



Developing an interdisciplinary culture of excellence

Working Together for Better Outcomes

Learning from different perspectives to improve delivery of solutions to land and natural resource challenges

Workshop briefing for participants based on the Developing an Interdisciplinary Culture of Excellence (DICE) project

Our objectives are to:

- Produce short guides on 'How do we best support and evaluate working together for better outcomes' for funders of research, researchers and wider users of research outputs
- Facilitate the sharing of perspectives from across funders of research, leading international researchers, and wider users of research outputs on how to support and evaluate working together for better outcomes
- Share and reflect on what we have learned during the James Hutton Institute's Developing an Interdisciplinary Culture of Excellence (DICE) project
- Produce a multi-author peer reviewed publication that synthesizes and communicates to an academic audience the process and key findings from our workshop

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This briefing paper is based on the 'Developing an Interdisciplinary Culture of Excellence' (DICE) project. The DICE project was funded by the James Hutton Institute (UK), and the research was undertaken between 2012 and 2014. This briefing summaries key messages from the DICE research, outlining findings on reasons to practice interdisciplinary research (IDR); what counts as IDR; how interdisciplinarity can be supported; and how it can be evaluated.

Why practice interdisciplinary research?

An interdisciplinary approach is widely advocated by funders and end users of research as well as scientists, particularly to investigate complex problems. Such problems often involve (i) uncertainties in scientific knowledge, (ii) human activities and interactions, and (iii) the political, economic and cultural dimensions of knowledge affecting research and its impact.

Yet customers want their needs to be taken seriously and results delivered accordingly. Companies look for solutions to their problems; policy makers and agencies are interested in policy-relevant research. Whether this is through disciplinary or interdisciplinary research is of less importance and interest to them (although many stakeholders see benefits from IDR). The Scottish Government's RESAS Division, a major funder of the Institute, is an exception and explicitly demands an interdisciplinary approach.

Stakeholder interviewees indicated that good research and communication in teams and within the Institute as a whole should underpin all research. Many of the interviewees' comments would apply to any good research project, team work and management, regardless of how many disciplines it spans. For them, the quality of project management and communication determines the quality of the result; the quality of internal and external communication determines the outcomes (e.g. knowledge exchange, policy impact).

Senior Institute staff agreed that an interdisciplinary approach has many benefits, in particular for tackling big questions or complex research issues such as the environment. IDR enriches understandings and can reveal gaps in knowledge about a problem. It was also seen to fit in well with the ethos of the James Hutton Institute. However, they noted that interdisciplinary approaches may not be able to adequately address some in-depth questions.

What is interdisciplinary research?

While the term 'interdisciplinary research' is commonly used to distinguish this approach from disciplinary, multidisciplinary, and transdisciplinary research, it is also sometimes used to refer to the latter two and to team-based research more generally. Within the literature, integration of disciplinary knowledge and methods is a key characteristic used to identify and assess the extent of interdisciplinarity in research, and to distinguish IDR from these other approaches to research. Integration is measured by the extent of blending of disciplinary knowledge and research methods, and the conceptual and institutional distance between collaborating disciplines.

Among our interviewees, there was a general understanding of interdisciplinarity as referring to working across disciplines towards a common goal, and usually to respond to a 'bigger picture question'. However, for many interviewees that meant working between social and natural sciences; for some it may have been multidisciplinary and for others transdisciplinarity. Several interviewees said that they saw no particular difference in meaning between these terms.

Institute staff survey responses showed a diverse understanding of interdisciplinarity. The majority (59%) understood interdisciplinary research as integrating different disciplines to work towards a jointly set objective, rather than working independently under a thematic umbrella, and not (necessarily) involving non-academic participants. Yet 21% understood IDR to include non-academic participants, and for 16% of respondents, research was interdisciplinary if different disciplines work towards a number of goals under one thematic umbrella. These different understandings influence the assessment of how much of their research individuals would label as interdisciplinary.

Survey findings showed no clear patterns of association between demographic and Institute-related variables (age, gender, science group affiliation and length of time worked at the Institute) and variables such as how respondents understand interdisciplinarity, levels of experience of IDR, whether they combined social and natural science approaches, and what proportion of their work is IDR. There was also no evident relationship between gender or age and attitudes to IDR.

How do we recognise interdisciplinary research?

Interviews with external stakeholders did not reveal much information about what kind of indicators they consider useful to recognise interdisciplinarity. They saw IDR as having “both scientific and user benefit” and “providing solutions to actual problems rather than parts of them.” Hutton Executive interviewees agreed that there was no perfect indicator to tell if IDR was happening, but still believed that non-perfect indicators were better than nothing. Senior managers suggested that different disciplines working together is a basic indicator of whether a project or piece of research is interdisciplinary. In considering interdisciplinarity, they distinguished disciplines not only broadly, i.e. across natural/social sciences, but also more narrowly, e.g. across disciplines such as chemistry-psychology, economics-soil science, biology-informatics, or disciplines within plant pathology.

We found that no single indicator identifies IDR; instead, a combination of different indicators is needed. Based on our respondents’ views on indicators, IDR at the Institute can be recognised by:

- a diverse mix of disciplines involved, leading to different perspectives being considered and integrated;
- a shared understanding of the problem and jointly determined research questions;
- research questions addressing complex and ‘real world’ problems;
- effort invested in developing a common language across the team;
- on-going, preferably personal, two-way communication;
- trust and good working relationships;
- a tendency for tasks to take slightly longer than anticipated;
- a diverse range of outputs (single disciplinary and interdisciplinary academic papers, synthesis papers, non-academic outputs and events), with number and background of authors playing a minor role as an indicator;
- being funded by an IDR programme; and
- greater advances in knowledge, but possibly with less depth.

Many of these indicators relate to the process of carrying out IDR (rather than the output). Several indicators are difficult to measure quantitatively and instead require a descriptive approach (e.g. to ‘measure’ whether there is a shared understanding of the problem).

How can we do interdisciplinary research better?

It is widely recognised in the literature that the processes involved in IDR are different from, and additional to, the processes involved in disciplinary research, i.e. research that does not involve integrating ways of thinking, knowledge, and research methods across disciplinary boundaries. Problems for IDR teams include resolving epistemological (beliefs about what knowledge is) and ontological (how to produce it) differences between disciplines. IDR team members need to spend more time to understand the problem to be addressed, and the different perspectives within the team; discuss and agree a research design; and sustain productive interactions during the project.

Some concerns were expressed about the difficulties that ontological and epistemological differences create for working together, and some suggested such differences may result in members of the team being less likely to communicate with each other effectively, or being less able to air their views confidently. Survey respondents also showed a considerable degree of awareness of the challenges and benefits of IDR, along with awareness of the personal attitudes, skills, and wider conditions needed to support this type of research.

Increasingly, the literature refers to social learning and effective knowledge exchange within teams as key to producing knowledge through interdisciplinary collaboration. Much emphasis is placed on interpersonal skills – in particular of team leaders – as the basis of good interdisciplinary team work. Our review showed high levels of convergence around the principle of integrated working, with attention given to ways of ‘harnessing’ disciplinary difference and conflicts to provide new insights unavailable from disciplinary approaches to research.

What do supportive conditions for interdisciplinary research look like?

The literature stresses that institutional support is needed for IDR from funding bodies, and the organisation where research is carried out. Support entails recognition of the more resource-intensive nature of IDR processes, and their lack of fit with existing, disciplinary-based organisational structures and cultures. There is increasing interest in how research organisations can encourage and facilitate interdisciplinary working in the design of organisational environments.

A number of themes emerged from our research about nurturing interdisciplinarity through supportive conditions:

- time – it takes longer to do IDR and this needs to be recognised;
- team building and communication – team members need to be open-minded and receptive, and effective formal and informal communication needs to be facilitated;
- research cultures and working environments need to be conducive;
- physical spaces – appropriate workplace design can enable interdisciplinary working;
- incentives for staff and training and skills– IDR should be considered in career evaluations and early career researchers need to develop their own discipline; and
- research funding – is a driver of IDR.

How should we evaluate interdisciplinary research?

Throughout the literature it is widely acknowledged that evaluation of IDR is not yet well-established and still requires development. However, it is generally accepted that evaluation after project completion is insufficient, and that this should be ongoing during the research process. The

literature refers to both qualitative and quantitative approaches, and mentions indicators such as: an appropriate focus for the research, with clear rationales for disciplinary input; appropriate collaboration of disciplines; quality of team interactions; evidence of IDR capacity building; quality of team leadership and research management; institutional support; and evidence of integrated work.

Interviewees found the question of indicators for evaluating IDR difficult to answer. Their responses often related to definitions and benefits of interdisciplinarity, as well as the skills, attitudes, and conditions that enhance interdisciplinary working. These responses suggest that evaluating the process of IDR is equally important as evaluating the output from that process.

From a funding body perspective it is acknowledged that evaluating IDR proposals is a challenge, in particular since a panel may consist of reviewers from one or just a few disciplines which could not adequately judge (large) interdisciplinary projects.

Although endpoint evaluation remains more common, the literature indicates that evaluation should be part of the research design, and involve IDR teams from the outset. Focusing on ongoing evaluation by research teams themselves allows for social/collective learning and process adjustment.

Conclusions and recommendations

To understand and assess IDR at the James Hutton Institute requires clarity about our conceptions of this approach at institutional, science group, Hutton theme, project, and individual levels. We infer from our findings that there is not yet sufficient clarity about interdisciplinarity to identify levels of IDR robustly. We used a working definition in the survey which yielded results that can be used as a baseline, but in absolute terms these results can be contested. The Hutton institutional structure already promotes and supports IDR in some ways (e.g. research themes, interdisciplinary teams), and perhaps more than many other research organisations. More effort at all levels is needed to enhance both the Institute values and a working culture that is conducive to IDR; we provided an extensive list of suggested actions which can be taken forward by individual staff, research teams, and Institute management.

We recommend that the Institute agrees on and commits to an operational definition of interdisciplinarity that makes sense to staff, customers and stakeholders. This definition should acknowledge broad and narrow interdisciplinarity, ideally naming example disciplinary collaborations that are counted as interdisciplinary, and agreeing on indicators to measure IDR, even if these indicators are only second best (such as cross-disciplinary authorship). We recommend repeating the survey at regular intervals to monitor trends in interdisciplinary working.

Conclusions, in the form of recommendations for the Institute were grouped into four areas:

- the time required to plan and do IDR;
- opportunities for discussion (formal and informal) and sharing experience/ knowledge;
- support for IDR from the Institute's management structure and processes, including training; and
- awareness that IDR depends on excellent project design, leadership and management.

Communication is linked to and important for all of the four areas.

Developing an Interdisciplinary Culture of Excellence (DICE)

The **Developing an Interdisciplinary Culture of Excellence (DICE)** project was funded by the [James Hutton Institute](#), and the research undertaken between 2012 and 2014. A **team** of researchers from across three of the Institute's science groups ([Information and Computational Sciences](#); [Social, Economic and Geographical Sciences](#); and [Environmental and Biochemical Sciences](#)) formed the research team:

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Kerry Waylen (Social, Economic and Geographical Sciences) helped us design the DICE research. Altea Lorenzo-Arribas, Biomathematics and Statistics Scotland (BioSS) helped us analyse survey responses. Colin Campbell (Director of Excellence), Bob Ferrier (Director of Impact), and Laura Meagher (Hutton Board) helped steer the DICE project throughout the research period.

Research methods

We used different methods (interviews, staff survey, and bibliometric analysis) to explore interdisciplinarity at the Institute. A literature review informed our empirical work and helped us contextualize our findings. The review was ongoing throughout the DICE project, and aimed to develop a framework for understanding how IDR can be practised on the basis of sound theoretical foundations for (i) disciplinary integration, knowledge exchange, and research production, and (ii) identification of IDR, and its evaluation.

Between March and November 2013, semi-structured key informant interviews were carried out with 15 senior Institute managers (all seven Theme Leaders, all five Science Group Leaders, and the three Executive Directors of Science) and with six external stakeholders with policy, operational and commercial backgrounds. They provided rich insights into experiences with and understandings of interdisciplinarity, and made suggestions about how to enhance IDR.

The survey of James Hutton Institute staff (November 2013) aimed to capture scientists' understandings of what IDR is; levels of IDR at the Institute; and staff views on barriers, challenges, skills, and supportive conditions associated with IDR.

For further information

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