciplinary, multidisciplinary, interdisciplinary and transdisciplinary research approaches

2.2 Conception, Opportunities and Challenges of Different Research Approaches

An illustration showing the basic definition of the disciplinary, multi-disciplinary, inter-disciplinary, and trans-disciplinary research approaches is presented in Fig. 1.

2.2.1 Multi-Disciplinary Research

Multi-disciplinary research features a combination of knowledge from various fields and disciplines to help understand more complex phenomena. In multi-disciplinary research, scientific and social challenges are independently addressed by two or more disciplinary domains [13]. In other words, research is considered multi-disciplinary when researchers from diverse fieldwork collaborate, but within the limits of their fields [14]. Research in the environmental area is a prime example of multi-disciplinary research, where engineering, ecology, geosciences, physics, and other disciplines can independently, yet collectively, aid in the solution of environmental challenges. Besides, most well-known universities worldwide became involved in multi-disciplinary research to establish collaborative work in medicine and other clinical health care fields [14]. An example of multi-disciplinary research outcome was identifying approximately 25,000 genes in human DNA, which resulted from co-operative work between engineers, biologists, bioinformatics specialists, and other scientists [14]. Moreover, multi-disciplinary research has been widely implemented between anthropologists and psychologists, which resulted in fundamental theoretical advances [15].

Even though adopting the multi-disciplinary approach in research work enables advanced investigations of more complex cases, such an approach faces multiple

challenges [6]. One main challenge facing multi-disciplinary research is that independent contribution of the participating discipline may restrict achieving the intended results. Thus, it is sometimes required to create new concepts based on shared knowledge in an inter-disciplinary manner [14]. Another challenge is related to the data-collection requirements of each researcher, which usually requires some trade-offs, thus hindering the team's ability to meet all the needs of the researchers [6].

2.2.2 Inter-Disciplinary Research

Inter-disciplinary research could be conceptualized as integrating the analytical strengths of multiple distinct disciplines to solve a given problem [16]. Such integration leads to eliminating the commonly faced gaps and challenges in terminology, approach, and methodology. The main difference between multi- and inter-disciplinary research is that the latter relies on shared knowledge created upon the direct interaction between disciplines, rather than the independent nature of multi-disciplinary research [13].

Inter-disciplinary research has gained significant ground over the years due to the nature of interactive work that results in accomplishing further objectives and obtaining better outcomes. For instance, research work conducted in the nanoscience field is directly based on the interactive work from chemical synthesis and physics disciplines [13]. Besides, molecular biologists, behavioral scientists, and even mathematicians could combine their knowledge to solve complex health issues, such as obesity and pain causes [16]. Moreover, one major scientific field is sustainability science, a field aimed at combining multiple disciplines to aid sustainable development, and which is considered either inter- or trans-disciplinary, rather than multi-disciplinary [17]. Perhaps, this is because it may be challenging to realize the goals of sustainability science without the synthesis of ideas from many disciplinary domains.

The engagement of researchers in inter-disciplinary research has undoubtedly increased over the past years, shown in a study conducted by Silva et al. [7], where it was quantitatively confirmed that science fields are becoming more inter-disciplinary. In this study, the degree of inter-disciplinarity showed a strong statistical correlation with the strength and impact of the publishing journals. Also, Carr et al. [5] reported that inter-disciplinary collaboration in publications is rising, based on the analysis of publications in the Institute for Scientific Information (ISI) journals. However, inter-disciplinary research could face a few challenges in implementation, mainly due to the disciplinary boundaries limiting communication between team members and stakeholders [18].

2.2.3 Trans-Disciplinary Research

Trans-disciplinary research is considered similar to inter-disciplinary research, as both are based on the interactive work between researchers from various disciplines, and sharing their knowledge beyond their specializations. However, the main difference between both types is that inter-disciplinary research primarily merges the work of academics in developing an integrated research output and product [19]. On the other hand, trans-disciplinary research encompasses different contributors (stakeholders) working collectively to utilize the knowledge outside their academic scopes, such as generating practical solutions, products, or policies to resolve issues [19].

One of the advantages of trans-disciplinary research is the ability to resolve highly complex and interdependent problems, where issues are unpredictable, not associated with a particular sector/discipline, and require the contribution from multiple stakeholders outside academia for decision-making purposes [20]. For instance, trans-disciplinary research could resolve various societal problems, which constitute significantly high complexity [21]. In such a case, the research results can be integrated with an action-oriented process among the stakeholders involved in providing practical solutions. The efficiency of trans-disciplinary research has been proven in multiple fields, where human interaction with natural systems or significant technical development is required [21].

One main field that requires trans-disciplinary research is sustainable science, which often requires either inter- or trans-disciplinary research, but mostly tends to need the second of the two [17]. Sustainability research problems are significantly considered complex, as they represent several problems and sub-problems belonging to various distinct sectors and disciplines and are constantly changing [17, 21]. Therefore, trans-disciplinary research offers the opportunity to combine different knowledge systems, leading to more effective collaboration between science, policy, and society, resulting in more appropriate solutions to the sustainable science field [22].

As mentioned earlier, one of the merits of trans-disciplinary research is combining the knowledge and efforts of a wide range of stakeholders, along with those of the researchers, to reach practical solutions. However, such an advantage could potentially create multiple challenges for conducting trans-disciplinary research. In particular, the wide variations in values, preferences, and beliefs of decision-makers and stakeholders could further escalate the complexity of problems [21].

2.2.4 Examples of Research Approaches and their Collaborative Activities

The clarification of the various research approaches can be deduced from the research tasks associated with exploring the use and impact of chemicals extracted from plants, as an example. A chemist may study the chemical composition of the plant extracts, which requires several preparation steps, such as grinding and

extraction of active ingredients from plants, developing and applying analytical testing methods, and identifying and classifying chemicals according to types and quantities. Microbiologists may assess the antibiotic properties of plants, which requires preparation steps similar to those used by the chemists studying the chemical composition of the extract. Additionally, the pharmacists are needed to assess the anti-cancer properties of plant extracts and biotechnologists to study the genetic effects of plants extracts. Chemists, microbiologists, pharmacists, and biotechnologists can generate research outcomes separately. However, microbiologists utilizing cook-book chemical techniques may not directly benefit from the expertise of a chemistry specialist in a team of chemists and microbiologists.

On the other hand, a team of chemists, microbiologists, biotechnologists, and pharmacists may work in an inter-disciplinary team focusing on the common goal of producing medical preparations from the plant extracts, as shown in Table 1. In such an inter-disciplinary team, the various team members bring the benefits of their expertise to produce a more scientifically sound and comprehensive outcome. Furthermore, inter-disciplinary collaboration makes researchers more aware of the various field tools, which provides opportunities for adopting such tools in their own disciplines. For example, an environmental specialist working on the production of biofuels from plant waste material may observe microbial inhibition due to the presence of antimicrobial agents in the plant material, which can then be further confirmed and understood through testing the anti-microbial, anti-cancer, and genetic effects of such materials.

Table 1 Example of research tasks exploring the use and impact of chemicals extracted from plants

| Task No. | Task | Common Tasks | Research Nature and Output | | |
|----------|--------------------------------|--------------------------------|----------------------------|---|--|
| | | | Multi | Inter | Trans |
| 1. | Grinding & extraction | Common to tasks 4, 5, 6, 7 & 8 | Chemistry | Various combinations, (i.e., chemistry+ microbiology + pharmacy) with common purpose of testing a potential medicine from plant extract | Various combinations (i.e., scientists, community, government, business & industry) depending on desired outcome |
| 2. | Preparation of chemicals | | | | |
| 3. | Testing chemical composition | | | | |
| 4. | Testing anti-microbial effects | | Microbiology | | |
| 5. | Testing anti-cancer effects | | Pharmacy | | |
| 6. | Characterizing genetic effects | | Biotechnology | | |
| 7. | Conducting clinical trials | | Medical, social | | |
| 8. | Producing biofuel from waste | | Environment | | |

The benefits of multi-disciplinary and inter-disciplinary research collaboration extend to reducing efforts through sharing common tasks leading to various shared outputs involving various discipline foci. An example of such benefits and outcomes is illustrated in Table 2 [23–25]. The project described here aims at assessing the presence, fate, and potential impacts of emerging contaminants in wastewater in Sharjah, United Arab Emirates. In this case, the project team involves a chemist, a pharmacist, an environmental specialist, a plant biologist, and a public health expert. Since the team members focus on common goals and objectives, the contribution of the team specialists are negotiated and agreed upon in an attempt to maximize and share benefits. The results of such combined effort will lead not only to enhanced understanding of the phenomena, but also to shared publications and research grants among the team members that otherwise would not have been possible.

3 Research Context of University of Sharjah

In 2014, the University of Sharjah (UoS) opted for reorganizing research management around three research institutes serving researchers and students from the various colleges despite the tendency to maintain research managed by the academic colleges and departments. The Medical and Health Sciences Research Institute serves four medical and health colleges. The Research Institute of Sciences and Engineering serves the sciences, engineering and computing colleges. And the

Table 2 Examples of multi-disciplinary and inter-disciplinary team collaboration project

| Task | Task | Common tasks | Team | Publications |
|------|--|--------------------------------|--|--|
| 1. | Development of novel analytical methods | Common disciplinary task | Chemistry, pharmacy, environmental science, engineering, plant biology & public health | “Simultaneous determination of pharmaceuticals by solid-phase extraction and liquid chromatography-tandem mass spectrometry” [24]. |
| 2. | Identification and quantification of chemicals | Inter-disciplinary orientation | | |
| 3. | Analysis of wastewater treatment plant performance | Inter-disciplinary | | |
| 4. | Analysis of human health risk from exposure | Inter-disciplinary | | |
| 5. | Uptake of pharmaceuticals by plants | Inter-disciplinary | | |
| | | | | “Contaminants of emerging concern in Sharjah wastewater treatment plant, Sharjah, UAE” [25]. |
| | | | | “Human health risk assessment of pharmaceuticals in treated wastewater reused for non-potable applications in Sharjah, United Arab Emirates” [23]. |
| | | | | Uptake of select pharmaceuticals by leafy plants (under review) |

Humanities and Social Sciences Institute serves five colleges: Arts, Humanities and Social Sciences; Business Administration; Communication; Law; and Sharia and Islamic Studies. The main purpose of this organization was to encourage cross-disciplinary collaboration through funding multi-disciplinary and inter-disciplinary research groups. Each research institute coordinates and funds research, providing opportunities for different research initiatives focusing on multi-disciplinary and inter-disciplinary studies. Since 2015, a total of 27 research groups/lines were formed in the Research Institute of Sciences and Engineering. Figure 2 indicates the number of academic departments involved in the various listed research groups/lines. A few research groups consist of researchers from one discipline. For example, researchers in the Civil Engineering Department formed two groups, with one focused on structural systems and the other on infrastructure. The various subdisciplines involved in the infrastructure group are shown in Fig. 3, which illustrates that seemingly disciplinary groups are in fact multi-disciplinary in the new research structure. In fact, the UoS research outcome has increased since this reorganization as evidenced by the number of research publications in the various research databases.

Apart from research activities, UoS is moving towards establishing unique multi-disciplinary/inter-disciplinary graduate programs to support research in the aforementioned centers and groups. For example, the Research Institute of Sciences and Engineering initiated various programs in collaboration with the concerned academic colleges and other UoS research institutes. Such programs include MSc. in

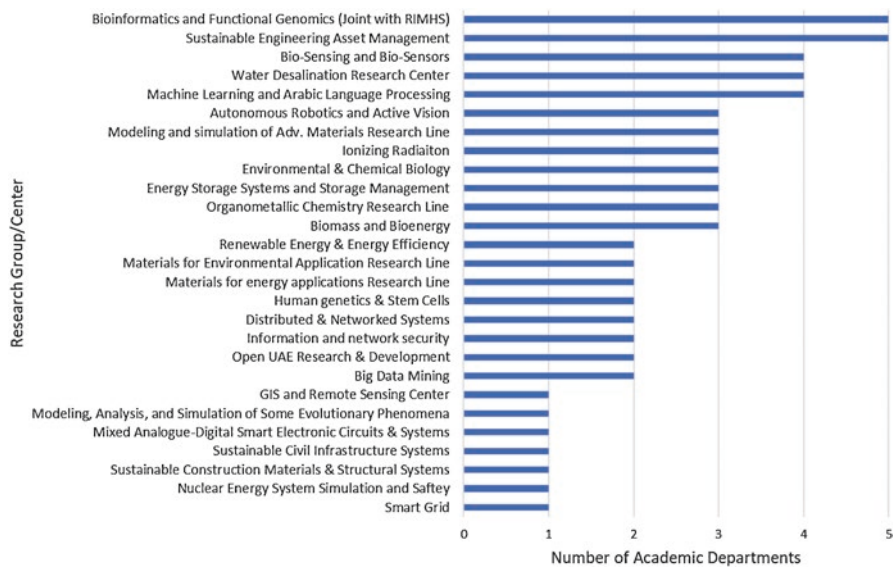


Fig. 2 Number of academic departments from the three colleges of Sciences, Engineering and Computing and Informatics represented in the various research groups/lines in the Research Institute of Sciences and Engineering at UoS

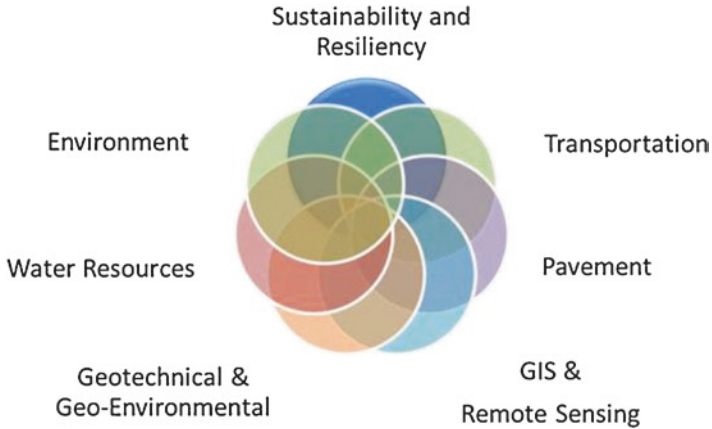


Fig. 3 Disciplines in the infrastructure research group in Civil Engineering Department at UoS

Environmental Sciences and Engineering; MSc. in Geographic Information Systems and Remote Sensing, and MSc. in Biomedical Engineering.

4 Opportunities in Multi-Disciplinary and Inter-Disciplinary Research

As stated earlier, a combination of methods grounded in different disciplinary philosophies offers many opportunities to strengthen research output and sustainable impacts. Some of these are:

- Meeting the personal interests of researchers to solve complex societal problems
- Potential for increased production and impact through collaborative endeavours
- Enhanced quality and citations of research publications
- Reduction of efforts through sharing common research resources and tasks
- Reduction of stress through team support and networking opportunities
- Opportunities to deal with complicated and real-life problems in society
- Participation in multi-and inter-disciplinary funding opportunities [13, 19, 22]

As drawn from the experience of the Research Institute of Sciences and Engineering, these research approaches increase the quality of research output and citations, thereby strengthening the institution's research reputation. Combining efforts and harnessing resources, including project software and required acumen, also save time, energy, and research assets. The approaches promote team and network building, both internally within the university and externally with other organizations. Through group and network building, faculty and researchers build synergy and access to more collaborative funded research and projects.

As Table 2 indicates, many research projects have been successfully conducted using different research orientations at the Research Institute of Sciences and Engineering, and findings were published in reputable journals. Despite the multi- and inter-disciplinary research opportunities, it is essential to acknowledge the inherent limitations and possible challenges to these research approaches.

5 Limitations and Challenges to Multi-Disciplinary and Inter-Disciplinary Research

The lack of clarity on rules and responsibilities, actual or perceived, can cause conflict and possibly resentment [26]. Roncaglia [26] identified four risk factors in multi-disciplinary teamwork: communication barriers; accessibility and availability of resources; group size; and accountability. The same limitations may also apply to inter-disciplinary teamwork. Communication barriers may be attributed to team members prioritizing their disciplinary contributions and lacking agreement on common aims and goals. Sharing available resources promptly and communication of data about resources are essential to nurturing teamwork and collaboration. Team size is another issue that may threaten collaboration, sharing of resources, shifting responsibilities, and productivity. The risk of misjudgment may also arise when team members from different disciplines differ in their approach and assessment, or when interdependence among team members results in ambiguity in terms of rules and responsibilities.

The following are possible challenges and limitations to multi-disciplinary and inter-disciplinary research [6, 14, 18, 21, 27, 28]:

- The dominance of disciplinary academic systems: Although all scholars acknowledge the need for collaborative research in concept development and innovation, it was found that some disciplines dominate others, thereby discouraging scholars from some fields.
- Administration and organizational boundaries: Some regulations and boundaries are considered favorable to some disciplinary areas, which may discourage collaboration among scholars from different fields.
- Promotion and incentives bias against other disciplines: Negative sentiments about co-authors may discourage scholars from being engaged in collaborative research of multi or inter-disciplinary nature.
- Publication obstacles: Some journals do not accept papers and findings emerging from multi- and inter-disciplinary research, perhaps because of preferences for specific disciplinary-focused publications. Differences in referencing style could also pose challenges for some scholars, which could discourage them from engaging in multi- and inter-disciplinary studies.
- Available funding opportunities: There are also limited funding opportunities for collaborative research. More so, some focused disciplinary studies are sometimes

promoted through institutional policies, which could be influenced by some perceived societal needs for scientific innovations.

- **Skills needed for engagement in integrative research:** Limitations in the research skills to employ and integrate different research philosophical paradigms and methods are also challenges hindering collaborative research.
- **Time factor:** Lack of enough time to plan and engage in multi-disciplinary research, possibly because of some official duties, may hinder the scholars' involvement in collaborative research. These may include teaching course loads and engagement in committees. Differences in time zone may also hinder valuable international collaborative research for educators.
- **Reliance on technology:** Over-reliance on technological tools as one of the conditions for funding and perceived effectiveness of inter-disciplinary research may discourage some scholars from collaborative research. For some scholars, they may not need technological tools. Still, funding for research assistants and the misconception about using technology could discourage those scholars from applying for collaborative research funding.

6 Skills for Multi-Disciplinary and Inter-Disciplinary Research

Nolan [29] suggested that inter-disciplinary and multi-disciplinary approaches require overcoming professional boundaries and rely on trust, tolerance, and sharing of responsibilities. The following are a set of skills required for successful multi- and inter-disciplinary research [26, 30–32]:

- ***Effective leadership:*** In any multi- or inter-disciplinary research, there is a need to have leaders with sufficient skills to ensure the participation of all team members and efficient sharing of resources and responsibilities, which is essential to improve processes and outcomes.
- ***Overcoming professional boundaries:*** Multi- and inter-disciplinary research require overcoming professional boundaries between members through showing respect for the various disciplines and trust in each other's roles and competencies, as well as the willingness to share responsibilities and outcomes.
- ***Communication:*** Researchers need to clearly communicate the contribution of their disciplines to other members from different fields. Effective communication requires team members to agree on common aims and goals and to recognize the contributions of other team members and their disciplines.
- ***Trust and tolerance:*** It is required to establish a level of trust between members in each other's competencies and accept the perspectives of other members.
- ***Self-management and adaptability:*** Researchers need to carefully identify their research priorities and to adapt to the way other members from different disciplines evaluate problems.

- **Non-technical skills:** Being able to establish good relationships with other members is essential for every researcher in order to have better communication, conflict management, and producing high-quality deliverables.

7 Conclusion

This chapter explored the opportunities and challenges in collaborative research endeavors using the inter-disciplinary and multi-disciplinary approaches. We looked into the extant literature on this subject and offered insight into the experiences of UoS. And drawing on the perspective from the Research Institute of Sciences and Engineering specifically, we concluded that multi-disciplinary and inter-disciplinary research have immense benefits to scholars and the community in addressing complex problems. We contended that using either of the two research approaches is not without some challenges and hindering factors. As such, stakeholders such as researchers, institutional leaders, and funding bodies need to keep exploring strategies for enhancing research grounded in the pragmatic paradigm using a combination of expertise and specializations. Table 3 shows the possible measures and efforts required for promoting and strengthening multi-disciplinary and inter-disciplinary research. Working with colleagues from other fields can foster research effectiveness for resolving complex issues, and enhance the adoption of collaborative research.

Management teams in institutions have to create a culture of collaboration, supported by appropriate policies and to raise awareness about the prospect of collaborative research along with adequate training. Besides, they need to provide essential

Table 3 Framework for promoting and strengthening multi-disciplinary and inter-disciplinary research

| Faculty | Management | Funding agency |
|--|--|--|
| Appreciating teamwork and collaboration Respecting and showing interest in other disciplines and their contributions Showing openness to learn new research-focused skills and benefit from other disciplines Willingness to share knowledge & compromising in collaborative research Dedicating scheduled time for collaborative research where responsibilities are shared | Inducing cultural change and removing unproductive boundaries Balancing disciplinary and collaborative research through leadership, policies and incentives Ensuring consistent strategies and policies Raising awareness and training Providing incentives (e.g., teaching load reduction), infrastructure and funding Reducing pressure to publish in top foreign journals and in foreign languages | Setting clear goals, objectives and expectations while providing adequate resources Having benefits directed towards social knowledge and technology-based economies Supporting the publication of findings from funded projects Offering training opportunities both locally and internationally Promoting collaboration among researchers to foster cross-fertilization of knowledge |

incentives, funding, and faculty resources to tap on multi- and inter-disciplinary research. With the need for research visibility fostering impacts and promoting institutional images, management needs to encourage faculty to publish in reputable journals, but this needs to be done moderately. The funding bodies also need to set clear rules and policies encouraging multi-disciplinary and inter-disciplinary research proposals. They need to promote research that focuses on different societal dimensions, tapping into the scholars' knowledge and expertise with various disciplinary orientations.

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