

A interdisciplinaridade: visão, boas práticas e desafios.

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2 de Outubro, 2023

Universidade de Coimbra



- Investigação científica, tipos; ecossistema
- Interdisciplinaridade
 - Desafios e oportunidades a diversos níveis
 - Exemplos de práticas (boas)
 - O percurso no Doutoramento; competências; dicas
- Discussão ...

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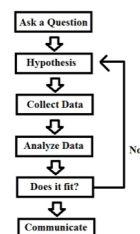
Investigação Científica

- A investigação científica (pesquisa) é um processo ordenado e sistemático de análise e estudo, através da aplicação de determinados métodos e critérios.
- Objetivo: produção de novo conhecimentos (ou aumentar o já existente).

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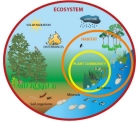
A investigação Científica tem que ser

- **Nova** (*to be aimed at new findings*)
- **Creative** (*To be based on original, not obvious, concepts and hypotheses*)
- **Uncertain** (*To be uncertain about the final outcome*)
- **Systematic** (*To be planned and budgeted*)
- **Transferable and/or reproducible**



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Ecosistema Científico



Ecosistema

grego antigo οἶκος **oikos** 'casa' e σύστημα **sýstema** 'o conjunto' 'o conectado'

Ecologia – como vivem os organismos vivos e como interagem (components + interações)



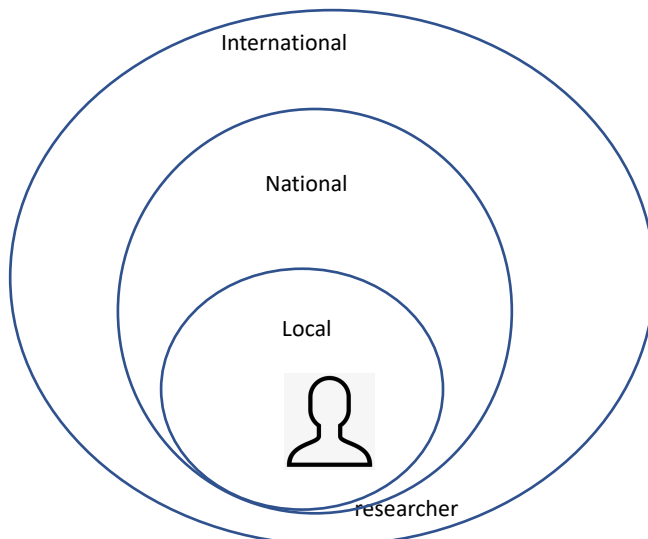
Ecosistema Científico

- Quais são os componentes? (Instituições? Pessoas?)
- Como interagem? (Networks)

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Ecosistema Científico

- Quais são os componentes? (Instituições? Pessoas?)
- Como interagem? (Networks)



Pessoas:

Investigadores/as | Docentes | Supervisores
 Coordenação de curso
 Estudantes Doutoramento (Investigadores/as iniciais)
 Estudantes Mestrado
 Pessoas de apoio à investigação

Instituições Académicas:

Universidade
 Unidade de Investigação (integradas, APSL)
 Grupo / linha de investigação
 Faculdade
 Departamento

Instituições não académicas

(Museus, empresas, autarquias, NGO, ...)

Instituições/agências de Financiamento

Locais, Regionais, Nacionais, Internacionais
 Públicas ou Privadas

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- Tipos de Investigação científica -

Uma classificação (tendo em conta a aplicação)

- **Básica | pura | fundamental (Blue Sky)**

...without any particular application or use in view ...

- **Aplicada**

... towards a specific, practical aim or objective

- **Desenvolvimento experimental**

... to produce new products or processes or to improve existing products or processes

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Classificação das áreas disciplinares ... da investigação científica

Table 2.2. Fields of R&D classification

Broad classification	Second-level classification
1. Natural sciences	1.1 Mathematics 1.2 Computer and information sciences 1.3 Physical sciences 1.4 Chemical sciences 1.5 Earth and related environmental sciences 1.6 Biological sciences 1.7 Other natural sciences
2. Engineering and technology	2.1 Civil engineering 2.2 Electrical engineering, electronic engineering, information engineering 2.3 Mechanical engineering 2.4 Chemical engineering 2.5 Materials engineering 2.6 Medical engineering 2.7 Environmental engineering 2.8 Environmental biotechnology 2.9 Industrial biotechnology 2.10 Nano-technology 2.11 Other engineering and technologies
3. Medical and health sciences	3.1 Basic medicine 3.2 Clinical medicine 3.3 Health sciences 3.4 Medical biotechnology 3.5 Other medical science
4. Agricultural and veterinary sciences	4.1 Agriculture, forestry, and fisheries 4.2 Animal and dairy science 4.3 Veterinary science 4.4 Agricultural biotechnology 4.5 Other agricultural sciences
5. Social sciences	5.1 Psychology and cognitive sciences 5.2 Economics and business 5.3 Education 5.4 Sociology 5.5 Law 5.6 Political science 5.7 Social and economic geography 5.8 Media and communications 5.9 Other social sciences
6. Humanities and the arts	6.1 History and archaeology 6.2 Languages and literature 6.3 Philosophy, ethics and religion 6.4 Arts (arts, history of arts, performing arts, music) 6.5 Other humanities

Frascati Manual, OCDE 2015

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Research with Impacts

Academic impact is the demonstrable contribution that excellent research makes to scientific advances, across and within disciplines, including significant advances in understanding, method, theory and application.

Publications
Patents
Citations
Training



Economic and societal impact is the demonstrable contribution that excellent research makes to society and the economy, of benefit to individuals, organisations and nations.

- Cultural impact.
- Economic impact.
- Environmental impact.
- Social impact.
- Impact on health and wellbeing.
- Policy influence and change.
- Legal impact.
- Technological developments

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Science as a Driver for Solving Global Challenges



The complexity of today's problems requires different approaches and creative, integrative solutions: **Interdisciplinarity is needed**

Investigação interdisciplinar

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A investigação Interdisciplinar



A investigação interdisciplinar é um modo de investigação realizada por equipas ou pessoas que integra:

informações, dados, técnicas, ferramentas, perspectivas, conceitos e/ou teorias de

duas ou mais disciplinas ou áreas de conhecimento especializado para

desenvolvimento de conhecimento fundamental ou a resolução de problemas cujas soluções estão para além do âmbito de uma única disciplina ou área de investigação

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investigação interdisciplinar

Pode ser subdividida em **dois modelos**

- investigação que visa **aprofundar o conhecimento e a competência das próprias disciplinas**, por ex. através de desenvolvimentos de metodologia que permitem abordar novas questões ou formar novas disciplinas ou subdisciplinas
- investigação **focada em problemas** e que abordam questões de relevância social, técnica e/ou política com menos ênfase em resultados académicos relacionados à disciplina

Estes são modelos apropriados para diferentes tipos de questões de investigação e exigirão diferentes combinações de conhecimentos especializados por parte dos investigadores/as

Os critérios para a escolha das disciplinas a serem envolvidas também serão diferentes em cada caso.

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Interdisciplinary Research

“Interdisciplinarity is driven by powerful scientific and societal needs; collaboration between the disciplines is thus a vital and necessary complement to the disciplines.”



<https://www.leru.org/files/Interdisciplinarity-and-the-21st-Century-Research-Intensive-University-Full-paper.pdf>

• University of Amsterdam • Universitat de Barcelona • University of Cambridge • University of Edinburgh
 • University of Freiburg • Université de Genève • Universität Heidelberg • University of Helsinki
 • Universitat Leiden • KU Leuven • Imperial College London • University College London
 • Lund University • University of Milan • Ludwig-Maximilians-Universität München • University of Oxford
 • Pierre & Marie Curie University • Université Paris-Sud • University of Strasbourg • Utrecht University
 • University of Zurich



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Bom exemplo

Doutoramento em Estudos Contemporâneos

Objetivos do Curso

- O ciclo de estudos visa apoiar a formação de investigadores autónomos e eficazes, imaginativos e rigorosos.
- Procura-se atingir esse objectivo fomentando a construção de conhecimento contemporâneo sobre a complexidade das sociedades e problemáticas emergentes.
- Para o efeito, o ciclo de estudos adopta uma perspectiva interdisciplinar, partindo da
 - história contemporânea
 - dos estudos europeus,
 - da ciência política,
 - dos estudos artísticos,
 - das ciências da comunicação,
 - das ciências da educação
 - e/ou das ciências da saúde.
- Salienta-se a relevância dos instrumentos epistemológicos, teóricos e metodológicos para a produção de saber científico ou tecnológico operativo.
- Promove-se a análise individualizada ou comparativa de fenómenos sociais à escala local/regional, nacional e internacional no curto, médio ou longo prazos.
- Estudantes ampliarão significativamente o respectivo grau de autonomia enquanto investigadores/as e serão capazes de estruturar abordagens interdisciplinares e comparativas.

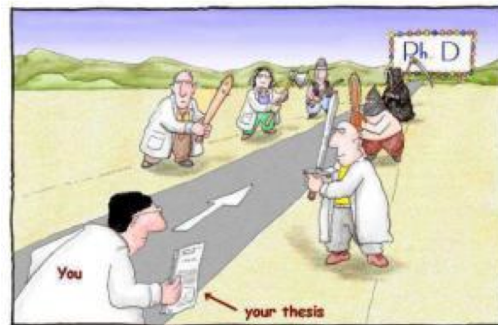
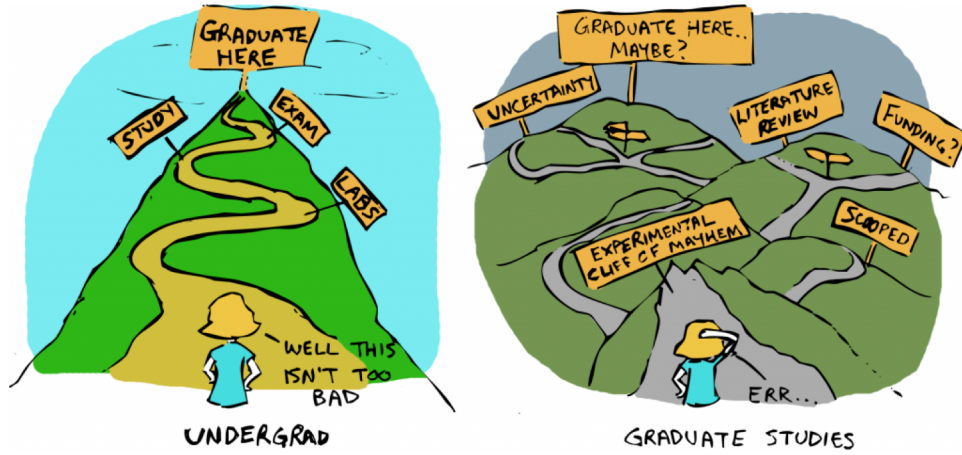
Objetivos da Aprendizagem e Competências a Desenvolver

- Identificar e delimitar objectos de estudo relevantes
- Seleccionar modalidades de investigação diversificadas e adequadas
- planear e executar projectos de investigação científica
- produzir e divulgar conhecimento científico.
- Adoptar, em simultâneo, perspectivas de análise de duas ou mais áreas de conhecimento (história, ciência política, estudos europeus, estudos artísticos, ciências da comunicação, ciências da educação e ciências da saúde); sobre dois ou mais países; nos curto, médio e/ou longo prazos.

Capacidade de

- respeitar os princípios deontológicos e os hábitos de debate (interno e com a sociedade em geral) adoptados pela comunidade científica
- compreender as implicações sociais do conhecimento científico e das tecnologias dele derivadas
- contribuir para a estruturação de sociedades mais conscientes, justas e sustentáveis.

O que distingue o percurso de estudante licenciatura de doutoramento?



Supervisor - a key person for success -

Main function: Helping PhD candidates to reach their full potential;

Commitment
Accessibility
Professionalism
Encourage
Guide
Respect
Encourage

Vários Tipos de Orientadores

Types of supervisors

Perfeccionista
perfectionist

Indiferente
Indifferent

**Pouco
critico/exigente**
Uncritical

Conservador
Conservative

Superficial

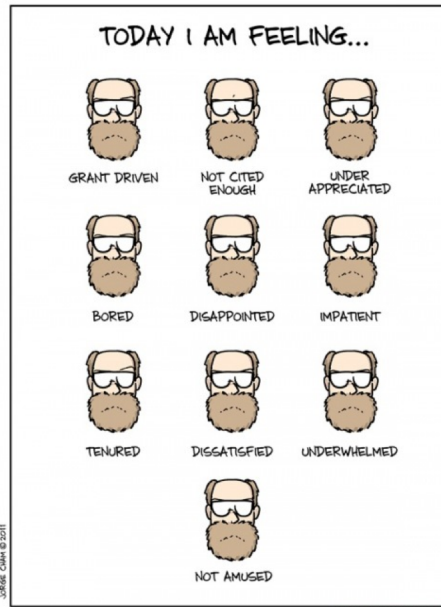
Muito exigente

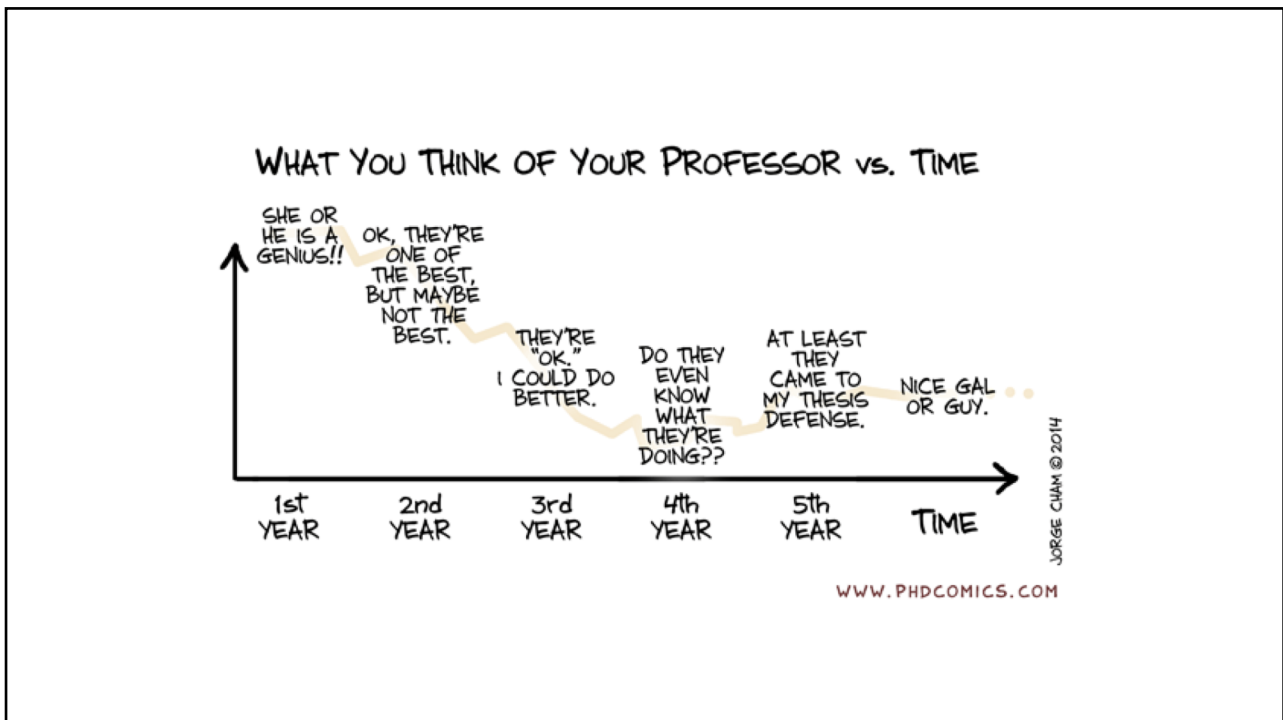
Confuso
confused

Moderado
Moderate

http://www.posterad.com/editorial/advice/exams/examinations_examiners_supervisors/get_the_most_from_your_postgraduate_supervisor/

DOES YOUR SUPERVISOR LOOK LIKE THIS?





As 10 coisas que irritam orientadores/as...



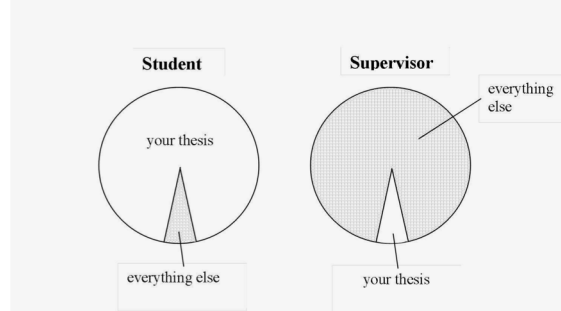
1. Desaparecer
2. Pressionar-me com datas, prazos e outras exigências
3. Continuar a trabalhar em textos que estou a ler para dar feedback
4. Assumir que sou a única fonte de suporte (ajuda, orientação, conselhos, informação burocrática, etc)
5. Pedir-me ajuda sem tentar resolver o problema, sem ler a bibliografia.
6. Concordar com coisas que eu sei que são irrealistas (prazos impossíveis...)
7. Não perceber o que estou a pedir/sugerir e não perguntar
8. Concordar (aparentemente) com tudo que que digo
9. Falar com outros colegas meus sem falar comigo primeiro
10. Não seguir com as minhas sugestões /recomendações sem terem argumentos para não o fazer
12. Fazer coisas "paralelas" e não informar-me (e vir a saber por outros)

Hopwood, N. (2010). A sociocultural view of doctoral students' relationships and agency. *Studies in Continuing Education*, 33(2), 103-117.

Relação orientando/a-orientador/a



Ouvir e obter feedback do orientado/as



Relembrar
... datas... reuniões...etc

Investigação interdisciplinar
Ceis20 e Doutoramento EC

Interdisciplinarity

- “A process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with only by a single discipline” (Klein & Newell).

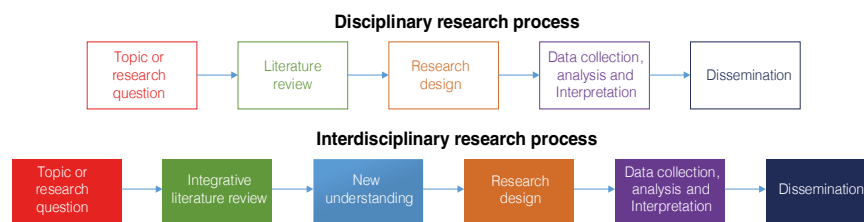


Figure 2. Comparison between the disciplinary and interdisciplinary research processes

Desafios

*“A **investigação interdisciplinar** requer frequentemente mais recursos de tempo, esforço, imaginação e financiamento do que a investigação disciplinar (e pode também envolver maiores riscos de fracasso),*

mas as recompensas podem ser substanciais, em termos de avanço do conhecimento e de ajuda a resolver problemas sociais complexos.

As pessoas na investigação interdisciplinar

10 key characteristics essential for successful interdisciplinary teams:

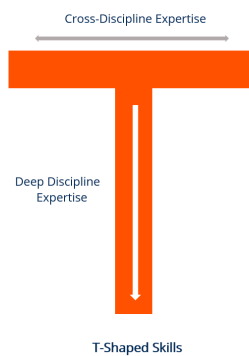
- Leadership and management
- Effective communication
- Personal rewards, training and development
- Appropriate resources and procedures
- Appropriate skills mix
- Positive and enabling climate
- Individual characteristics
- Clarity of a shared vision
- Quality and outcomes
- Respecting and understanding roles

The lack of 1 or more of these 10 characteristics is what causes ID (HE) ventures to fail.

Nancarrow S A, Booth A, Ariss S, Smith T, Enderby P and Roots A (2013) Ten principles of good interdisciplinary team work. *Human Resources for Health*; **11** (1): 19.
And <https://www.nature.com/articles/palcomms20151>

Formar/desenvolver investigadores/as em “T “

T-shaped researchers cultivate deep disciplinary expertise, for example, by building disciplinary credibility through publication in the top journals in their field, while simultaneously fostering the ability to look beyond their own disciplines and appreciate the norms, theories, approaches, and breakthroughs in other disciplines.



Brown, R., Deletic, A. & Wong, T. Interdisciplinarity: How to catalyse collaboration. *Nature* **525**, 315–317 (2015).
<https://doi.org/10.1038/525315a>

Develop T-shaped researchers

How? Which mechanisms?

- co-supervision of researchers by a minimum of two disciplines
- interdisciplinary trainings to reach disciplinary specialists
- learning labs to build interdisciplinary skills
- co-create shared conceptual frameworks to “exploit the integrative power of conceptual frameworks.”

Brown, R., Deletic, A. & Wong, T. Interdisciplinarity: How to catalyse collaboration. *Nature* **525**, 315–317 (2015).
<https://doi.org/10.1038/525315a>



Contents lists available at [ScienceDirect](#)

Futures

journal homepage: www.elsevier.com/locate/futures



Who is doing inter- and transdisciplinary research, and why? An empirical study of motivations, attitudes, skills, and behaviours



Maria Helena Guimarães^{a,*}, Christian Pohl^b, Olivia Bina^{c,d}, Marta Varanda^e

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^c Instituto de Ciências Sociais, Universidade de Lisboa, Portugal

^d Geography and Resource Management, The Chinese University of Hong Kong, Hong Kong

^e SOCIUS/Instituto Superior de Economia e Gestão, Universidade de Lisboa, Lisbon, Portugal

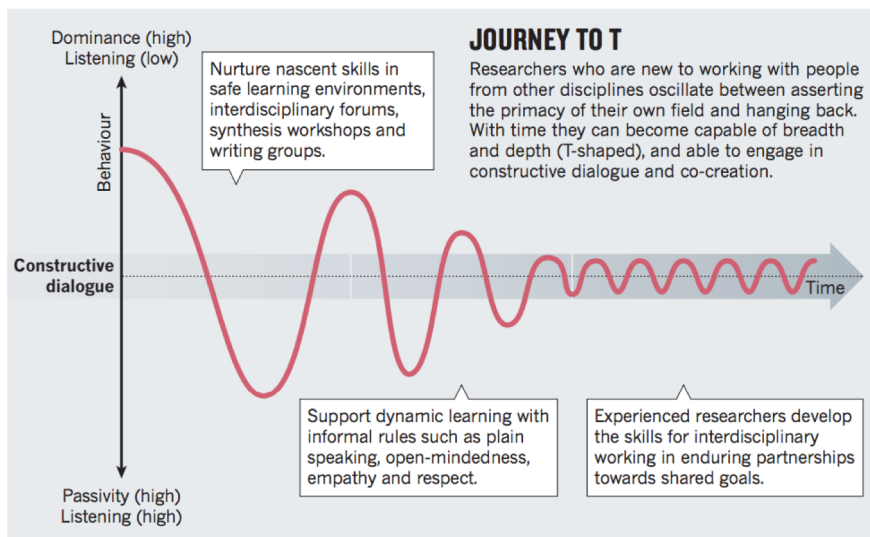
Maria Helena Guimarães; Christian Pohl; Olivia Bina; Marta Varanda. "Who is doing inter- and transdisciplinary research, and why? An empirical study of motivations, attitudes, skills, and behaviours". *Futures* 112 (2019): 102441-102441. <https://doi.org/10.1016/j.futures.2019.102441>.

Table 1
Review of the characterization of inter- and transdisciplinary individuals.

Topics	Title	Details	References
Motivation	ETHIC	Individual ethics, a desire to improve society and contribute to the advancement of the common good	Augsburg (2014), Bruce et al. (2004), de Freitas et al. (1994), Fam et al. (2017), Gibbons and Nowotny (2001), Giri (2002), Godemann (2008), Hoffmann et al. (2017a, 2017b), Jacobs and Niesaber (2011), Klein (2004), Montuori (2012, 2013), Niccolino (1999), Robinson (2008), von Wehden et al. (2019), Wall and Shankar (2008)
	REWARDS	Extrinsic motivation for rewards or anticipated benefits	
	REAL-WORLD PROBLEMS	A desire to engage with societal issues that do not primarily emerge from disciplinary journals or academic discourse alone	
	FULFILMENT	Grounded in experience and the possibility of making a difference in the life of the researcher and those of others	
Attitudes and skills of individuals	OPENNESS	Recognition of the existence of different levels of reality governed by different types of logic. Openness to myths and religions. Acceptance of the unknown. Ability to take on new ideas. Absolute respect for the collective, repulse with shared knowledge and understandings, ability to look beyond one's own disciplinary boundaries.	
	TOLERANCE	Tolerance of ideas opposed to one's own. Ability to build networks within the realm of the "unfamiliar". Capacity to engage in meaningful dialogue that suspends one's point of view.	
	REFLEXIVITY	Rigorous argument. Capacity for disciplined self-reflexivity.	
	MODEST POSITIONALITY	Ability to admit that it is impossible to ever perfectly solve or understand an issue completely. Humble attitude toward the immensity of knowledge.	
	CREATIVITY	Individual creativity.	
	CURIOSITY	Permanent inquisitiveness. Curiosity about and willingness to learn from other disciplines.	
	FACILITATOR	Commitment, connectedness, good communication and listening skills, flexibility, adaptability, capacity to build bridges	
	INTEGRATION AND COMPLEXITY	Capacity to absorb information. Ability to reflect on knowledge integration processes. Ability to think in a complex and interlinked manner and relate to the logic of complexity. Ability to locate and work with pertinent information, compare and contrast different methods and approaches, clarify how differences and similarities relate to a designated task, and generate a synthesis, integrative framework, or more holistic understanding for a particular theme, question, or problem	
	AWARE	Social conscience and awareness	
	CRITICAL THINKING	Metacognitive skills that enable lifelong learning, including critical-thinking skills, learning on demand, and self-directed learning	
Attitudes and skills of teams	TEAM MANAGEMENT	Ability to manage and work in a team	Augsburg (2014), Bruce et al. (2004), Hoffmann et al. (2017b), Hollander et al. (2008), Pohl and Hirsch-Hadorn et al. (2008), Robinson (2008), von Wehden et al. (2019)
	FACILITATE COMMON LEARNING	Capacity to promote learning amid the diversity of participants and to explore and clarify their differences so that dialogue and collaborative integration can occur. Overall interest in facilitating common group learning and problem solving in ITD projects	
	SOCIABILITY	Ability to build good working relationships with team members	
	LEVEL HEADED	Capacity to understand theoretical and methodological issues surrounding inter- and transdisciplinary research questions	
	CONFLICT RESOLUTION	Ability to create synergies, resolve differences, and enable compromises among project participants	

Table 2
Review of the behaviors and the challenges of inter- and transdisciplinary individuals.

Topics	Title	Details	References
Behaviors	RISK TAKERS	Intellectual risk takers, confident enough in their own roles and professional identities to respect one another as equals and to share responsibilities, knowledge, and autonomy with others	Augsburg (2014), Fam et al. (2017), Gibbons and Nowotny (2001), Jacobs and Nienaber (2011), Klein et al. (2008), Nicolescu (1999), Robinson (2008), Stokols (2014), Wall and Shankar (2008)
	TRANGRESSION	Transgressive approach to knowledge and particularly to knowledge institutions, especially the university, since transdisciplinarity challenges the university modus operandi of disciplinarity. Engagement in new modes of thinking and taking action.	
	PRACTICAL	Co-producers of new hybrid forms of knowledge, issue driven, and prefer practice over theoretical or epistemological claims	
Challenges	SOLID DISCIPLINARY BACKGROUND	Need to have a qualification in a discipline or a profession to acquire a solid background before crossing boundaries between disciplines	
	RECOGNITION FIRST	Pursue ITD when well-grounded in a discipline/field/topic	



Brown, R., Deletic, A. & Wong, T. Interdisciplinarity: How to catalyse collaboration. *Nature* **525**, 315–317 (2015).
<https://doi.org/10.1038/525315a>

Nurture constructive dialogue

- the need to develop the conditions and informal rules that empower researchers to engage across disciplines, which in practice is often challenging due to vast differences between disciplinary jargon.
- Core to a constructive dialogue is also fostering
 - shared empathy
 - respect
 - trust for alternative scientific approaches
 - learning to communicate effectively across disciplinary boundaries.

How?

- Sustained and structured interactions across disciplinary groups and individuals, and mobilizing a range of communication mechanisms.
- Regular team meetings, conferences, away days, shared work spaces, annual meetings, and cross-institutional working groups
- Ensuring time and funding is available to support regular in-person interactions (for instance via annual meetings).
- To best support interdisciplinary collaboration among researchers, authors recommend developing an effective communication framework, including elements such as reflections on implicit disciplinary discussions, vocabularies, cultural values and norms.

Brown, R., Deletic, A. & Wong, T. Interdisciplinarity: How to catalyse collaboration. *Nature* 525, 315–317 (2015). <https://doi.org/10.1038/525315a>

MAKE IT MAINSTREAM

Ways to promote interdisciplinary research

Funders

- Manage funding from an interdisciplinary perspective while reinforcing research impact. Discipline-based agencies must form joint funding programmes.
- Panels should include a balance of experts from the social and biophysical sciences, with a strong appreciation of other disciplines. It is also useful to include end-users of the research (for example, practitioners and policymakers).
- Calls for funding should request balance between disciplines and prefer teams that have a proven record of collaboration. Publication in applicants' own disciplines should be essential; publishing in other disciplines is desirable.

Institutions

- Introduce key performance indicators that promote T-shaped researchers. For example, include qualitative measures of impact on policy and practice, as well as conventional academic indices.
- Identify institutional research strengths that show potential for interdisciplinary collaboration and incentivize it through seed grants.
- Reduce transaction costs: for example, through summer schools to develop constructive dialogue skills. Provide platforms — seminars, research workshops, debating competitions — to discuss challenges

in cross-disciplinary research and offer insights into the norms and cultures of other disciplines. Co-locate researchers from different disciplines who work on the same grand challenges.

- Invest in interdisciplinary PhD cohorts, co-supervised by academics from diverse departments or faculties.

Publishers

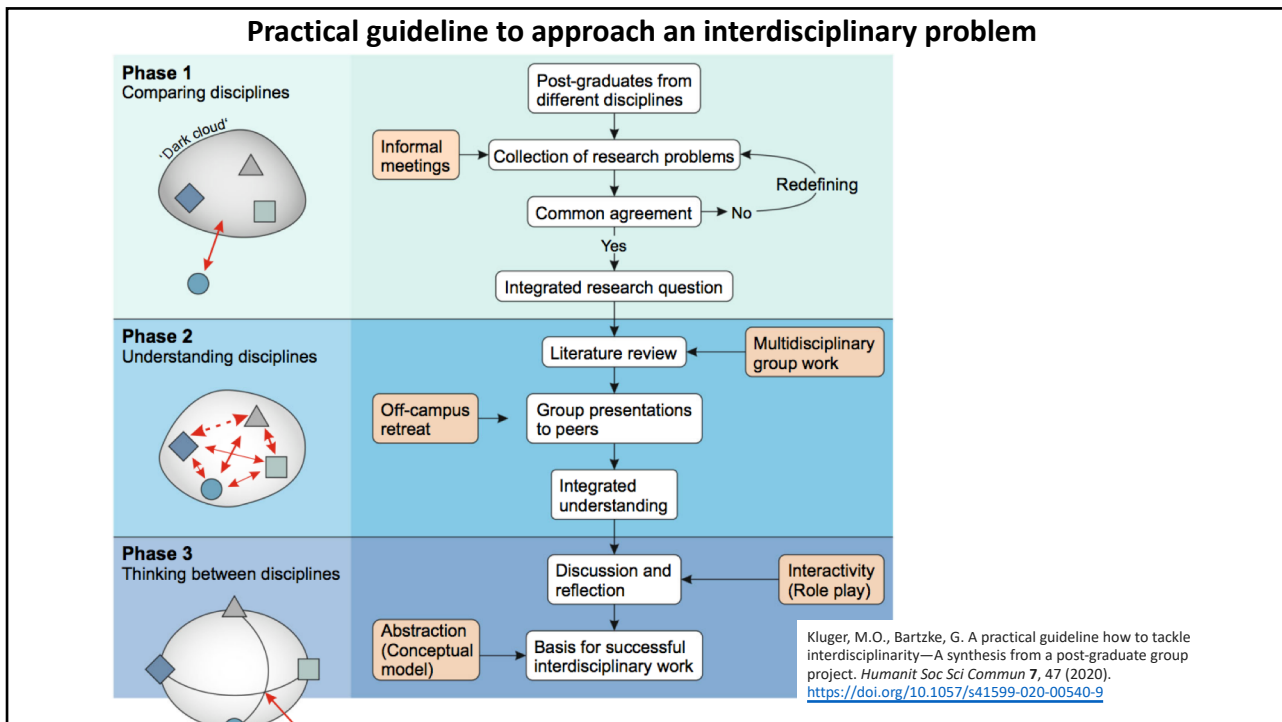
- Invest in and create high-quality interdisciplinary journals, managed by editorial teams or boards of T-shaped researchers.
- Run special issues in high-impact, single-discipline journals that focus on interdisciplinary research.
- Peer reviewers should assess work using their disciplinary expertise, while being tasked to be open to innovations across disciplines.

Researchers

- Build stamina, patience and self-awareness to manage the long journey of establishing a productive interdisciplinary team.
- Put your best ideas forward even if they are unfinished, and be open to alternative perspectives from other disciplines, policymakers, industry practitioners and community members.
- Prioritize depth early on, and embrace breadth by building relationships with those from other fields and practices.

Brown, R., Deletic, A. & Wong, T. Interdisciplinarity: How to catalyse collaboration. *Nature* 525, 315–317 (2015).

<https://doi.org/10.1038/525315a>



Dez dicas para escrever projetos de investigação inter e transdisciplinares

1. Lembre-se de que sua proposta será lida por diversas pessoas, não apenas por aquelas dentro da sua área de pesquisa: não assuma conhecimento da sua disciplina – descreva (concisamente) por que sua pesquisa é importante, inovadora e impactante etc.
2. Não descreva sua proposta apenas como interdisciplinar ou transdisciplinar. Explique por que uma abordagem inter ou transdisciplinar é necessária para alcançar os resultados pretendidos da investigação.
3. Propostas inter e transdisciplinares poderão ser avaliadas por aqueles com experiência em pesquisa colaborativa, e não em sua disciplina. Escreva claramente para um leitor comum – use o mínimo de linguagem técnica e abreviaturas e definir termos especializados brevemente quando são usados pela primeira vez.
4. A colaboração e a integração assumem muitas formas e exigem muito trabalho. Descreva que tipo(s) de colaboração/integração prevê (teórica, metodológico, etc.) e as formas específicas pelas quais se prevê alcançar essa colaboração/integração.
5. Explique os métodos que planeia usar e, se forem novos, forneça exemplos onde foram utilizados com sucesso noutros campos.
6. Tenha em conta os custos extras associados ao trabalho inter ou transdisciplinar
7. Se a investigação envolver novas colaborações, assuma que essas relações levará tempo para desenvolver e fornecer oportunidades (formais e informais) para que isso aconteça, principalmente no início do projeto.
8. Planeie os “outputs” que serão produzidos ao longo do projeto – isto protege contra falhas e satisfaz as necessidades dos diferentes colaboradores Se a investigação incluir parceiros não académicos, descreva o que eles trazem para a investigação, com o que e quando se espera que contribuam e como eles se beneficiarão com a participação. Planejar uma série de resultados a serem produzidos ao longo da vida útil do projeto.
9. Publicações académicas geralmente são de pouca importância para parceiros sociais que muitas vezes necessitarão de resultados mais específicos - Ex: programa de atividades ou nova ferramenta a testar – para justificar a sua envolvimento contínuo no projeto.
10. Os critérios de autoria variam consideravelmente entre disciplinas. Descreva como serão alocadas autorias para os resultados do projeto - ou um processo para concordar sobre isso no início do projeto - caso contrário, isso pode se tornar um problema.

<https://www.shapeidtoolkit.eu/wp-content/uploads/2021/12/Top-ten-tips-proposals.pdf>

SHAPE-ID
Shaping interdisciplinary research in Europe

TOP TEN TIPS | WRITING
INTERDISCIPLINARY PROPOSALS



Top Ten Tips for writing inter- and transdisciplinary
research proposals from SHAPE-ID partners. © J. Jansal-Escobedo

Boas práticas na UC

- Cursos e recursos nas escolas doutorais
 - <https://www.uc.pt/research/escolas-doutorais/recursos/>
 - Recomendo: <https://www.uc.pt/iii/nature-masterclasses/>
- Comunicação de ciência: seguir o website do Instituto de Investigação Interdisciplinar:
- Projetos semente
- Projetos de comunicação

- etc

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