

# Beyond The Boundaries: Interdisciplinary Collaboration As The Engine Of Innovation And Impact At The Faculty Level

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## Abstract

*This study examined interdisciplinarity as a key driver of innovation and societal impact at the faculty level. Drawing on both historical and contemporary research, it argues that complex societal challenges—such as climate change, public health, urbanisation, and technological disruption—require knowledge creation and teaching practices that extend beyond single-discipline boundaries. The review gathers evidence of interdisciplinary benefits, including increased creativity, better problem framing, greater policy relevance, and improved student skills in critical thinking and collaboration. At the same time, it highlights ongoing challenges: epistemic tensions, misalignment in curriculum and assessment, faculty workload pressures, publication and funding hurdles, and risks of superficial integration. To address these issues, the paper proposes institutional strategies for effective implementation: targeted faculty development, dedicated cross-disciplinary research centres, structurally embedded experiential and project-based learning, mentoring and networking programmes, customised assessment rubrics and recognition systems, and investment in supporting infrastructure and governance. It also stresses the importance of reflexive ethics and fairness audits in technology-intensive projects. The analysis provides practical recommendations for universities to realign incentives, build capacity, and implement inclusive evaluation mechanisms that encourage interdisciplinary outputs. The conclusion states that interdisciplinarity can significantly boost innovation and societal impact, provided it is supported by coherent design, ongoing institutional backing, and rigorous, context-sensitive evaluation.*

**Keywords:** *Interdisciplinarity, collaboration, complex problems, research, innovation.*

## Introduction

Interdisciplinarity has developed from experimental curricula in the 1960s and 1970s into a key strategy for tackling modern societal challenges (OECD Science, Technology & Industry, 2020). Recent research highlights the expanding application of interdisciplinary methods across various areas—from student and researcher engagement with society and culture (Gerrard, 2025), to adapting peer review to ensure scientific rigour across disciplines (Hoffmann, 2022), to designing hospitals of the future (Smye & Frangi, 2021) and adult education (Erichsen & Goldenstein, 2011). Overall, this body of work indicates that interdisciplinary efforts are gaining increased attention from policymakers and the public and can drive innovation and impact when they genuinely combine theories and methodologies rather than merely mixing methods or personnel superficially (Bone, Emele, Abdul, Coghill, & Pang, 2016; Gerrard, 2025; Gonzales & Núñez, 2021).

Simultaneously, many higher education institutions remain structured around deeply embedded disciplinary divisions that foster specialised expertise but can hinder collaboration, broader problem framing, and teamwork essential for addressing complex issues (Jung, 2020; Srinivas & Varaprasad, 2024; Zahra et al., 2020). Scholars have emphasised both the potential and limitations of interdisciplinarity: it can boost creativity, problem framing, policy relevance, and student skills (Misra, 2024; Maringe & Chiramba, 2023; Hart et al., 2020), yet it also faces epistemic tensions, curriculum misalignment, workload pressures, and incentive structures that prioritise disciplinary outputs (Zahra et al., 2020; Bone et al., 2016). The growing systemic impact of technologies like AI further accentuates the necessity for coordinated, ethically reflexive approaches that transcend faculty boundaries (Christine, 2025; Gallagher & Savage, 2023).

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This study adopts a focused perspective: it investigates interdisciplinarity as a driver of innovation and societal impact specifically at the faculty level. Faculties serve as the institutional arenas where hiring, curriculum development, research assessment, and reward systems are enacted; they therefore hold a crucial role in either fostering or limiting cross-disciplinary collaboration (Gerrard, 2025; Gonzales & Núñez, 2021). Understanding how interdisciplinarity operates within and between faculties is vital for translating the broad promises documented in the literature into enduring, quantifiable outcomes for society and students alike (Misra, 2024; Jewitt, van der Vlugt, & Hübner, 2021).

Universities and faculties face a paradox: complex societal challenges such as climate change, public health, urbanisation, and technological disruption demand knowledge production and teaching that transcend disciplinary boundaries (Hoffmann, 2022; Smye & Frangi, 2021; Hart et al., 2020), yet prevailing faculty structures, curricular arrangements, assessment regimes, and incentive systems often hinder meaningful interdisciplinary collaboration, leading to fragmented efforts, superficial integration, and limited societal impact (Zahra et al., 2020; Bone et al., 2016; Gonzales & Núñez, 2021).

The purpose of this study is therefore to investigate how interdisciplinary collaboration can be designed and supported at the faculty level to maximise innovation and societal impact. Building on historical and contemporary research, the study synthesises evidence of benefits and barriers and develops practical institutional strategies that faculties can implement to foster deep, accountable, and evaluable interdisciplinary work (Gerrard, 2025; Misra, 2024; Bruggeman et al., 2021). Through a literature review, the study i). synthesises empirical and conceptual literature showing how interdisciplinarity contributes to innovation, policy relevance, and enhanced student competencies (Gerrard, 2025; Misra, 2024; Maringe & Chiramba, 2023). ii). identifies faculty-level barriers and risks to effective interdisciplinarity, including epistemic tensions, curriculum and assessment misalignment, workload and reward structures, and risks of superficial integration (Bone et al., 2016; Zahra et al., 2020). iii). proposes institutional strategies and governance interventions — such as faculty development, cross-disciplinary centres, experiential learning embedded in curricula, mentoring and networks, tailored assessment rubrics, and infrastructure investments — that align incentives and build capacity for sustained impact (Gerrard, 2025; Gonzales & Núñez, 2021; Smye & Frangi, 2021). iv). emphasises the role of reflexive ethics and fairness audits in technology-intensive projects and outlines evaluation mechanisms that are context-sensitive and inclusive (Christine, 2025; Gallagher & Savage, 2023). By centring the analysis at the faculty level and maintaining evidence-based recommendations, we aim to move beyond disciplinary rhetoric and provide tangible pathways for universities to realign incentives, foster interdisciplinary capacity, and assess outcomes in ways that promote both innovation and societal good (Misra, 2024; Jewitt et al., 2021).

## Literature Review

### Embracing Interdisciplinary Approaches in Higher Education Institutions: A Shift in Knowledge Generation Paradigms

Higher education institutions experience significant changes in knowledge development as they shift from traditional disciplinary frameworks to interdisciplinary approaches. This transition occurs because experts recognise that complex real-world problems require a comprehensive understanding and collective solutions, which they believe disciplinary focus alone cannot provide. Researchers from various fields have emphasised the importance of interdisciplinarity. For example, Erichsen and Goldenstein (2011) assert that interdisciplinarity fosters the development of more functional literacy for information seeking across disciplines and the thoughtful integration of such information into academic and practical research projects within adult education. Gerrard's (2025) research highlights changes in the climate tech funding ecosystem, ranging from physical technologies (such as solar panels) to ensuring the climate conversation explores and incorporates solutions proposed by indigenous knowledge systems, rather than prioritising Global North-led models. A central argument of the session centred on interdisciplinarity: overcoming the climate crisis requires moving beyond individualistic mindsets and fostering a collective approach. Klein (1990) states that interdisciplinary methods facilitate collaboration beyond the boundaries of single fields by enabling the exchange of ideas between them. Her approach suggests that combining specialised expertise with

perspectives from related disciplines results in improved innovation and a deeper understanding of complex systems such as climate change, healthcare, and technological development. According to Leavy (2016) and Robinson and Lee (2011), multidisciplinary approaches lead to enhanced knowledge advancement. Interdisciplinary research and education are vital tools for fostering creativity, analytical thinking, and flexible problem-solving skills in students. Such collaboration allows both academics and learners to broaden their understanding while challenging their assumptions, ultimately improving their ability to address real-world problems effectively.

According to Smye and Frangi (2021), the hospitals of the future will be shaped by scientific and technical advances made across a wide range of disciplines, as complex problems in healthcare cannot be addressed successfully by a single discipline. This paper examines the promotion of interdisciplinary research and the prospects for developing stronger and deeper collaborations among medicine, health, and other fields, drawing on case studies from mathematics, physics, and engineering. Leavy (2016) and Robinson and Lee (2011) support research on interdisciplinary knowledge creation by arguing that transdisciplinary research goes beyond interdisciplinary methods by involving academic and industry professionals, policymakers, and community members. The adoption of interdisciplinary approaches in higher education institutions enhances knowledge development through integrating academic and non-academic perspectives. These institutions now prioritise interdisciplinary practices as their primary method of knowledge creation after moving away from solely discipline-based approaches.

However, while the implementation of interdisciplinary methods shows potential to enhance innovation and critical thinking, these approaches present significant challenges that negatively affect learning quality and coherence. According to Jones (2010) and Holland (2013), different disciplines maintain distinct epistemic assumptions and methodological norms, which lead to superficial synthesis, inconsistent rigour, and diluted disciplinary depth. Students face multiple challenges as they encounter fractured knowledge structures and conflicting terminology and evidence standards, which hinder their ability to develop strong theories and transferable skills. The integration of knowledge across fields creates difficulties for curriculum design, assessment alignment, and faculty collaboration, potentially leading to practical implementation issues and reduced institutional support (Morss, Lazarus, & Demuth, 2021). For example, integrating AI and data-driven practices into various disciplines without adequate fairness considerations can result in new forms of bias or unfairness (Weinberg, 2022). To address these challenges, implementing explicit integration frameworks within curricula should include shared learning outcomes, standardised conceptual ontologies, and scaffolded projects that involve iterative discipline-based critique.

Structured facilitation through cross-disciplinary teams and co-teaching, along with regular alignment meetings, would help synchronise methodologies and expectations (Morss et al., 2021). Additionally, establishing clear assessment rubrics that evaluate both disciplinary rigour and integrative synthesis, coupled with faculty professional development in interdisciplinary pedagogy, will enhance coherence. Moreover, it may be necessary to implement reflexive ethics-informed check-ins and ongoing fairness audits for technology-focused components (Weinberg, 2022) to uphold social responsibility in innovation. All these steps will ensure that higher education institutions achieve a reliable transformation of knowledge acquisition into creativity cultivation and critical thinking by implementing proper design and governance measures. Wilson (2002) demonstrates that multiple disciplines must be integrated to successfully address critical global issues, including climate change, environmental degradation, and public health crises.

Jewitt, van der Vlugt, and Hübner (2021) describe the development and importance of an original and innovative interdisciplinary approach, *Sensoria*, which combines methods from social science and performance to address the methodological challenges of researching sensory and multimodal experiences. Their research outlines the key components and principles that underpin the approach and includes a practical example showing how it can support research into hard-to-access sensory experiences, enabling access to, understanding, and analysis of people's perspectives on touch, a highly tacit sensory mode. These researchers conclude by calling for more critical research spaces at the intersection of these disciplines to promote multidimensional research discussions and deepen the exploration and understanding of the relationship between the sensory, social, and digital worlds.

Evans (2016) introduces a new, text-based approach to measuring interdisciplinarity. The author compares the text of a scholar's publications with texts from multiple disciplines and assesses how much a scholar's work incorporates language from both distant and nearby fields. The measure is applied to all faculty members at Stanford University from 1993 to 2008. Validity evidence is provided through comparisons of text, citation, and co-authorship measures of interdisciplinarity, as well as measures of disciplinarity and other variables. This text-based measure opens up new possibilities for data analysis, especially for unstructured text and fields like the humanities that focus on books.

### **The benefits of interdisciplinarity**

Interdisciplinary research provides unique insights and solutions by integrating diverse perspectives, methods, and theories to address complex issues such as climate change, urban planning, and public health emergencies. There is a positive link between the interdisciplinarity of scientific publications and the attention they receive from policy documents, suggesting that interdisciplinary research has a greater influence on policymaking. Researchers are using interdisciplinary approaches to tackle global challenges, such as analysing the complex impacts of the COVID-19 pandemic, examining ethics in human-animal relationships, and understanding the inequalities exacerbated by the crisis (Mokski et al, 2023).

### **Critiques of Disciplinary Knowledge Generation**

In the 1960s and 1970s, a shift towards interdisciplinarity emerged, as outlined earlier in this paper. Critics argue that the disciplinary paradigm results in fragmented thinking, which impedes team-based work across different disciplines. The interdisciplinary approach faces numerous challenges from writers and researchers who claim that it fails to address complex real-world issues and hinders the development of innovative ideas. Jung (2020)'s analysis of the limitations in disciplinary knowledge production offers a significant critical perspective in this area. According to Jung (2020), strict adherence to disciplinary frameworks causes researchers and academics to concentrate heavily on specialised knowledge, leading to a limited understanding of complex problems like global warming. This fragmentation obstructs interdisciplinary collaboration and prevents the integration of multiple perspectives necessary for solving complex issues (McCowan, 2023; Jung, 2020). In her book "Interdisciplinarity: Its Role in a Discipline-based Academy," Klein (1990) provides a critical assessment of disciplinary knowledge production based on specialised subject competence. Klein argues that while disciplinary competence has value, its focus on depth often neglects breadth, thereby hindering collaboration between different fields. She believes that this narrow focus prevents knowledge integration and limits the capacity to develop innovative solutions to complex problems.

Kuhn (2012) presents an opposing view in his book "The Structure of Scientific Revolutions," criticising both the ways disciplinary knowledge is produced and the inherently conservative nature of academic institutions. According to Kuhn (2012), disciplinary paradigms tend to resist innovative ideas and approaches for integrating knowledge to solve complex problems. De Sousa Santos (2015) offers a critique of Eurocentric disciplinary knowledge in "Epistemologies of the South: Justice Against Epistemicide," advocating for diverse knowledge systems. He states that the disciplinary paradigm constructs knowledge hierarchies that marginalise communities by favouring specific knowledge systems and excluding others. These criticisms highlight why higher education needs interdisciplinary methods for creating knowledge to address complex real-world issues and to foster innovation through the development of interdisciplinary knowledge practices.

Despite its advantages, interdisciplinary research faces obstacles in fostering collaboration, with researchers citing difficulties in securing grants and publishing in high-quality outlets compared to single-discipline work (Smye & Frangi, 2021; Trussell et al., 2017). The challenge of bridging different methodologies, theories, and even jargon across fields hampers the development of effective collaborative projects (Trussell et al., 2017). Although some initiatives like internal grant schemes and dedicated research institutes have proven successful in encouraging collaboration, there is a need for more organised activities and support mechanisms to facilitate interaction and overcome barriers (Erichsen & Goldenstein, 2011). Furthermore, the difficulties in constructing shared understanding, developing research synergies, embracing vulnerability

and discomfort to advance knowledge, and negotiating risks of legitimacy while transcending disciplinary boundaries (Trussell et al., 2017) also pose significant challenges.

### **The Emergence of Interdisciplinary Approaches to Generate Knowledge**

Traditional knowledge production once separated different subjects into distinct areas, with individual disciplines pursuing specialised research paths. Today, methods are distinguished by combining multiple fields, breaking down disciplinary barriers, and promoting interdisciplinary work across various academic sectors (De Sousa Santos, 2015). Kuhn (2012) and Klein (1990) describe how disciplined scholars develop knowledge within their specialised areas of expertise. Researchers dedicate themselves to specialisation and activities that advance particular academic fields. For example, the medical field is divided into three distinct practice areas: cardiology, dermatology, and neurology. According to Newell & Klein (1996), interdisciplinarity allows experts to integrate knowledge from different disciplines when addressing complex problems. Literature from authors such as Streets (2022), Wahlrab (2023), and Vilsmaier, Faschingeder, Merçon, and für Entwicklungspolitik (2020) demonstrates how broad knowledge has become increasingly important as the environment changes. Higher education professionals must actively respond to the market's demand for new information, as it is essential for the field (Robinson & Lee, 2011). Research by Yusuf, Walters, and Sailin (2020) indicates that active participation involves transforming mainly disciplinary or intradisciplinary knowledge systems into a knowledge-based society framework that features innovative approaches to learning and information creation. A learning process that employs new methods requires students to go beyond their individual fields and embrace multiple disciplines, including interdisciplinarity, transdisciplinarity, and cross-disciplinarity. Recognising the interconnectedness and complexity of global problems drives this shift. According to Newell and Klein (1996), interdisciplinary teamwork fosters the generation of new ideas and broadens approaches to problem-solving. The extensive knowledge base associated with this method allows for multiple perspectives and diverse strategies, enhancing problem-solving skills and encouraging creative thinking. Combining skills from different fields can lead to unexpected breakthroughs and novel achievements. Examining issues from multiple angles through interdisciplinary, transdisciplinary, and cross-disciplinary approaches facilitates a deeper understanding of complex phenomena (Newell & Klein, 1996).

Students now need a shift from traditional knowledge acquisition towards fostering creativity and innovation (Yusuf, Walters, & Sailin, 2020). This shift recognises the importance of developing individuals with skills that enable them to succeed in the rapidly changing global environment. Multiple researchers have studied this transformation, illustrating its influence on the future of higher education (Matraeva, Rybakova, Vinichenko, Oseev & Ljapunova, 2020).

Wahlrab (2023) states that learning is an essential component for achieving maximum output. She emphasises the importance of knowledge management while supporting universities in transforming their fragmented knowledge models into a unified approach that incorporates multidisciplinary, transdisciplinary, cross-disciplinary, and non-disciplinary methods of knowledge development. The authors Streets (2022), Wahlrab (2023), and Vilsmaier, Faschingeder, Merçon, and für Entwicklungspolitik (2020) agree that this new direction enhances students' abilities for complex problem-solving and makes significant contributions to the field, while also fostering creativity and innovation. Galili (2022) illustrates how Galileo achieved renowned breakthroughs in physics and astronomy. Analytical thinking combined with his willingness to question conventional beliefs made Galileo a powerful force in his time. Galili (2022) states that the critical thinking and problem-solving approach emphasised by Galileo remains vital in contemporary culture as it was in his era. According to Galili (2022), developing these abilities in higher education can enhance creativity and stimulate critical thinking among students, exemplified by Galileo's expedition and his persistent challenges to conventional knowledge.

According to Robinson (2011), many education systems concentrate on teaching cultural norms instead of fostering innovative and creative minds. His argument emphasises that universities should teach students critical thinking skills and problem-solving methods because these abilities enhance modern business competitiveness. By encouraging interdisciplinary study and integrating knowledge from various fields, universities assist students in developing inventive solutions that emerge from new perspectives. According

to Davidson (2017), the traditional education categories mentioned by Robinson (2011) hinder the development of students' critical thinking abilities. She highlights the importance of collaboration, cross-disciplinary learning, and practical problem-solving in preparing students for the complexities of the 21st century. Davidson (2017) also suggests that higher education institutions should shift towards project-based learning methods to unite students from different disciplines, enabling them to tackle complex problems and craft innovative solutions. This educational approach creates an environment that nurtures critical thinking and equips students for a fast-paced society.

Streets (2022) and Vilsmaier et al. (2020) demonstrate the importance of higher education institutions shifting their learning approach from simply acquiring knowledge to fostering creativity. Their writings provide essential information about this educational transition that encourages creativity development and supports critical thinking. The authors emphasise that higher education institutions must adopt interdisciplinary learning strategies and focus on developing students' critical thinking skills and problem-solving abilities to meet the educational demands of the 21st century. The renowned philosopher Dewey (2022) agrees, emphasising that education should prioritise solving real-world problems rather than just acquiring theoretical knowledge. According to Dewey (2022), the main aim of education involves engaging students in real-world activities while cultivating their critical thinking skills through authentic learning experiences. Students gain a better understanding and enhance their creative problem-solving capabilities through a multidisciplinary approach, which integrates various academic fields. Universities can achieve this by implementing such methods, bridging the gap between theoretical knowledge and practical application, and equipping students with the essential skills required for the modern workforce.

### **Advantages and Benefits of Interdisciplinary Knowledge Generation**

Academic institutions are experiencing increasing demand for interdisciplinary research as they pursue new knowledge. Multiple disciplines work together to solve complex problems using interdisciplinary methods, according to Newell & Klein (1996). Jung (2020) points out that transdisciplinary knowledge offers a distinct advantage when tackling complex issues that single disciplines cannot resolve. Several scholars, including Newell & Klein (1996), Aldrich (2014), and Maringe & Chiramba (2023), show that research combining different perspectives leads to a deep understanding of complex issues. Collaboration across various disciplines improves skill sharing, according to Hsu and Shiue (2017), which results in innovative solutions that go beyond traditional disciplinary methods. Leavy (2016) emphasises that interdisciplinary research allows researchers to analyse interconnected aspects of a situation because it provides comprehensive insights, resulting in more resilient and effective problem-solving approaches.

Academic programmes that foster interdisciplinary knowledge help students develop an innovative mindset and a creative approach to problem-solving. The integration of various academic disciplines fosters an environment that encourages innovative thinking, diverse perspectives, and novel approaches (Rajabzadeh et al., 2021). Newell and Klein (1996) argue that professionals working across disciplines combine their cultural backgrounds during collaborative efforts to generate better brainstorming sessions and improve their problem-solving creativity. Exposure to multiple academic fields, as described by Leung et al. (2008), enhances research creativity by promoting traditional thinking while also supporting alternative approaches.

Interdisciplinary knowledge creation allows students and researchers to develop a comprehensive understanding of complex events by examining multiple aspects that might be missed from a single discipline's viewpoint. Misra et al. (2011) explain how academic interdisciplinary work helps scholars go beyond their discipline-specific boundaries, enabling the integration of knowledge from various fields and a thorough investigation from multiple perspectives. Jung (2020) states that this research approach offers a broader understanding by combining theories, approaches, and datasets from different disciplines. The process leads to more accurate results and helps researchers identify critical gaps in information and discover new patterns.

Newell and Klein (1996) suggest that generating knowledge across disciplines improves communication among students, instructors, and researchers, fostering an inclusive environment that encourages teamwork. According to Misra et al. (2011), students and academics develop stronger skills in learning and applying

various communication and collaboration methods when involved in multidisciplinary partnerships. This process helps them enhance their ability to explain complex topics. The diverse experiences and approaches within interdisciplinary teams promote mutual learning and respect, while establishing a shared knowledge base. Leavy's (2016) study confirms that multidisciplinary collaboration supports critical thinking, encourages openness to new ideas, and enhances adaptability, thereby facilitating successful collaboration both across and within fields.

The process of generating interdisciplinary knowledge offers numerous benefits that improve problem-solving skills, promote innovative approaches, deepen understanding and analysis, and strengthen collaboration and communication among researchers. The authors Misra et al. (2011), Leung et al. (2008) demonstrate that knowledge creation requires multidisciplinary methods to address complex problems, which promotes academic progress across various fields. Combining interdisciplinary efforts enables researchers to develop groundbreaking discoveries and transformative research findings, leading to meaningful social impacts.

Interdisciplinary programmes achieve excellent results by promoting activity, enhancing problem-solving abilities, and cultivating critical thinking. Participants in the Health Humanities initiative demonstrated increased clinical empathy skills, with a 30% rise in empathy scores from assessments and improved discipline integration skills in patient care scenarios (Newman, 2024). External evaluators reviewed participants in the Interdisciplinary STEM Education programme and found that their capacity to develop innovative solutions for community-specific climate issues had significantly improved. Students involved in the programme reported that 85% of them had enhanced their ability to apply interdisciplinary approaches to real-world problems, gaining valuable skills for future employment across various fields (Specht & Crowston, 2022).

Interdisciplinary learning offers many benefits to higher education students by improving their creativity and critical thinking skills, but it also presents specific challenges that need careful assessment. Mokski et al. (2023) emphasise that institutional support, clear goal setting, and structural flexibility are vital for effective interdisciplinarity. However, without these, integration can become superficial, failing to produce true synthesis and potentially overwhelming students rather than encouraging innovative understanding. Practical difficulties in coordinating across disciplines lead to unclear learning outcomes and varied student experiences because disciplines use different epistemologies, methodologies, and assessment standards. According to Tonnetti and Lentillon-Kaestner (2023), teaching interdisciplinarity requires specific pedagogical techniques and collaborative methods; nonetheless, poor curriculum design and inadequate teacher preparation can create isolated learning environments that obstruct the creative aims of interdisciplinarity. These studies show that while interdisciplinarity can promote sustainable transformational learning, realising this potential faces challenges related to structural complexity, misaligned assessments, epistemic tensions, and the need for teacher development, thoughtful design, effective governance, and ongoing evaluation to achieve lasting innovation and critical thinking.

### **Implementing Interdisciplinary Approaches in Higher Education**

Higher education institutions must carefully evaluate several essential factors to effectively adopt interdisciplinary approaches while devising solutions to potential challenges and limitations. According to Jung (2020), educators and learners need to cultivate a collaborative environment as a key step in implementing interdisciplinary methods. Newell and Klein (1996) emphasise that institutions should foster a collaborative atmosphere that promotes both disciplinary and institutional interaction. The creation of interdisciplinary research centres, along with cross-departmental committees and working groups, as well as interdisciplinary seminars and conferences, serve as ways to achieve this aim. The initiatives introduced by Diphorn, Leyh, Knittel, Huysmans, and Van Goch (2023) facilitate collaboration among different faculty members, enabling them to share expertise and identify research issues requiring interdisciplinary solutions.

Student participation in interdisciplinary learning is essential for effectively applying interdisciplinary approaches. Student engagement in multidisciplinary courses should go beyond mere observation, as

emphasised by both Diphhoorn et al. (2023) and Newell and Klein (1996). The authors clarify that students must actively combine multiple disciplines when solving problems collaboratively and develop critical skills such as thinking critically, synthesising information, and communicating effectively. Hsu and Shiue (2017), along with Greenfield and Niemczyk (2023), suggest various teaching strategies including project-based learning, case studies, and collaborative projects to support this goal.

Higher education institutions encounter various challenges when implementing interdisciplinary methods, according to Hsu and Shiue (2017) and Greenfield & Niemczyk (2023). Leavy (2016) emphasises that programme creation and faculty selection present difficulties in balancing specialised knowledge of specific subjects with broad disciplinary understanding. Achieving this balance becomes more complex because it requires both discipline-specific knowledge development and the integration of multi-disciplinary studies. Progress becomes more difficult to achieve due to obstacles created by faculty members and students who uphold strong disciplinary boundaries. The lack of clear evaluation criteria presents a significant obstacle for transdisciplinary initiatives. Rallis and Goldring (1993) assert that current assessment methods do not effectively measure the detailed components and impacts resulting from interdisciplinary collaboration. Research institutions must develop appropriate evaluation systems to recognise the unique benefits of interdisciplinary approaches in research and educational activities.

Higher education institutions must foster collaborative environments and promote student engagement through active learning to effectively implement their approach. The success of interdisciplinary integration relies on institutions creating supportive settings, offering faculty development programmes, adopting new teaching methods, and developing assessment criteria for multidisciplinary projects. Following these strategies is crucial for institutions to successfully incorporate interdisciplinary techniques, resulting in enriched learning experiences and transformative research outcomes.

After successful implementation, it is essential to recognise the need to evaluate the effectiveness of the initiatives. The assessment of these interdisciplinary initiatives requires careful attention in this context. The evaluation should include both qualitative and quantitative methods. The research conducted by Laursen et al. (2022) uses various assessment techniques, such as pre- and post-programme surveys, focus groups, and analysis of project outputs. The Critical Thinking Assessment Test (CAT) functions as a standardised tool to measure critical thinking development, while rubrics assess the collaborative and creative elements of project work. Student reflection comments, along with peer assessment feedback, offer additional insights into personal growth and team dynamics. Using inclusive evaluation metrics helps prevent discriminatory reward systems often found in scholarly environments, as noted by Davies et al. (2021). Some institutions have developed specific assessment metrics to evaluate diverse contributions to projects, ensuring all participants' input is recognised.

### **Successful Interdisciplinary Initiatives: Learning from Experience**

Higher education institutions achieve their goal of fostering innovation and critical thinking skills through successful interdisciplinary initiatives that combine multiple areas of expertise to address complex problems. The "Health Humanities" initiative acts as a global example, uniting medical science with literature, ethics, and social sciences to improve medical education. Its main aim is to develop comprehensive understanding and empathy skills in future medical practitioners. Students from diverse disciplines collaborate on projects and workshops to analyse case studies by applying narrative medicine and ethical perspectives (Newman, 2024).

The "Interdisciplinary STEM Education" programme exemplifies a successful framework that combines engineering with environmental science and social policy courses. Students at the University of Colorado Boulder engaged in projects that examined how climate change affects urban infrastructure through their joint programme. The initiative aims to teach students practical problem-solving skills while enhancing their social awareness as participants. The implementation process involved co-curricular design, during which faculty members from various departments collaboratively taught modules, emphasising practical learning experiences and team collaboration (Specht & Crowston, 2022).

The successful implementation of interdisciplinary initiatives faces three main obstacles: institutional barriers arising from disciplinary boundaries, time limitations for teamwork, and communication challenges between different fields. Klein (2008) notes that varying disciplinary cultures can create misunderstandings that hinder effective teamwork. Several best practices have emerged to improve the effectiveness of interdisciplinary work. The success of interdisciplinary collaboration relies on clear communication, as it allows teams to reach common goals through shared terminology (Newman, 2024). Educational institutions should establish dedicated funding for interdisciplinary projects and develop motivational programmes that encourage participation from faculty and students across different fields. Structured reflection within interdisciplinary experiences helps participants assess their work and experiences, leading to improved programme development (Laurson et al., 2022).

### **Future Directions and Recommendations**

Based on the reviewed literature, it is advised that higher education institutions undertake comprehensive efforts to develop effective interdisciplinary knowledge, along with benefits for critical thinking and innovation. These institutions must fully embrace multidisciplinary collaboration, as this approach demonstrates strong potential to address complex social challenges and foster innovative solutions. It is vital for them to transform their academic programmes by introducing interdisciplinary classes that enable students to analyse different subjects while integrating content from related fields. These courses should emphasise the interconnectedness of multiple disciplines and promote teamwork and analytical thinking. This will undoubtedly require the following:

#### **Faculty Development**

Any educational institution requires faculty development to succeed. The education sector demands that faculty members continually expand their knowledge and expertise because the academic environment is always evolving. The future growth of faculty can be enhanced through initiatives that promote the development of transdisciplinary knowledge. Higher education institutions must provide their faculty with opportunities to participate in multidisciplinary collaborative work. Establishing interdisciplinary research grants, teaching workshops, and faculty forums are effective methods to achieve this goal. These programmes aim to equip faculty with essential tools and support services while fostering an environment of institution-wide collaboration and creativity.

The development of interdisciplinary knowledge management should be a priority for faculty development programmes, which should also support the creation of interdisciplinary knowledge. The institution must ensure that interdisciplinary collaborative outputs are properly managed for distribution and sharing across the entire organisation. The effectiveness of multidisciplinary research and teaching activities can be improved through the implementation of efficient knowledge management systems by institutions. The implementation of technological infrastructure and platforms receives funding support from institutions for developing information exchange and collaboration between different fields of study. The development of communal databases and internet-based forums for cooperation and knowledge management systems serve as examples for this purpose. The use of these tools requires universities to provide their faculty members with comprehensive training and support programmes.

The development of faculty skills can be enhanced through workshops, seminars, and conferences that unite educators from different academic disciplines. Such events enable researchers to present their work while engaging in intellectual discussions, fostering new research collaborations. These platforms should serve as channels for sharing knowledge generated via interdisciplinary studies. Establishing cross-disciplinary research centres requires important partnerships with external organisations. Institutions should form collaborations with industry, government agencies, and charities to achieve meaningful results. Involving external stakeholders in interdisciplinary research strengthens society's ability to solve problems and apply knowledge practically.

A recommendation for promoting and organising interdisciplinary knowledge involves creating recognition systems and incentives that motivate staff to participate in interdisciplinary projects. Implementing

recognition programmes alongside remuneration structures will encourage faculty members to engage in transdisciplinary research and teaching activities. Higher education institutions should also support interdisciplinary research through funding, establish teaching awards, and revise their promotion criteria to acknowledge interdisciplinary work. The authors argue that staff development is essential for creating and managing interdisciplinary knowledge. Academic institutions can foster an environment conducive to interdisciplinary collaboration by providing necessary tools and benefits and actively encouraging staff involvement. The advantages of this approach benefit both staff members and the institution's educational and research standards. Higher education institutions need to nurture their staff through interdisciplinary methods, as these skills are increasingly demanded in the competitive global academic landscape.

### **The development of Cross-Disciplinary Research Centres**

Higher education institutions can enhance interdisciplinary knowledge development and management by establishing cross-disciplinary research centres. These centres should serve as dedicated spaces where faculty from various disciplines collaborate on research projects that go beyond traditional boundaries. The authors believe these centres will promote the exchange of ideas and knowledge among faculty members from different backgrounds. Such institutes will foster innovative research by bringing together experts with diverse perspectives, knowledge, and approaches. Through their established platforms, these organisations will enable researchers to work across disciplines to address complex problems that a single field cannot solve.

The development of research centres across various disciplines requires institutions to allocate appropriate funding for these initiatives. These grants, along with research funds, should be specifically designated for multidisciplinary scientific work. Academic members will be able to focus on collaborative research through financial support, which will help to advance multidisciplinary knowledge.

The development of supportive systems for interdisciplinary collaboration is a vital recommendation. A physical space must be provided to enable scholars to work together, hold meetings, and share resources. Educational institutions need to invest in technology and data infrastructure, including shared databases and research management software, to facilitate smooth communication and information exchange. Academic members require procedures that encourage their active participation in interdisciplinary research activities. A reward system with recognition mechanisms should be established to support this. Educational institutions should offer tenure and promotion benefits for interdisciplinary work, recognise interdisciplinary projects during faculty assessment procedures, and create special awards for interdisciplinary achievements.

### **Integration of Interdisciplinary projects and experiential learning**

Higher education institutions should include interdisciplinary projects alongside experiential learning to enhance and expand interdisciplinary knowledge. This method goes beyond traditional classroom teaching by enabling students to engage in real-world projects that involve collaboration across various disciplines. Incorporating interdisciplinary projects into academic programmes allows students to utilise knowledge from multiple fields to tackle complex practical challenges. When students collaborate with peers from diverse backgrounds, they gain multiple perspectives and strengthen their analytical and problem-solving abilities. This hands-on teaching approach fosters innovative and adaptable skills that are highly valued in today's interdisciplinary workforce.

The implementation of multidisciplinary projects and experiential learning requires educational institutions to create pathways that enable students to work on interdisciplinary projects from start to finish. This can be achieved by integrating multidisciplinary courses alongside capstone projects and research experiences into the curriculum. These specialised projects address major challenges and practical issues, allowing students to contribute value to society while developing skills across various disciplines. The adoption of assessment and reflection techniques by institutions will help optimise the benefits of interdisciplinary, project-based learning. Students can process and share their interdisciplinary learning experiences through activities such as journaling, group discussions, and presentations. Assessment methods should evaluate

both subject-specific knowledge and the ability to apply information across disciplines, including skills like teamwork, analytical thinking, and effective communication.

### **Establishment of mentorship programmes and organising networking events**

Higher Education Institutions should establish mentorship programmes and sponsor networking events, according to the authors' recommendations. The authors predict that mentorship programmes will play a vital role in developing and managing multidisciplinary knowledge creation. Implementing mentorship programmes facilitates knowledge sharing and collaboration by connecting experienced professionals or researchers from different disciplines with junior members or students. Through their expertise, mentors provide valuable insights to mentees based on their past interdisciplinary work. Through mentorship, mentees gain a deeper understanding of multiple subjects while learning how to apply multidisciplinary approaches in their work. Mentors serve as role models who inspire mentees to actively pursue and manage transdisciplinary knowledge creation and administration throughout their careers.

The combination of network events and mentorship programmes acts as an effective strategy to enhance interdisciplinary knowledge. These gatherings bring together participants from various professional sectors, including academia, industry, government institutions, and non-profit organisations. The events encompass conferences, workshops, seminars, and symposiums that focus on multidisciplinary themes. Network events encourage knowledge sharing and help build connections, facilitating the exchange of ideas and the development of new multidisciplinary research pathways. Sharing experiences among participants helps identify common research interests, enabling them to form collaborative partnerships across different academic fields. Participants gain insights from their shared experiences and recognise shared research goals, fostering cooperative projects that link diverse disciplines. The multidisciplinary nature of these events allows participants to look beyond their individual specialisms and explore innovative solutions to complex challenges.

Multiple factors must be considered before establishing mentorship programmes and organising network events. The successful implementation of mentorship schemes depends heavily on careful planning and effective coordination among all components. The development of programmes and activities requires meticulous planning that addresses the unique needs and goals of transdisciplinary knowledge creation and management. The selection of appropriate mentors with relevant experience must be undertaken carefully, while network events should concentrate on issues that promote interdisciplinary dialogue.

Network gatherings and mentorship programmes need inclusive practices for all participants and equal opportunities to promote diversity throughout their activities. Involving groups of individuals from different genders, ethnicities, academic backgrounds, and nationalities will strengthen interdisciplinary perspectives and create a welcoming environment for knowledge sharing. To realise this goal, institutions should actively recruit marginalised groups through diverse and inclusive policies, which must be integrated into mentorship selection and organisation processes.

Network activities and mentorship programmes require adequate resources and support for successful execution. The programmes need financial backing for mentorship and logistical assistance for networking events, alongside dedicated time and resources to enable mentors and mentees to participate effectively. Academic institutions, industrial partners, and funding organisations should collaborate to secure the necessary resources and support.

### **Tailor Assessment and Recognition techniques to multidisciplinary**

The development of assessment and recognition systems that evaluate multidisciplinary approaches should be a key priority in the future to promote interdisciplinary knowledge creation and management. These methods enable institutions to measure transdisciplinary competencies while providing quantifiable and recognisable assessments of individual or team capabilities. Institutions should establish efficient assessment and recognition procedures to validate interdisciplinary work, which will improve both collaboration and the development of new knowledge. Rubrics are effective tools for evaluating

multidisciplinary skills and competencies through the creation of assessment frameworks that define and assess these capabilities. These frameworks should integrate disciplinary expertise with interdisciplinary skills, including analytical reasoning, effective communication, teamwork, and problem-solving abilities. Rubrics serve as valuable tools for assessing various types of work, such as individual assignments, group projects, and research outcomes. The standardised evaluation process offered by rubrics ensures consistent assessment across diverse work outputs. Assessment instruments help students, researchers, and professionals understand evaluation standards and areas for development in their multidisciplinary work.

This study previously discussed how to establish interdisciplinary awards or recognition programmes as a solution. We recommend that such awards either maintain their current discipline-specific focus or expand to acknowledge outstanding achievements in interdisciplinary teamwork and innovative projects. Institutions should create an environment that values multidisciplinary work by publicly recognising and rewarding these accomplishments, thereby motivating others to engage in interdisciplinary collaboration. They should also implement self-reflection and self-assessment procedures to evaluate collaborative work. The assessment process should encourage participants involved in multidisciplinary projects to reflect on their experiences and assess their progress in interdisciplinary skills. This process helps participants identify their weaknesses and set objectives for future interdisciplinary efforts. Self-assessment tasks can be further improved by incorporating peer feedback and mentorship to offer additional perspective and guidance.

Developing effective methods for multidisciplinary evaluation and recognition requires involvement from various stakeholders. The assessment process involves participation from faculty members, students, industry partners, and experts from different academic fields. Hence, a comprehensive and inclusive review of multidisciplinary work becomes achievable through institutions that gather feedback from diverse perspectives. The assessment and recognition strategies of institutions can link to broader interdisciplinary activities via partnerships with external organisations, as previously recommended, and through collaborations.

The authors highlight that institutions should regularly review and update their assessment and recognition methods to remain aligned with the changing practices and knowledge in transdisciplinary fields. As interdisciplinary areas constantly evolve with new approaches and perspectives, assessment and recognition systems must be flexible and adaptable to accurately mirror the ongoing processes of transdisciplinary knowledge creation and management. Feedback from stakeholders gathered during periodic evaluations will deliver valuable insights to improve these strategies and ensure they stay effective.

## Conclusion

Interdisciplinary learning and research offer powerful ways to tackle complex problems of our time and develop the creative, critical skills that students and society need. However, achieving this potential requires more than informal collaboration: it demands deliberate institutional redesign—including faculty development, dedicated research centres, cohesive curricular frameworks, robust assessment and recognition systems, and ongoing resource commitments. Equally important are inclusive mentoring and networking practices, governance structures that align incentives with interdisciplinary goals, and ethical safeguards for projects involving technology. When universities implement these combined measures and continuously evaluate their practices, interdisciplinary efforts move beyond mere rhetoric to genuine innovation and societal impact. Ultimately, interdisciplinarity succeeds when institutional commitment, thoughtful teaching, and thorough evaluation come together—transforming disciplinary strengths into collaborative problem-solving abilities that foster both academic creativity and tangible public benefits

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