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ZEN AND THE ART OF TRANSDISCIPLINARY POSTGRADUATE STUDIES: QUALITY CRITERIA



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Prepared for the ALTC Fellowship

Zen and the Art of Transdisciplinary Postgraduate Research

**Quality criteria for inter- and trans-disciplinary
doctoral research outcomes**

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August 2009



Support for this Fellowship has been provided by the Australian Learning and Teaching Council, an initiative of the Australian Government Department of Education, Employment and Workplace Relations. The views expressed in this report do not necessarily reflect the views of the Australian Learning and Teaching Council Ltd.

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2009

Please cite this manuscript as: Mitchell C A & Willetts J R 2009. Quality criteria for inter- and trans-disciplinary doctoral research outcomes. Prepared for ALTC Fellowship: Zen and the Art of Transdisciplinary Postgraduate Studies. Institute for Sustainable Futures, University of Technology, Sydney.

Introduction

Disciplinary, multi-disciplinary, inter-disciplinary (ID) and trans-disciplinary (TD) research are all essential if we are to make headway on the defining challenges of our time: adapting to and mitigating the effects of climate change, eliminating poverty, improving equity, and many others.

The role of higher education is to provide high quality offerings and outcomes across these research forms. Quality frames for work within disciplines (i.e. disciplinary and multi-disciplinary research) have evolved with the development of disciplines. These frames are widely known and used (implicitly) within disciplines. Quality frames for inter-disciplinary research (IDR) and trans-disciplinary research (TDR) are less well developed because their nature is to juxtapose different epistemologies, making the process of determining quality fraught, and because they are young - explications of what differentiates this work are still being developed.

Our experience in working in the ID and TD field has exposed us to strong differences in how people judge quality in different disciplines and their expectations of ID and TD work. For instance in seeking to publish ID and TD work, papers have received outright rejection from a particular journal, whilst being strongly complimented and accepted to another highly ranked journal. Equally, another example is a doctoral assessment process in which a panel member of one disciplinary background said “I just can’t see a PhD in this work”, while another replied “I can see three”.

The gap in quality frames becomes particularly significant for postgraduate students, supervisors, and examiners. Students need to produce a thesis that will pass examination, and papers that will be published. Examiners of doctoral theses need guidance on how IDR and TDR differs from disciplinary research, and to be alerted to appropriate expectations from such work. Supervisors need to mediate the process to help deliver these outcomes.

This document seeks to explore and describe appropriate interpretations of broad quality criteria for evaluating IDR and TDR. In line with the view of Kiley and Mullins (2004), we recognise that criteria and their use are just one part of the process of judgement of quality of research that occurs for an examiner of doctoral work, and that many other factors influence how research is interpreted and judged, not least the level of experience of the examiner. In contrast to our approach in this work, Laudel (2006) argues that the answer to evaluating new forms of ID and TD research lies not in different criteria but rather in the ‘relative empowerment of applicants and enforced ‘interdisciplinary learning’ of reviewers with careful monitoring of institutional rules of assessment’. We agree in principle, and in practice, would argue that in the context of the Australian thesis examination process, that is particularly difficult to achieve, since examiners are external, and at arm’s length - typically they do not meet or converse with each other, the candidate, or the supervisor. The opportunity to create and monitor interdisciplinary learning is, for now, severely restricted.

We maintain that our focus on criteria is a vital contribution toward providing much needed guidance for students, supervisors and examiners on appropriate standards for an ID or TD doctoral thesis, and forms a valuable input to on-going debate and negotiation about how quality of IDR and TDR is assessed.

Scope

There are three dimensions that define the scope of this work. The first dimension is the stage of a researcher's development – our focus is on doctoral research, or third cycle in European terms. That is, we distinguish and focus on doctoral research from other research (e.g., undergraduate honours, other postgraduate (e.g., Masters), post-doctoral, etc.). We include within our scope the spectrum of doctoral research from conventional to practice-oriented theses.

The second dimension relates to summative and formative processes. We limit our focus in this document to summative evaluation and assessment of a thesis or exegesis as a product. So while we recognise interactions between product and process and the role of graduate attributes and formative processes that support development of a high-quality product, these are the focus of the accompanying document¹.

The third dimension concerns the disciplines and how they interact – the number of disciplines, how they are engaged with, and the relationships between them. This document is focused on both ID and TD research. We see IDR as combining theories, and generating knowledge and insights from different disciplinary frames with a practical, problem-solving intent. We define TDR as including the spectrum of qualitative and quantitative evidence from the spectrum of epistemological domains, which means going beyond IDR and questioning disciplinary knowledge, generating new methods and insights, and including a legitimacy of lay knowledge. We also see TDR as based in collaborative generative processes in which values or ethical stances are made explicit.

Approach and Methodology

This document sets out the imperative for ID and TD work in universities, investigates how ID and TD doctoral research differs from other research, and the difficulties associated with judging its quality. We then turn our attention to doctoral research, and consider emerging work on ID and TD doctoral pedagogy. Finally, in our analysis of the literature, we synthesise global approaches to criteria for judging doctoral quality. We then synthesise these literature-based analyses with insights from practice to propose a modified set of criteria for evaluating ID and TD doctoral research outcomes.

We draw on three sources of IDR and TDR practice. The first is our own practice as supervisors of multiple ID and TD students and co-developers of a critically reflective community of practice approach to our doctoral research program within a transdisciplinary research organization, the Institute for Sustainable Futures (ISF). Over a decade, our group has been strongly engaged with and contributed to the literature and theory that informs transdisciplinary research approaches (Willetts and Mitchell 2006). The second source is a set of two workshops with 30 experienced IDR and TDR supervisors and students held in Brisbane and Sydney in May 2008 as part of an Australian Learning and Teaching Council Fellowship investigating formative and summative approaches to this issue of quality in postgraduate IDR and TDR outcomes. The workshops included individual and small and whole group discussions and written

¹ This document is one of two resource documents to arise from an ALTC Fellowship. The second document focuses on ideas for good practice in the supervision of ID and TD postgraduate research.

responses reporting resonance or otherwise of supervisor and student experiences related to the generic criteria drawn from the literature. The third data source is examiner comments from past students at our research institute: we analysed and extracted passages that related strongly to the generic criteria and how they have been experienced to take on meaning during the examination of an ID or TD thesis. The richness of the latter two sources is retained by extensive use of quotes to exemplify our arguments.

How do ID and TD doctoral research differ from other kinds of research?

In characterising how ID and TD doctoral research outputs differ from other research outputs, we explore three areas: the pressures for change on universities and doctoral programs generally, the evaluation of ID and TD research more generally, and the emerging literature around ID doctoral pedagogy and processes and implications of these for summative evaluation of doctoral work of this kind.

Change in higher education and doctoral programs

Change can be categorised as either evolutionary or revolutionary, and higher education is in a time of revolutionary change. Today's environment of globalisation, information and communication technologies, alongside an increasing knowledge economy, requires an explicit focus on shifts in the 'deep structures of consciousness and towards the development of transdisciplinary expertise' (O'Hara, 2007). Equally, the demands of societal issues around sustainability and climate change require solutions beyond those likely to emerge from single disciplinary perspectives. Doctoral programs are profoundly implicated, since they represent the highest level of tertiary education. One response is that of Boud and Tennant (2006), who argue that there is a need for a broad spectrum of doctoral processes - from thesis-based PhD to practice-based doctorates with a diverse spectrum in between.

The revolutionary change underway is reflected in new ways of seeing the role of academics in society and the impacts of this on doctoral training. Kendall (2002) wryly notes 'we gather that doctoral training needs to be reinvented, to be "rapid and relevant and rigorous".' Many authors have listed the pressures driving this change (e.g. Gilbert 2004, Usher 2002, Boud and Tennant 2006). The demands of a knowledge economy are always chief among them, and Gibbons et al (1994) now classic characterisation of Mode 1 and Mode 2 knowledge are never far away in these litanies. Nicholls (2001) characterised the gulf in understandings between traditional views of academics and their work and new roles of academics responsive to today's world. Of interest here are the calls for transdisciplinarity as the preferred framework for organising the pursuit of knowledge, and the idea of quality through social accountability rather than peer review. What this means for doctoral research is that it must be firmly contextualised so it responds to and influences issues in the here and now, and that it is no longer confined by traditional disciplinary traditions and rules.

Evaluation of ID and TD research

The evaluation of IDR and TDR quality is necessarily attracting increasing attention. Intriguingly, what individuals look for in terms of quality, and how they practice IDR, seems to reflect their original discipline. In Boix Mansilla's (2006) empirical qualitative study of 55 researchers at five major US research institutes, she found three distinct

conceptions of what constitutes IDR, and their conceptions of key epistemes reflected the likely epistemes of original disciplinary training. For example, systems modellers from the Santa Fe institute had a largely objectivist stance which resulted in an IDR episteme of 'conceptual bridging' whose judgement criteria are generalisability and elegance. Such preferences privilege particular disciplines and epistemologies, and limit the capacity for evaluating other dimensions.

This continuity was mirrored in the report (Boix Mansilla et al. 2006:p70) of a meeting of a select group of leading researchers, research administrators, science and social science journal editors, where science administrators put a premium on good evaluators and good processes, whilst others were keen to unpack the 'social and epistemic forces that govern peer review contexts'. The meeting's keywords - relevance, impact, scientific merit, and original work (p71) - demonstrate this continuity between our articulation of expectations about quality in disciplinary and interdisciplinary work. Participants noted that these are negotiable where interdisciplinary work is established e.g., biochemistry, and much less negotiable when 'interdisciplinary work in incipient fields brings together disciplinary perspectives in less precedented ways'. That is, when we move towards TDR.

It is interesting to speculate on whether this continuity holds for TDR, where we and others (e.g., Ison 2008) argue that a high degree of epistemological self-awareness and pluralism is warranted. Julie Thompson Klein's afterword to a special edition of 'Research Evaluation' dedicated to evaluating quality in TDR in 2006, suggests not. She identifies five overriding themes, each of which has resonance with our focus on doctoral research. The 'expanded meaning of quality' points to the tensions associated with a rigorous review process that seeks to accommodate pluralism; the 'centrality of integration' is a recurring theme with implications for the criteria; the 'interaction of social and cognitive factors' links to need for cultural competence, examined in the next section; and the 'value of coaching the process' and 'need for change in peer review' point to the difficulty associated with the arms' length approach to thesis examination in Australia, and highlight the importance of judicious choice of examiners.

Donald Schon prophetically noted in 1995 that the new scholarships of application and integration, which parallel IDR and TDR, proposed by Boyer in his seminal work, *Scholarship Reconsidered*, required modern research universities 'to learn organisationally to open up the prevailing epistemology so as to foster new forms of reflective action research'. In the companion publication, *Scholarship Assessed*, Glassick et al. (1997) proposed six generic criteria for evaluating the quality of research from any discipline and with any intent. These criteria have been widely adopted. Wickson et al. (2006) reinterpreted them for transdisciplinary research, and proposed the following modifications:

- From clear goals to responsive goals
- From adequate preparation to broad preparation
- From appropriate method to evolving methodology
- From significant results to significant outcome
- From effective presentation to effective communication
- From reflective critique to communal reflection

For some years, we have worked closely with both these sets of criteria in our graduate research program at the Institute for Sustainable Futures, articulating what they might mean in our context, and testing their validity and usefulness for both planning and evaluation. We integrate these concepts and experiences into the modified criteria later in this document.

What is clear from all this is that IDR and TDR is a tall cognitive order, particularly for graduate students. The implications for the summative criteria and formative processes associated with guiding this kind of research are subtle, yet profound.

Scholarship of ID and TD doctoral education

To date, surprisingly little has been written about ID and TD doctoral research pedagogy or its evaluation. It is an emerging field in the literature, which comprises mostly reflective accounts of practice (e.g., Neuhauser et al. (2007)) and few empirical studies (e.g., Mitrany and Stokols (2005)). This may reflect the relatively under-researched space of doctoral education in general (Pearson 2005).

Cultural competence is a key requirement in ID and particularly TD [graduate] research. Some authors conceptualise disciplines as cultural groups (e.g., Reich and Reich 2006). Our experience (Palmer et al., 2007) leads us to wonder whether it is actually epistemological divides that are the hardest to negotiate. Manathunga et al.'s (2006) ID doctoral pedagogy, from a cultural studies epistemic framework, encompasses four dimensions relating to cultural competence and reflexivity:

- Relational, mediated, transformative and situated learning experiences;
- Intercultural knowledge and skill development to enable research students to move beyond disciplinary cultural relativism to interdisciplinary synthesis;
- Enhancing students' higher order thinking and metacognitive skills as they wrestle with multiple disciplinary perspectives; and
- Enhancing students' epistemological understandings of their original discipline and how this knowledge relates to and sometimes conflicts with that of other disciplines.

Each of these has implications for the summative criteria we turn to next.

In a rare empirical study, Mitrany and Stokols (2005) report one of the very few (perhaps the only) longitudinal study of what constitutes TD PhD quality outcomes. From a social ecology school in California focused on public health, the study reviewed about 140 PhD theses produced over 20 years. Whilst we are unable to comment on the theses themselves, we would characterise the approach to the study as interdisciplinary and aligned with Boix Mansilla's (2006) conceptual bridging episteme, since the intent was to develop 'objective measurement criteria' which would provide 'reliable and reproducible measures' of the transdisciplinarity of the dissertation projects. The criteria they identified were:

- conceptualisation and integration of the research topic and its antecedent disciplines;
- multidisciplinary composition of the dissertation committee;
- diversity of research methods used in the dissertation study, for example, ranging from qualitative to quantitative to improve convergent validity;

- contextual scope includes temporal, spatial, and socio-cultural elements;
- levels of analysis bridged and number of levels integrated in dissertation, from cellular to global; and
- translation of research concepts, methods, and findings into community problem solving strategies.

In the process of quantising these criteria, much richness was lost. Nonetheless, they represent an important contribution, and serve to inform our modified criteria.

In terms of our own practice, we have found it useful to conceptualise three outcome spaces associated with TDR. Holding these outcome spaces in mind has consequential outcomes for doctoral students. The outcome spaces are firstly, the situation or problem space which may be a sector, a situation, a societal issue or problem or an aspect of practice in some domain. The second outcome space is that of peer reviewed, academic knowledge in the more conventional sense. The third outcome space relates to transformational change within the researcher, and mutual (perhaps transformational) learning by stakeholders involved in, or influenced by the research. Developing outcomes in each of these spaces requires time and significant planning, and inevitable tensions between achievements in one outcome space diminishing the time and opportunity to contribute to another, despite all being important. This tension is particularly fraught for Australian postgraduate students whose enrolment period is strictly limited by government funding arrangements.

The thesis, firmly situated in the peer-reviewed 'knowledge' outcome space, therefore needs to explicitly capture and document achievements in the other outcome spaces such that they may be valued in the doctoral examination process (see Figure 1). The criteria for evaluating a thesis therefore need to create space for all three types of outcomes.

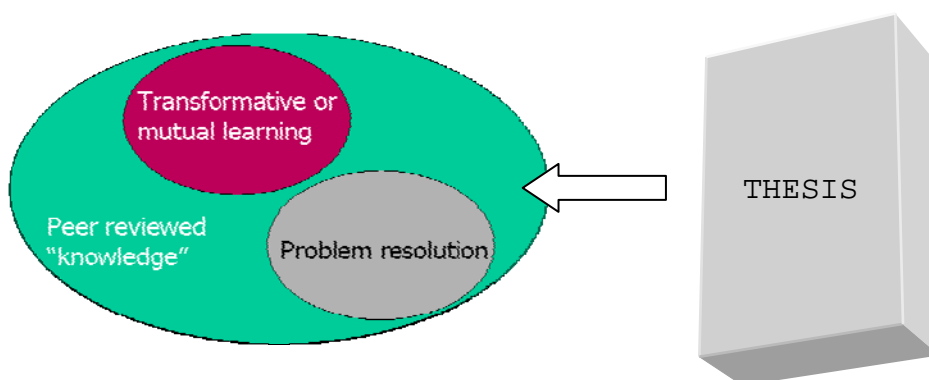


Figure 1: Relationships between the three outcome spaces in an ID or TD thesis.

Synthesising broad set of generic quality criteria

In seeking to gain a view of the kinds of criteria used under different disciplinary contexts and for different doctoral research types, we examined two broad sets of literature. The first group were primarily drawn from institutional contexts across Australia (e.g., publications from the Australian Council of Deans and Directors of

Graduate Studies (DDoGS)) and the European Union (e.g., the Dublin Descriptors) and these provided descriptors of doctoral research, as well as attributes and outcome descriptors. The second group comprised research conducted in this area, including seminal works like Mullens and Kiley (2002) in Australia, Lovitts (2007) in the US and Winter et al. (2000) in the UK. Such research explores the perspectives of examiners of doctoral theses and the processes and criteria they use to determine acceptability and quality of a thesis.

Across this literature on doctoral-ness and the PhD examination process, the following generic categories of quality criteria emerged in a recurring way:

- Substantial original contribution to knowledge
- Well-designed and structured coherent argument
- Engages critically with literature of appropriate breadth and depth
- Evidence of critical reflection/reflexivity of own work
- Grasp of theoretical perspectives and grasp of methodology
- Mastery of the topic
- Effective and well-finished presentation

Below we provide a broader description of each of these including related language and concepts.

A **substantial original contribution to knowledge** refers to ideas expressed in the institutional literature in Australia (DDoGs, 2005) about originality, publishability, applicability and (potential) impact. Such ideas are mirrored in the EU Dublin descriptors (Quality Assurance Agency, 2001) which refer to the need for original research that 'extends the frontier of knowledge'. Literature based on examiners and examiner's reports across different disciplines provides a similar criterion on 'a substantial body of research that provides an original contribution to knowledge' (Tinkler and Jackson, 2000) and ideas about originality linking it to creativity, elegance and even art when the thesis is an outstanding one (Mullins and Kiley, 2002: p379). Examiners of practice-based PhDs also refer to originality and publishability, this time defined in terms of innovations in practice (Winter et al., 2000).

Well-designed and structured coherent argument is a criterion that is brought to the forefront in research on the examination process and examiner's perspectives. Mullins and Kiley (2002) elaborate on this idea of coherence in terms of how the conclusions follow on from the introduction, how well explained the process is, and an authoritative confident tone. The framework of best practice in doctoral examination of the Australian Council of DDoGs (2005) also mentions 'coherent and cogent argument'. Practice-based literature discusses a related idea of 'transparency of the process followed' (Winter et al, 2000).

The DDOGS doctoral descriptors (2005) discuss the need for a doctoral researcher to engage with significant depth of the latest knowledge or breadth of knowledge for interdisciplinary work. Mullins and Kiley (2002) similarly mention that the literature review should reveal an overall grasp of what is going on in the field, and include references that are up to date and substantial enough. Other sources focus more

strongly on the nature and process of engagement, mentioning the need to demonstrate critical engagement in a way that critiques established positions (Winter et al., 2000). By combining these two ideas, a criterion of '**engages critically with literature of appropriate breadth and depth**' was assigned. This process of engaging with the literature is a part of fulfilling Glassick et al.'s (1997) step of adequate preparation in quality research, which, for work that crosses disciplinary boundaries, has been defined by Wickson et al., (2006) as necessarily broad preparation.

Evidence of critical reflection and reflexivity of own work is another criterion for quality research also put forward by Glassick et al. (1997) and the Dublin descriptors also capture the idea of being 'capable of critical analysis, evaluation and synthesis of new and complex ideas'. In terms of how such a skill should be demonstrated in doctoral theses, Mullins and Kiley (2002) report that examiners mention evidence of critical self-assessment and even being critical of their own argument. Winter et al. (2000) speak of demonstrating being 'self-critical in the inquiry and of the methodology and require that limitations are noted.

Grasp of theoretical perspectives and grasp of methodology refers to a set of inter-related ideas around alignment of epistemological stance, theoretical perspective and methodology (Crotty, 1998) or in other words, 'how the analysis is related to its methodological and epistemological context' (Winter et al., 2000). These same authors speak of the need for 'clear and continuous links between theory, method and interpretation' for practice-based PhDs (Winter et al., 2000). Mullins and Kiley (2002; p383) include 'coherence of theoretical and methodological perspectives' as one of five substantive elements in the final judgement of a thesis by an examiner.

Mastery of the topic is a criterion that is mentioned in some form in some literature, and not in others. Lovitts (2007) includes the need for '**mastery of the field**', the Dublin Descriptors speak of '**mastery of skills and method**' and Mullins and Kiley (2002: p383) mention the need for 'a creative view of the topic'.

At the pragmatic level, research has found **effective and well-finished presentation** to be of strong importance to the impression a thesis makes on examiners (Mullins and Kiley, 2002; Lovitts 2007). The best practice guidelines from DDoGS in Australia (2005) mentions the need for appropriate use of academic language, and being free from typographical and grammatical errors. Literature on practice-based PhDs similarly reports the need for the work to be well-finished (Winter et al., 2000).

Where this leaves us is that the literature on the examination of doctoral outputs shows that similar broad criteria are used across wide-ranging epistemological domains. However experience shows that the context of the discipline determines the meaning of these criteria in practice, and their interpretation varies widely between disciplines. Emerging research in IDR shows the 'home' discipline influences the epistemological stance towards quality, as we showed earlier, and epistemological pluralism may be a prerequisite for TDR. We therefore now move to translate these criteria to reflect the unique characteristics of ID and TD doctoral research, based on the literature in the previous section and the three sources of data noted in our methodology.

What do the generic quality criteria mean in the context of ID and TD research?

This section explores the meaning of the generic criteria in the context of ID and TD research practice. Our aim is to set out how they might be interpreted for this kind of research. To do this we identify and provide examples of what they look like in ID and TD practice based on our practice, two workshops with experienced ID and TD doctoral supervisors, and examiners' comments from our graduates. We close this section with a summary table noting the key points captured for each criterion.

Substantial original contribution to knowledge

The terms 'substantial' and 'knowledge' were viewed with concern by experienced interdisciplinary and transdisciplinary supervisors, and based on our own practice and experience we support this concern.

The main concern with 'knowledge' was that it may be interpreted in a narrow, Mode 1 sense (Gibbons et al., 1994) by some examiners. The idea of what counts as knowledge, and indeed, what counts as substantial or original, changes and is dependent on the disciplinary and epistemological stance of the individual (examiner). Supervisors were clear that 'knowledge' should be broadly interpreted, and should include impact. Some examiners do understand this, as the following quote from a report on a thesis concerned with improving the impact of development aid shows:

'The thesis contains many original ideas, and concludes with a set of proposals that represent a genuinely original contribution to knowledge. The candidate's ideas for adapting the Logical Framework approach come at a crucial time in the development of this management tool. Despite its great and proven usefulness, as evidenced by its almost universal adoption by aid agencies, it has come under criticism on a number of counts, but particularly because of its inability to cope adequately with "wicked" problems (especially those involved in people-centred projects, which are so important because of the poverty reduction strategies now being widely adopted). The candidate's ideas for coping with this weakness represent a valuable, and timely, contribution to knowledge.'

Engaging in interdisciplinary and transdisciplinary postgraduate research means engaging with a wide variety of disciplines and epistemological standpoints, as well as with the world at large. A quote from an examiner of a transdisciplinary thesis about induced traffic growth demonstrates this:

'It tackles a crucially important policy area but one that is also complex and invokes elements of economics, modelling, engineering, and sociological perspectives in order to understand the issues in play. The thesis is strong on concept, theory, empirical rigour, understanding of science and displays a sophisticated understanding of the interplay between theory, data, and knowledge.'

Each discipline or standpoint needs to be engaged with at a depth that, as a minimum, enables its artefacts (theoretical frameworks, methodologies, methods, analytical

frameworks, etc) to be applied with integrity². In addition, the idea of impact extends the coverage of the thesis beyond disciplines and epistemological stances to the areas of their application, such as industry sectors, organisational processes, government policies and their implementation, etc., such that the outcomes of the thesis mesh well enough to influence decisions and actions in that space.

For most ID and TD research students and supervisors, especially with the increasing focus on completions in shorter timeframes, there is tension here. In the limited duration of a PhD, it may be unreasonable to seek 'significant' contributions across all the domains of disciplines, epistemological stances, and areas of work. Articulating the different kinds of contributions is part of this. What is clear is that it is incumbent on ID and TD students to be forceful, explicit and clear about the nature and extent of their contribution in terms of additions and/or shifts to knowledge and practice in broad terms. An examiner sums up this quandary and his response:

'In putting these approaches together, there is an almost inevitable loss of the traditional single-discipline PhD format, based on a model of scientific research with a well defined hypothesis, well defined conceptual framework in which it will be investigated, and empirical data collected and analysed according to the traditions of the subject. In accepting the concept of a transdisciplinary thesis, I think this loss must be accepted - it would be far too great a test to expect that a candidate could construct, ab initio, a completely new theory embracing all the different research traditions, and test it with an appropriate new analytical approach. This would be a life's work, not a PhD thesis.'

Our experienced supervisors preferred a focus on the originality of the contribution. They construed 'original' in a variety of ways. It could be the particular synthesis or integration of existing knowledge: 'no one else has combined knowledge in this way', or as an examiner noted 'The major contribution of this thesis is its extensive and synthetic critical review across a number of fields.' Our supervisors argued it could also be the particularity of the situation: 'originality arises from the research problem and justification' or 'introducing a new perspective' or 'because it is they who are constructing and holding the piece', that is, '[a]pproaches where the researcher's experience is foregrounded are always original.'

Our supervisors and examiners were clear that contributions to practice, and in particular, creative contributions to practice, are core to ID and TD thesis outcomes.

To summarise, we propose a modified criterion of 'original and creative contribution to knowledge and/or practice' for IDR and TDR.

Well-designed and structured coherent argument

Many supervisors agreed this criterion to be critical, and potentially more critical to ID and TD than other traditions. One supervisor proposed that 'TD research is all about argument, [...] argument is fundamental' and another that 'when you're bringing in material from multiple disciplines, synthesis and integration is critical'. Yet another spoke of the need to 'be [...] able to tell a story that navigates [...] diverse conceptual, methodological and empirical territories'. Several others noted it as an important

² We return to this idea of sufficiency in the criterion concerning literature.

criterion given the challenge of constructing a clear argument in a complex context and thus the ability of this criterion to provide a good basis for judgement of the quality of a thesis.

Examiner's comments mirror these views, in complimenting how two high-quality theses have demonstrated performance against this criterion. For example 'the candidate has deftly synthesised a broad set of academic and professional literature to develop cogent treatment of the difficult problem of ...' and 'the thesis is more substantial and wide-ranging than most others I've seen. It covers a very wide range of related phenomena in a systematic and coherent way.'

An extension of seeing the criterion as critical was the proposition by one of the supervisors that, given the lack of traditional disciplinary norms, in ID and TD work there is a need for the student to actually 'define the framework for assessing coherence'. Building on this idea, a comment by another supervisor is how argument is key to 'convincing examiners of [the] validity of the work'. Others expressed this as the need for 'ownership of the argument', 'personal and scholarly presentation of setting [the student's] own research boundaries', and retaining 'an authentic voice of the individual'. That is, the authenticity of the author's voice 'can be ignored' when you are writing within the discipline to which you belong. However, in TD, the 'dance between observer, process, [and] observation should be evident.'

In terms of preparing the final thesis, one supervisor explained that 'getting the 'meta' picture right has been essential in helping them [the students] comprehend for themselves their contribution, their stance (epistemological and role), how to deal with the paradoxes that arise when research traditions of different types are married and question one another.'

This point about paradoxes raised a refinement to the criterion suggested by supervisors at the workshop. Significant dialogue took place around the notion of coherence and incoherence, since in ID and TD work, coherence must take into account the ambiguity and uncertainty that arises from disciplines interrogating one another. As such, supervisors proposed the idea of 'aware (in)coherence' which is explicated by the idea that the thesis should show that the student has 'explicitly thought about contradictions and convergences' and 'engaged with and recognised issues of ambiguity and complexity that inevitably arise in ID or TD work.' Aware (in)coherence relates to the notions of cultural competence noted earlier, and the idea of maintaining 'the right to not resolve contradictions, gaps and limitations but to discuss issues arising in your research.' This goes deeper than a token acknowledgement of problems in the research, towards the idea that it is an intellectual strength to be able to acknowledge and recognise such problems: 'sometimes views, perspective and experiences need to be held in creative tension'.

In conclusion, 'critically aware, coherent argument' stands as an essential criterion for differentiating quality ID and TD research.

Engages critically with literature of appropriate breadth and depth

Exploration of this criterion by our ID and TD supervisors and students gave rise to two particular challenges - balancing breadth and depth, and critiquing and synthesising outside one's discipline - and two opportunities - that of finding new insights through the process of bringing new lenses to bear on existing work, and of engaging beyond

the literature with other artefacts, stakeholders and beneficiaries of the situation space itself. Each of these is explored further below.

For interdisciplinary and transdisciplinary work, balancing breadth and depth is particularly challenging. Our supervisors were of the view that depth should take precedence, and that perhaps creativity should be more important than breadth. To keep the depth manageable, the focus should be on key texts - a step beyond texts that are merely relevant to a focus on early, source, and/or transformative texts - 'to follow the idea along the branch and back to the trunk'. A student must demonstrate their grasp of key debates, and in so doing to argue for that which is included and that which is not - 'to make sure you have heard a range of voices relevant to the topic and understood key positions'. One supervisor said 'you don't have to always go deep into a literature to discern its broad shape and perspective, but you need to go deep enough for your purpose. This is exemplified by the following examiner's comment:

'...[T]he breadth of coverage of this thesis is extraordinary. Many fields are covered! Clearly the coverage is not as in depth in any one of the areas covered as it would be in a thesis that simply concentrated on one of these areas. However, it is clear that the candidate has achieved a high level of understanding of the various fields of literature covered and has 'picked the eyes' from that literature to serve his needs in the thesis.'

Equally, amongst our examiner's reports are cases where candidates have been criticised for insufficient understanding of concepts or literatures used. One examiner notes that 'the danger with a thesis of this breadth is lack of depth. There are several areas where the thesis would benefit from some further investigation of theoretical models and knowledge base, especially from a more critical perspective.'

The difficulty, of course, is in establishing credibility with the audience. 'Critical' and 'appropriate' will have different meanings to different audiences. Our supervisors noted the need to be convincing to an audience. That comes through both the choice of sources, and the treatment of those sources. The choice has been dealt with above, in the discussion of breadth and depth. The treatment of the literature presents its own challenges. Developing and expressing judgement and criticality outside one's own discipline is a difficult and risky business, and requires engagement at some depth with different epistemological positions and deep epistemological self-awareness and pluralism.

Transdisciplinarity has, by nature, a more permissive stance than disciplines - the question of orthodoxy and how to deal with it is important, and perhaps best dealt with through demonstrating the capacity to interrogate literature from across epistemological perspectives. In addition, candidates must demonstrate capacity to not just interrogate, and provide critique of different literatures, they must also synthesise across them, a demanding task in and of itself. An examiner's comment that addresses this issue is:

'The thesis was an unusual and interesting one for this reviewer. It forced me to remember that [...] the task set by a Doctorate in an inter- and transdisciplinary field places a candidate in a particularly difficult situation. It requires competence in a number of diverse disciplines as well as competence in bringing the disciplinary insights together coherently. [...] What will be unique

and original is the inter- and transdisciplinary synthesis. The candidate demonstrated her capacity to accept and work with various academic disciplines and to synthesise the results of her work in them in an interesting and productive way.'

This challenge of engaging across literatures is also an opportunity: to see issues in one discipline from another discipline's perspective may strengthen criticality. Another supervisor noted the opportunity to 'make original contributions ... [through] understanding ... [and explicating] the way particular literatures intersect'. In these ways, new insights can emerge from an ID or TD literature review.

ID and TD supervisors and students also noted the opportunity to engage with other artefacts and societal perspectives, not texts. Some wondered about 'other forms of scholarly practice', another made reference to art, non-scholarly literature, and poetry. A third made reference to engaging with the recipients and beneficiaries, in line with the mutual learning and stakeholder dimension of our outcome spaces. Taking this idea further, based on our own practice at ISF this criteria should include a focus on the extent to which the student has demonstrated engagement with the research context (or societal problem being addressed or situation) and the different stakeholder perspectives that inevitably feature as a part of this context. Several examiners of ISF theses noted positively how candidates engaged with their research context, whether it was the policy context relating to climate change and energy for example, or urban water in Sydney.

Finally, on the scope and role of engaging with existing literature, one supervisor felt the literature should establish a context and position the research as addressing a need. Another noted quite a different role - its function may be to aid the overall coherence of the argument or line of inquiry, rather than to be housed in a separate section. Some noted that 'the literature review evolves - as you encounter more relevant areas in the methods [and] results, the lit[erature] review expands in scope.'

All of this poses a significant difficulty for the supervisor to provide adequate timely guidance, allowing and encouraging the student to explore, without going down too many blind alleys. When students and supervisors do not share 'home' disciplines, this difficulty is even more acute.

To summarise this then, engaging in the academic and societal research context is a bigger and harder task for ID and TD research than disciplinary research. The need for plurality and synthesis is stronger in ID and stronger still in TD than elsewhere – what is essential is evidence of the capacity to engage across disciplines, to bring local meaning out of the different disciplinary and epistemological frames. For ID and TD work, this means engaging with the literature and practice (or situation or sector) in ways that demonstrate being both up-to-date and substantive.

We propose a revised criterion of 'engages critically and pluralistically with appropriate literature, artefacts, the research context, and multiple perspectives within it.'

Evidence of critical reflection/reflexivity on own work

Our ISF experience of this criterion was mirrored by the ID and TD workshop participants: it is especially important for ID and TD work. Indeed, supervisors at the workshops were clear that this criterion, more than any other, determines the level, or

calibre, of an ID or TD doctorate. If TD work encompasses transformational learning, at least for the researcher and potentially for some of the stakeholders, then critical reflection and reflexivity are key, and should be 'hugely encouraged'.

The process of moving beyond the confines of one discipline and engaging with others is personally, fundamentally challenging - it 'will often require some soul searching'. It requires developing an awareness of your own epistemology and engaging respectfully with diverging views, and is critical because it will 'change your judgements about other work'.

The primary difficulty is how best to evidence this in the work, including how much of the personal to include and in what form. Here, supervisors expressed diverse views. At one end of the spectrum is the view that personal reflection has no place in the final [ID] thesis. At the opposite end, other supervisors noted that 'writing it succinctly can be a challenge'. They cautioned the need to avoid self-indulgence and to be wary of slipping into 'confessional writing'. That leaves a very broad spectrum in between.

Since process is key to ID and TD work, the opportunity to demonstrate critical reflection and reflexivity seems to be in bringing the process to the fore, perhaps through a 'specific 'reflective voice'' that shows 'explicit engagement with the process of research across disciplines and the challenges, insights, etc'. Other supervisors talked about 'demonstrat[ing] awareness of contradictions and gaps between materials from different contexts', in 'externalising [the] internal processes of [the] researcher', for example, to 'acknowledge limitations of the work...[demonstrate] ability to question or be tentative about history of ... research... ability to question one's own focus, writing, methodology, etc... ability to offer alternative perspectives'. Some preferred the use of first person, whilst others believed 'a journey of discovery does not have to be in the first person'.

It could also be evidenced in a student's capacity to articulate their position, its relativity to other positions, and its impact on the choices they have made in theory, methodology, data collection, analysis, and communication. It is dependent on what is foregrounded and backgrounded within the thesis. An examiner's comment on an ISF thesis touches on this: 'It was pleasing to see a sober and balanced assessment of [...] methods per se near the end of the thesis. This showed a properly critical and evaluative approach.'

Grasp of theoretical perspectives and grasp of methodology

In IDR and TDR, it is likely that at least some aspects of the theoretical framework and methodology will emerge and evolve during the process of the project i.e., they will be developed and forged in the course of the work, rather than taken off the shelf and applied (Wickson et al. 2006). An examiner's comment explicates this:

'The candidate really had to develop his own techniques. This is not a 'recipe book' thesis where you simply take a tried and true technique and apply it in the lab to a different species or system! This thesis has required much more inventiveness.'

For this reason, the key word that emerged within our workshop groups and from years of reflection on practice within ISF was alignment i.e. alignment between ontology, epistemology, theoretical perspective, methodology, methods, data, analysis,

interpretation, and claims, and all of this needs to match the nature of the enquiry space in order to provide useful outcomes into that space. This means more exploration than would normally occur within a disciplinary space, stronger justification of choices and claims, and then writing it up in 'a very distilled way'.

Furthermore, critical engagement is key to this process, and might go beyond a limited interpretation of 'grasp' - one supervisor used the metaphor of physically grasping - the idea that if you have a good grasp of something, then you can use it efficiently and effectively as a tool to create beautiful things - if your grasp is not so good, then the tool could be dangerous to you and those nearby, and employing it might lead to messy, ugly outcomes. A critical understanding of methodologies from different fields enables a student to justify their research design choices. This may well be a publishable outcome in itself. A minimum is for the thesis to demonstrate a clear 'audit trail to explain how [they] arrived at the outcome'.

This poses difficulty in the choice of examiners - often, examiners might be expert in one, but not all, of the methodologies used in the thesis. The student then needs to 'make sure they have explained the other methodologies in ways that let [the examiner] make a judgment of worth / grasp without being an expert in what is grasped.'

The revised criterion we then propose is 'alignment between epistemology, theory, methodology, claims, and enquiry space'.

Mastery of the topic, field or skills and methods

This criterion created the most consternation within the workshop processes we held. A few participants wondered about the opportunity of mastery as a means of knowing enough to let go - one recounted a story Dizzy Gillespie told: 'First, you need to learn all the rules, and then you let them go and can make it sing.' This supervisor went on to say 'for TD work, I think the student needs to have mastered the topic sufficiently to be able to 'think above or across' i.e., to have an enlarged vision of the field so that they can say something significant in an ongoing conversation.' This is hard in practice, as noted by a doctoral student in her final year: 'In my single disciplinary honours thesis, I pretty quickly came to a point of confidence in the literature/topic. I've been waiting for the same feeling of confidence in the topic for my ID PhD, and it gets further away the more I read.'

Many of our workshop participants were of the view that mastery is a term very closely related to disciplines, and although the groups noted the credibility that comes with the idea of undertaking an apprenticeship in order to become a master, they also noted the term's 'unpleasant hierarchical connotations'. Some felt the tension between creativity and mastery, and between curiosity and mastery, would be detrimental to ID or TD postgraduate work, and that mastery might be an 'over-claim'. The consensus was that it is likely to be disabling in ID or TD research when connected to the idea of a topic.

In contrast, the idea of mastery of process emerged from several participants in different guises - in reflexivity, in criticality, in application of the theory and methodology, and finally in communication, 'need to be a clear and clever communicator (master communication) to convey and convince', or even a 'master of language and style to achieve mastery of process (in narrative based work)'.

This last concept resonates with ideas emerging from the ISF experience, about the need for mastery of how to intervene in a system, of theory and practice and how they interact, of balancing breadth and depth, and of satisfying multiple needs through balancing the competing outcome spaces.

A candidate who has engaged with a space from many different angles, and with all three outcome spaces in mind, may indeed achieve mastery, demonstrating sufficient depth (know-what) alongside appropriate tools (know-how) to create change towards a preferred outcome in that space.

A revised expression of the criterion about mastery for ID and TD postgraduate work might be: mastery of the process and/or outcome spaces of ID and TD research.

Effective and well-finished presentation

The focus of this criterion shifts for ID and TD theses. In disciplinary examinations, it seems to be on the micro level - sentence structure, typographical errors and such. For ID and TD theses, this micro level is taken as read, and effective communication assumes a much greater level of importance at the macro and meta levels, because students need to produce a compelling multi-lingual argument. That is, they need to be able to avoid jargon that will confuse non-specialist examiners, at the same time as being able to retain the intent and integrity behind the specific meaning terms have in particular contexts. The student has to 'demonstrate they have understood the importance of communicating to a diverse audience'. Where a student is seeking to contribute to all three TD outcome spaces, this is particularly significant, and challenging.

Many workshop participants noted the value of figures and diagrams to get over the 'bar to communication' that jargon sometimes represents, particularly to examiners outside the field: 'the use of clear, well explained graphics not only helps to clarify but requires the writer to make explicit quite fundamental assumptions of the argument and implications of the findings.' However, for supervisors unfamiliar with graphics, data presentation in this form presents challenges: 'I worry that my lack of expertise in reading these things [(e.g. archeological grids, scientific tables)] will not pick up anomalies. It also sometimes makes for aesthetic breaks to the text that I find disconcerting.'

Finally, some workshop participants noted the opportunity for ID and TD doctoral outputs to take forms other than words - to be other kinds of artefacts of creative expression.

The best ID and TD theses are 'elegant - even beautiful', and a revised form of the criterion applicable to ID and TD research is 'effective communication for diverse audiences'.

Summary

It is possible to distil the above detail to a useable format that captures the most significant elements of the quality criteria as they relate to ID and TD doctoral research. Table 1 below summarises the document, capturing the key points of consideration in how generic criteria might be appropriately interpreted for ID and TD research, and the suggested modified terms of use to describe these criteria.

Table 1: Interpretation of criteria for ID and TD research and suggested modified forms of these criteria.

Criteria based on the literature on doctoral-ness and examiners views	Key points about what it means for ID and TD research	Modified form of criteria (closer to how it might be appropriately interpreted for ID and TD research)
Substantial contribution to knowledge	<ul style="list-style-type: none"> • ‘knowledge’ needs to be interpreted broadly • contributions toward, or impact of the research context, situation, area of work and practice need to be included (which relates to socially robust knowledge in the problem space) • the adjective ‘substantial’ may be misleading, more important that the student articulate the nature of the contribution and its significance 	Original and creative contribution to knowledge and/or practice
Well designed and coherent argument	<ul style="list-style-type: none"> • critical criterion for ID and TD research for demonstrating validity of the research and providing strong synthesis across diverse areas • requires an authentic voice of the researcher to come through • may include aware [in]coherence for dealing with paradoxes likely to arise in ID and TD research 	Critically aware, coherent argument
Engages with literature of appropriate breadth and depth	<ul style="list-style-type: none"> • balancing breadth and depth is important, depth (even in new areas) must always be sufficient to allow appropriate use for the purpose at hand • developing and justifying critique outside one’s core discipline is challenging and yet essential • engagement beyond literature (with artefacts or societal perspectives/problem situation) is important • the need for strong synthesis across different areas is strong 	Critical, pluralistic engagement with appropriate literature, artefacts, the research context and multiple stakeholder perspectives within it
Evidence of critical reflection	<ul style="list-style-type: none"> • critical criteria in determining the calibre of an ID or TD doctorate, as it is essential to developing an awareness of one’s own 	Evidence of critical reflection/reflexi

	<p>epistemology and engaging respectfully with diverging views inevitably encountered in ID and TD research</p> <ul style="list-style-type: none"> • may be explicitly or implicitly discernable in the final doctoral work 	<p>vity on own work</p>
<p>Grasp of theoretical perspectives or grasp of methodology</p>	<ul style="list-style-type: none"> • requires evolving development of a methodology to align with the underlying theoretical perspective and methods used • requires a critical understanding of methodologies from different fields to enable a student to justify research design choices. 	<p>Alignment between epistemology, theory, methodology, claims, and enquiry space</p>
<p>Mastery of topic</p>	<ul style="list-style-type: none"> • challenging and potentially impossible with respect to the topic • mastery in the approach taken, or through influence and application are more relevant and important 	<p>Mastery of the process and/or outcomes</p>
<p>Effective and well-finished presentation</p>	<ul style="list-style-type: none"> • requires use of multiple languages and effective approaches to communicate across disciplines 	<p>Effective communication for diverse audiences</p>

Implications and conclusions

Our elaboration of how ID and TD doctoral research differs from other research, and how generic quality criteria should be interpreted within its context makes clear the considerable demands place upon an ID or TD student. Against almost every criterion are additional challenges and dimensions that a student must wrestle with to maintain both rigour and relevance in their research approach compared with a traditional disciplinary PhD. For example they need to engage not only with literature, but also a sector, situation or practice. They need to choose and be prepared to evolve a methodology that suits both the research investigation and the societal audience for that research. And the ways in which the research is communicated need to work across diverse disciplinary audiences as well as relevant societal perspectives.

Another implication of the modified set of criteria we have presented, and particularly relating to the criterion on original contribution, is the challenge of judging the societal impact of the research (not just the academic merit) within the time-frame and context of a doctoral thesis examination process. Impacts are likely to occur beyond this time-frame, and there is an implication that students need to where possible provide evidence of actions taken to secure those impacts within the research approach. We

discussed this earlier in the conceptualisation of three outcome spaces for ID and TD research, and how the thesis, which sits in the peer-reviewed academic outcome space, needs to encapsulate mutual learning space and the problem space by providing evidence of action and influence.

Finally, we would like to note the difficulty of identifying examiners who are able to take into account the complexity of interpreting quality criteria for ID and TD doctoral work expounded in this document. It is our hope that it provides stimulus for further research, debate and dialogue in this important area, and also supports existing and prospective ID and TD students, supervisors and examiners in appropriately dealing with the many challenges this kind of significant work raises.

Acknowledgements

We are indebted to successive generations of ISF research students and supervisors for their enthusiastic engagement with the topics presented here. We are also indebted to the participants of the ALTC Fellowship workshops for significantly enriching our conceptions of what it is to do high quality ID and TD research. We acknowledge the fine efforts of examiners of ISF theses, and congratulate them on their epistemological plurality and willingness to depart from conventional research approaches.

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