Researching the interdisciplinary curriculum : the need for 'translation devices'

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Abstract

This paper discusses conceptual and methodological challenges facing two researchers investigating the development of interdisciplinary curricula in two new secondary schools, one in the UK and one in New Zealand. It is a discussion of research in progress that will be of interest to readers because of both the methodological challenges discussed and the research area itself. The key issue we identify is one for both researchers and teachers; how might the concepts and perspective of one discipline be brought into a relationship with another to enable deep learning? This question in turn highlights a key methodological challenge: developing the means to describe and evaluate new forms of curricular design and implementation where traditional discipline-based curriculum has been rejected in favour of interdisciplinary ones. The integrative aims of interdisciplinarity are also examined. We employ Bernstein's (2000) concept of *knowledge structures* and *languages of description* to theorise a continuum of approaches to curriculum integration, from *functional* to *principled*. This methodological manoeuvre is made possible by the development of a *translation device*. This procedural mechanism makes accessible to analysis the organising principles that are in play in the interdisciplinary curriculum design practices we have observed. We conclude with recommendations for the interdisciplinary curriculum researcher.

Keywords: curriculum integration, interdisciplinarity; curriculum; knowledge; methodology

Introduction

This paper explores one of the key methodological challenges that emerged for two researchers within the context of researching the development of interdisciplinary curricula; developing the means to describe and evaluate the forms of interdisciplinarity evident in the curricular design and implementation in two new secondary schools. One school is in the UK and the other in New Zealand. The paper is a discussion of research in progress that will be of interest to readers because of both the methodological issues discussed and the research area itself. However, we draw only lightly on the empirical data collected to date as the focus of the paper is on the methodological and analytic challenges rather than on the specifics of the empirical studies which are beginning to be reported elsewhere (author). The emphasis is on our roles as analysts and theory builders whose object of study is interdisciplinary curricula in secondary school settings.

While interdisciplinarity is certainly not a new phenomenon (Barnes, 2015; Beane, 1997; Wineburg & Grossman, 2000) it has remerged recently as part of '21st century' future-focussed discourses in education (Ministry of Education, 2009; Hipkins, Bolstad, Boyd & McDowell, 2014; Scott, 2015). At all levels from primary to tertiary it is promoted as an approach that can enhance and enrich learning and knowledge production by bringing two or more disciplines together. Frodeman (2014) suggests the aim of interdisciplinarity is the *integration of knowledge* across disciplines, but what form might this integration take? Can interdisciplinarity result in some type of deep conceptual synthesis that provides new theoretical insights, or is it more likely that disciplinary concepts retain a level of independence with some form of bridging of concepts that enriches a central concern? What is needed as these ideas take hold in a variety of educational contexts is a means of evaluating both polemical claims and empirical instances. We can imagine enhanced knowledge production and problem solving where academics in possession of highly developed

disciplinary identities and knowledge come together to focus on a particular problem, but is this possible at the level of the school where such identities and knowledge bases are yet to be developed? The nature and the quality of this 'bringing together' of subjects is a central concern. From a pedagogical perspective integration of subjects is well argued for because the approach appears to stimulate student interest and motivation by providing strong links to 'real-world' problems (Barnes, 2015; Drake, 1998; Ministry of Education, 2009), but from an epistemological and conceptual perspective it is less clear what students might gain through integration (Wineburg & Grossman, 2000; Naidoo, 2009; 2010; Dowden, 2014).

The central argument of this paper is that the potential for the interdisciplinary curriculum to be fully understood is dependent to a degree on the methodological process of creating a 'language of description' - a form of 'translation device' or conceptual rubric that allows theory and data to interact. More specifically in this case, this device becomes the means through which instances of interdisciplinarity can be examined, compared, understood, and explained. This argument is developed in two parts. In Part 1 we briefly examine the nature of interdisciplinarity and disciplinarity as a necessary starting point in providing a broader context for the paper. The focus is on epistemic structures within disciplinarity rather than on the broader social aspects of the epistemic communities in which knowledge is developed and made accountable. Part 2 draws on the context established in Part 1 to consider this central methodological concern - the process of developing the conceptual means to analyse what we have found in our empirical work.

Part 1. The research context: interdisciplinarity and the importance of disciplinary epistemic structure

Calls for interdisciplinarity in education derive from diverse sources (Barrett, 2007) but the most common arguments draw on what Moore (2011) terms an 'apocalyptic ontology'; the need for radical changes to education so learners can be better prepared for uncertain futures. A key argument is that knowledge needs to be reconceptualised as process rather than content (Delors 1998; Gilbert, 2005). Hence, we see calls for generic or meta-skills such as those referred to by Jacob (2015):

> the knowledge economy requires an adept workforce … no longer are higher education institutions able to train graduates to address all of the current and emerging challenges from a singular disciplinary source. Interdisciplinary (ID) approaches to research and training are essential underpinnings to best meet the dynamic needs of today's higher education students (1).

Chettiparamb (2007) notes two main threads in the literature on interdisciplinarity. The first 'argues for interdisciplinarity normatively, positioning it either in terms of filling the gaps that disciplinarity leaves vacant or in terms of transience surpassing what disciplinarity can ever hope to achieved' (p. 13). The second thread is described as phenomenological in the sense that 'it emanates from observation of practice. This view posits that interdisciplinarity already exists within the disciplines' (p. 15). For example, the OECD report of 1972 on interdisciplinarity notes that specialisms within disciplines are essentially interdisciplinary (Chettiparamb 2007, p. 26). Education is a case in point. It is a knowledge *region* more than a singular discipline (Bernstein, 2000) drawing as it does on other disciplines for its theories, methods, and procedures. In this sense, the research work of the authors is interdisciplinary as we draw on concepts and methods from various disciplines to focus on the challenges of researching an interdisciplinary curriculum in schools.

Within Higher Education 'interdisciplinarity has been largely normatively accepted as part of the academic landscape. Thus, in both teaching and research, the drive for interdisciplinarity is encouraged through the Higher Education Academy and the Research Councils' (Chettiparamb 2007, p. 1). Moreover, Frodeman (2014) suggests 'interdisciplinarity is envisioned as the panacea for what ails both research and education. Within the academy calls for new interdisciplinary initiatives have become a conventional way to indicate one's reformist orientation' (p. 38). In schools, calls for interdisciplinarity are closely linked to the arguments mentioned above for more generic approaches to the development of knowledge, skills, and dispositions (Delors, 1998; Hipkins, Bolstad, Boyd, & McDowell, 2014; Scott, 2015). On the other hand, a key concern identified in the counter-arguments is how to balance the agenda for research and curricular reform so that knowledge production and education are not reduced to a focus only 'on products with an exchange value in the market … vocational applications rather than knowledge' (Sarakinioti et al. 2011, p. 72).

The context then of this paper is the trend in the curriculum towards interdisciplinary studies, which combines curricula from two or more disciplines. A key claim made in favour of integrated studies at the school level is that it allows students to see how ideas are connected and thus increases engagement and retention (Barnes, 2015; Drake, 1998; Wineburg and Grossman, 2000). On the other hand, Young and Muller (2016, p. 184) caution against the weakening of subject boundaries in which 'the disciplines have increasingly to justify themselves in terms of some other idea of relevance'. Naidoo (2010), in a context of secondary schools in South Africa, further critiques the integration of subjects, pointing to the potential for lower academic quality in integrated teaching and the difficulty of mediating the conceptual structure of the subjects. This idea of conceptual structure, how concepts are

sequenced and integrated as systems of meaning, has significant implications for access to academic knowledge no matter what form the curriculum organisation takes (Rata 2016; Winch, 2013). What then are the implications for learning where subjects with differing conceptual structures are brought to together in some way, and where the means for bringing subjects together is external to the disciplinary concepts? Can sufficient access to the disciplinary concepts be provided when the focus of this combining is around themes or problems? These questions have led author to theorise two forms of curriculum: one that emphasises conceptual progression, the *progressive knowledge* curriculum; and the other which views knowledge as process, the *21st Century* curriculum. The degree to which these two approaches are dominant in the curriculum design is likely to have a bearing on the level of design challenge for teachers in regards to providing access to disciplinary systems of meaning.

Claims made for interdisciplinary curricula, therefore, centre around the value of problem-based learning as being learner-led, in which cross-curricular projects are central to learning and involve students in constructive investigation (Thomas, 2000). Ertmer and Simons (2005) ask whether evaluative criteria, specifically assessment of and for learning, are visible in such emergent forms of curricula. This raises the question of the veracity of interdisciplinary outcomes, given that schools are increasingly adopting these approaches, and leads us to ask, what are the drivers for interdisciplinarity and whether this approach engenders better learning outcomes for students? Our suspicion is that some form of combination of 21st century, project-based approaches that are strongly underpinned by conceptual progression will provide a strong model for future-focussed learning (Naidoo, 2010). This is a great challenge, even for experienced teachers, in knowing and determining what such

progressions should look like within varied integrative contexts (author; Wineberg & Grossman, 2000).

Developing an analytic framework: disciplinary knowledge and its epistemic structure

To proceed in the process of describing our methodological journey we draw on Bernstein's (2000) concept of *hierarchical and vertical knowledge structures*. These concepts enabled us to develop an *analytic framework* (Maton & Chen, 2016); the utilisation of some developed theory that contains concepts for analysis of the underlying organising, causal, or generative principles in the empirical data. At the centre of this analytic framework is the concept of epistemic structure identified above as having important pedagogical implications for students' access to disciplinary concepts (Muller, 2006; 2009; Rata, 2016; author). These concepts will allow us to consider interdisciplinarity more deeply and to consider the assertion of teachers in Naidoo's (2010) study that curricula integration is more difficult than it appears particularly where there are inherent differences in the conceptual structure of subjects.

Within the vertical discourse of academic knowledge production Bernstein identifies two types of internal knowledge structure: *hierarchical and horizontal*. A hierarchical knowledge structure is most commonly found in the physical sciences and comprises 'very general propositions and theories, which integrate knowledge at lower levels, and in this way, shows underlying uniformities across an expanding range of apparently different phenomena … towards greater and greater integrating propositions, operating at more and more abstract levels' (161). The typical knowledge structure found in the social sciences, arts, and humanities by way of contrast, consists of 'a series of specialised languages with specialised modes of interrogation and criteria for the construction and circulation of texts' (p. 161).

Within sociology for example, Bernstein notes the 'languages' of functionalism, post-structuralism, post-modernism, and Marxism which have emerged and developed segmentally. So *integration* is the key developmental concern within the physical sciences resulting in hierarchical structures, whereas development in the social sciences results in *accumulation*; a series of segmented languages. This differentiation of internal knowledge structures – hierarchical or horizontal - has clear implications for interdisciplinarity. For example, one might question whether apparently disparate conceptual structures can be mediated in some way to enable knowledge building in an interdisciplinary context (Naidoo 2010) or is it only closely aligned disciplines that share some common concepts that may be usefully brought together? Within horizontal knowledge structures for example Bernstein (2000) suggests that sets of languages 'are not translatable, since they make different and often opposing assumptions, with each … having its own criteria for legitimate texts, what counts as evidence and what counts as legitimate questions or a legitimate problematic' (p. 162).

Most significantly Bernstein draws our attention to the fact that there is an interdependence between the social base for knowledge production, its acquisition as broadly represented in the concept of field or arena, and the resulting knowledge structure, hierarchical or horizontal. For example, he suggests in the case of hierarchical structures that what is dominant within the socialising process of 'becoming' in the discipline is 'mastering the procedures of investigation and instruments of observation and understanding theory; developing the imaginative potential of the language comes much later if at all' (p. 164). On the other hand, initiation into a discipline with a horizontal knowledge structure is more likely to involve the acquisition of a 'gaze'; 'a particular mode of recognising and realising what counts as an 'authentic' sociological reality' (p. 164); 'what counts in the end is the specialised language, its position, its perspective, the acquirers 'gaze', rather than any one

exemplary theory … 'truth' is a matter of acquired 'gaze'' (p. 165). Cognisance of the original episteme of a discipline is critical then to understanding the methods, techniques, and procedures that a discipline adopts in knowledge production, what counts as an object of study, and how the discipline treats its own nature as the subject of reflexive analysis (Squires, 1992). As Abbott (2001) suggests, the discipline is the starting context for the interdisciplinary curriculum, together with the disciplinary gazes (Bernstein 2000, 164) of those involved in designing the curriculum. These combined dimensions (epistemic and social) constitute a notion of practice that shapes how the various curricula develop and how they may or may not be integrated with other disciplines.

Part 2. Methodological manoeuvres: languages of description and developing a 'translation device'.

In this section, we draw on another of Bernstein's (2000) concepts, languages of description, and the associated idea of a translation device. Methodologically Bernstein distinguishes between an internal language of description (L1) and an external one (L2). In our case the means by which teachers and curriculum designers talk about and tacitly understand the interdisciplinary curriculum formulates the internal language of description (L1) as the 'principles of description to which it gives rise' (Bernstein, 2000: 91).

The external language L2, on the other hand is a "theoretically grounded, conceptual language for modelling the generative principles of varying forms of social practice" (Moore 2006, p. 135). This external language is a language of enactment (Moss, 2001) because it is the means by which one can generate a model, as a space of possibilities. For example, when the possible forms of social practice, such as interdisciplinary curricula development, are realized empirically they require an "external language of description" for their forms to be

recognised (Bernstein, 2000, p. 132). Here the external language of description acts as a *translation device* between the analytic theorisations and the data, providing a model capable of describing something other than itself (Moore and Muller, 2002, p. 633). The risk for the researcher lies in the absence of a model in which the research is 'marooned' in the specific context: 'Without a model the researcher can never know what could have been and was not. Without a model, the researcher only knows what his/her informants have enacted (Bernstein, 2000, p. 135).

The development of an external language of description becomes a translation device because it creates a set of rules, or grammar, for the data that allows us to compare and contrast data in principled ways. It is important to note that through the translation device the data speaks back to the theory and in doing so may modify its development; a dynamic evolution of both internal and external languages. Morais (2002, p. 565) suggests that translation devices 'represent the dialectical relation between the theoretical and the empirical - the internal language of description directs the external language of description, and this directs the practical structuring of research and the analysis and interpretation of results'. Examples of empirical studies that have applied languages of description include Dowling's (1995) translation of the language of school mathematics text books into sociological discourse and author model of curriculum development in higher education from which a theoretical conceptualisation of autonomy is derived. For the researcher, it is the transparency of this translation that enables the competence of the translator (the researcher) to be checked and verified (Maton and Chen, 2016). The implication of this for the interdisciplinary curriculum researcher is the requirement to develop an external language of description as a translation device capable of examining the outcomes of interdisciplinary curriculum design.

Developing an internal language of description: conceptualising interdisciplinary curriculum design

It is important to note here that the interdisciplinary curriculum design process, while ultimately having students' achievement as its focus, is realised in practice in the first instance by teachers creating structures for curriculum delivery and texts such as curriculum plans, handbooks, lesson plans, and other documents. These structures and texts can be said to represent curriculum design and planning outcomes which make visible the way in which the interdisciplinary curriculum is being understood and developed. The job of the researcher is to establish the basis of these practices; to identify how the interdisciplinary outputs are produced and legitimated and subsequently what effect they have on student learning. By way of example we begin by noting the contrasting ways in which the two schools approach curriculum structuring. In School 1, the secondary school in the UK, this structure takes the form of project based fieldwork, known as *expeditions*, in which several subjects such as English literature, history, and art are combined and taught together. In contrast, in School 2 in New Zealand, the curriculum is structured by overriding broad themes realised as problems or *areas for investigation* in modules (where subjects are integrated) and SPINS (where subjects stand-alone). While similar in their curricular and pedagogical aims the two schools diverge regarding how the *interdisciplinary* curriculum is organised. What challenges us here, as researchers, is how we can develop a description of these characteristics that represents an accurate interpretation derived from our knowledge of the field of education, an understanding of the phenomena we are investigating, and the data we choose to collect and analyse. We have begun to identify an increasingly coherent and explicit system of concepts for analysis, including knowledge structures (Bernstein, 2000), conceptual progression (Rata, 2016), curriculum structure (author), and arguments in favour of subject integration (Beane, 1997; Drake, 1998; Barnes, 2015; Hipkins, Bolstad, Boyd & McDowell; Frodeman, 2014;

Savage, 2011; Sulla, 2015; Wineburg & Grossman, 2000). At an early stage, we could identify that the interdisciplinary curriculum practice we observed in both schools was effective in engaging students and that teachers were committed to make the curriculum work. At the same time, we became curious about the decision-making operating in this practice and the degree to which conceptual integration was taking place. We characterise this as a form of internal language that describes the logic of interdisciplinary curriculum-making operating in the two schools, but not the underlying principles that account for the differences between them.

As discussed earlier in this paper, the approaches that teachers take when developing the interdisciplinary curriculum may be influenced by the interrelationship between their disciplinary gaze and the epistemic structure of the subject itself (Bernstein, 2000, p. 164), or by other sorts of motivating factors such as the apparent logic of student-centred (Sulla, 2015), 21st Century (Bolstad, 2012), or social justice discourses in education (Beane, 1997). Where disciplinary structure is considered, approaches are likely to vary according to whether the epistemic structure of the discipline is horizontal or vertical (see the explanations of knowledge structure above) and the degree to which this is explicit or implicit to the teacher or curriculum designer. Disciplines such as history, for example, exhibit a horizontal structure in which knowledge is developed segmentally, while others such as physics have a hierarchical knowledge structure (Bernstein, 2000). It can also be seen that horizontal knowledge structures tend towards a weaker system of meanings with a less dense and interrelated epistemic structure (Maton, 2011).

One potential outcome of this weaker system of meanings in the context of interdisciplinary curriculum design can be seen in the way history, for example, is more likely to provide, implicitly at least, a shaping or guiding influence on the form the curriculum takes rather than

a more explicit conceptual contribution. In our research we have observed that history teachers who are (co-) designing interdisciplinary curriculum bring broad themes or topics to the table rather than discrete sets of historical concepts. Integration of history concepts in interdisciplinary curriculum therefore, tends towards less visibility and a more overarching curricular influence in response to this weaker integrative potential. However, it is also important to note that the reproduction of disciplinary knowledge in educational settings is subject to theories of pedagogy adopted by teachers, which are themselves horizontal structures of knowledge (Morais, 2002, p. 566). This could have the effect of limiting or increasing the possibility of integration through the basis on which teachers make an informed choice of which disciplines to combine. Interdisciplinary curriculum design, therefore, can be conceptualised as having an emphasis on the management of the curriculum in which teachers pay attention primarily to the selection and pacing of content and rather less to how knowledge is sequenced and progressed conceptually (author). The implications of this conceptualisation of interdisciplinary curriculum making will now be discussed in relation to its organising principles and how it might be examined and analysed in relation to three key considerations for the researcher.

The emergence of three key analytic considerations for the researcher

The first challenge for us as researchers was to consider the outcomes of interdisciplinary curriculum design as an organising principle and to make a choice concerning the *unit of analysis*. The question arose as to whether the analysis was to be of the meso level formulation of learning and teaching interaction (i.e. at the level of modules or units of study or instruction that might last several weeks) or whether to examine the micro level of learning activity (i.e. at the level of individual activities, tasks, exercises or challenges for the learner, that might only last part of one lesson). Taking the example of a module of work at School 2,

knowledge of microbes (biology) is theorised as enhancing understanding of dietary choices (health/physical education) and in the integration of these disciplines at the level of micro activity the teacher is challenged to select, sequence, and pace concepts from the disciplines being studied together. It is interesting to note that we observed that teachers were challenged by the amount of planning needed at both the micro and meso level in the interdisciplinary curriculum. Furthermore, we noted that this led to a trial and error approach to planning in which the teacher learns through experience what does and does not work when disciplines are brought together (see also Naidoo, 2010). Also, at the meso level of the teaching unit or module, conceptual progression, the coherent integration of concepts into structured systems of meaning that are the building blocks of disciplines (Rata, 2016), tended to withdraw from view and was replaced by broad topics or themes that were more easily described in handbooks and learning materials.

A second organising principle for our research was the degree to which concepts from different disciplines *interrelate* (see discussion in Part 1). In School 1 the interdisciplinary curriculum unit of work, *Let's Get Physical*, aimed to combine biology, sports science, and mathematics. The guiding question 'How can science make us superhuman?' directed the expedition towards the effect of science on athletes' performance, and an understanding of how the body works but the emphasis is on measurement, recording, and analysing metrics. Thus, mathematics became the dominant idea in the interdisciplinary approach, and while this may have suited the purposes of the project for learning it was less likely to result in a true integration of the disciplinary concepts, especially at the micro level. Similarly, in School 2, in a unit of work combining biology and health, *i-Care*, the 'therapeutic' idea of caring for oneself and developing strategies and knowledge to support this placed biological knowledge (of microbes for example) in an instrumental relationship with the more dominant, everyday

idea. Here the teacher needed to be aware of the way the integration may have affected the potential for knowledge to become disconnected from its disciplinary system of meaning, and the danger that one can subject may become instrumental to the other.

A third consideration for us as researchers arose from the need to examine the relations that organise and constitute the outcomes of interdisciplinary curriculum design and the (inter)disciplinary materials, objects, and content that were put to use by the teacher. The need for a constructive alignment (Biggs 1996) between the teaching methods and learning targets was critical here. For example, the way in which key texts were chosen for School 1's unit of work *All Together Now* (guiding question 'What makes a successful community?) privileged a literary conception of community (in the selection of Paul Fleischman's fictional work, *Seedfolks*) as opposed to say it's geographical or historical development. In one sense the dominance of one or other discipline is perhaps inevitable given that the means of evaluation in educational contexts is via formal assessment of learning, and that the criteria for this evaluation is developed and validated in disciplinary concepts (e.g. in how examination boards and subject associations are closely aligned in the UK, and how national Achievement Standards drive curricula content in New Zealand). One might also ask again whether assessment criteria exist that can examine the learning outcomes of interdisciplinary learning (Naidoo 2010) or to what extent the outcomes of interdisciplinary curriculum design are recognisable as new forms of knowledge for which criteria exist or are potentially created? In the next section, we will outline the notion of a translation device capable of making these organising principles of practice first visible and then, second, accessible for deeper analysis and comparison.

Towards a translation device for examining the integration of disciplinary concepts

Having begun to examine the organising principles of practice operating in interdisciplinary curriculum making we echo the point made earlier that interdisciplinarity is promoted as an approach that brings together and enriches knowledge and learning and that it is the nature and the quality of this 'bringing together' or integration that is our central concern in this paper. We are seeking the basis for establishing 'what counts as data and what provides for their principled reading' (Ensor and Hoadley, 2004, p. 92). Our developing analysis of the data has revealed two paths towards integration in interdisciplinary curricula. The first path is where a strong conceptual base exists independently for each of the disciplines involved. This is illustrated in the way that learners produce work that is assessed according to existing disciplinary assessment frameworks and rubrics. The second path towards integration is where a conceptual framework for assessment does not yet exist. An example would be where meanings emerging from an interdisciplinary curriculum project such as *Grand Designs* (guiding question 'What is it about nature that inspires us?') leads to new understandings for students and teachers such as the interaction of human and physical processes in the environment and novel insights into the ethical consideration of topics such as creationism versus evolution. The distinction here is not in the academic level that learners achieve (and whether they outpace or exceed national expectations of learning) but rather whether it is generative of novel insights – or more importantly perhaps if it enables learners to go beyond their contexts, as an example of powerful knowledge (Young, 2009); to extend what is presented in a disciplinary context to identify and explore that which might be possible in an interdisciplinary perspective. It is important to note that where the criteria for evaluating the outcomes of integration do not exist, the result is likely to be generic, or meta-skills, of 'learning to learn' (Bernstein, 2000). The degree to which these forms of integration vary in the cases we have studied suggests a typology of integration as shown in Table 1.

Table 1: A typology of (inter)disciplinary curriculum design integration

This typology shows how the two paths of integration are distinguished by the orientation of the disciplinary conceptual base towards internal epistemic structuring for path 1 and external, thematic or problem-based for path 2 and how the (inter)disciplinary integration varies from weak(er) to strong(er). The strength of this integrative variation is indicative of the type of integration that is likely to hold sway in the interdisciplinary context. For example, weaker conceptual integration suggests that the basis of integration is *functional or pragmatic* – in other words on how the curriculum is organised or managed (author). Stronger integration, on the other hand, is indicative of a *principled* form of integration that more likely to involve the combining of *concepts* from different disciplines. In the latter, it is more likely (but not inevitable) that attention is paid to conceptual progression in the curricular design (Rata, 2016). The outcomes of these forms of integration are shown in the last column. It should be noted that both paths can result in the development of generic or meta-skills, although our research is showing that the outcome is differentiated by purpose: i.e. by the explicit targeting of competences such as 'learning to learn' in the functional/pragmatic form of integration, as opposed to meta-skills being the implicit and subsidiary outcome of the more (epistemic) principled approach. At this point the typology describes and conceptualises what we observe to be the case in our research schools. To go beyond this theorisation, we need the means of reading or translating the integrative paths and how this is enacted in practice. In other words, how might this typology inform how the interdisciplinary curriculum is designed and evaluated in other contexts? For this we need to develop the model further.

A translation device for interdisciplinary curriculum design research

The typology derived as a first stage in theorising interdisciplinary curriculum design in the cases we are examining, shown in Table 1, can be used to describe types of integration that vary according to the strength of epistemic synthesis and the purpose that drives it. Our task now is to move beyond the internal description that the typology provides in order to identify the organising principles of the practices we are actually examining by means of a model (Bernstein, 2000, p. 135). However, the model is inert if it is not responsive to empirical data that helps to identify further generative principles. The model shown in figure 1 acts as a translation device for our research in that we can examine the extent to which interdisciplinarity achieves the integration of knowledge from two or more disciplines into one synthesised whole. A dimension of integration is emerging based on the degree of context dependence that exists or that becomes possible. Allowing for the fact that all knowledge, regardless of its verticality, is to some degree conceptual, it can be argued that forms of knowledge that emphasise strategies and procedures, and which are segmentally organised, have a form of integration which is *functional*. Whereas, knowledge whose integration is at the 'level of meanings', can be said to have a form of integration which is *conceptual* (Young and Muller, 2016, p. 171).

Figure 1: A continuum of integration in interdisciplinary curriculum design

On this continuum, a stronger conceptual coding for interdisciplinary curriculum design represents a principled shift and a stronger emphasis on conceptual integration. Reading this from the left to the right one sees increasing context independence. Towards the functional pole one would expect an increase in the pragmatic purpose of aligning disciplines together, in say how the organising principle governing the interdisciplinary impulse arises from

instrumental purposes or what author terms 'external organisers'. Stronger functional/ pragmatic emphasis is likely to shift the emphasis towards the generic, for example how personal engagement of the learner is valued, or what competencies they appear to be developing. A movement towards the conceptual pole indicates a shift towards the epistemic basis of the curriculum and places the emphasis on knowledge building and conceptual progression. As a translation device, it should work at the meso (teaching unit or module) level and at the micro (specific learning activity) level. The crucial point is that this model can capture an infinite set of positions, as opposed to a discrete set of cases, suggesting that this elaboration of the model is a topology rather than a typology. The interrelationship between the internal and external languages of description provides us with a means of recognizing various modalities of practice but perhaps most importantly, it provides us with a means of imagining (and ultimately developing and testing) alternative modalities of teaching as well.

The concept and use of a translation device offers a methodological mechanism that serves to provide the researcher with the means of approaching context independence while also being relevant to specific contexts. This offers a greater basis for trustworthy claims about the interdisciplinary curriculum and the opportunity for reflexivity to avoid circularity: 'Internal languages are the condition for constructing invisibles, external languages are the means of making those invisibles visible, in a non-circular way' (Bernstein, 2000, p. 133). It is the external language of description that attempts 'to close the discursive gap between theory and data' (Moore, 2006, p. 38) in which 'to close the gap is thus a normative moment in the research act' (Young and Muller 2016, 173). What remains is the need to further interrogate this model with further data from our studies, as we have started to do in the examples of interdisciplinary curriculum design practice given above.

Conclusion: Implications for the interdisciplinary curriculum design researcher

The integrative aims of interdisciplinarity appear to implicate either an epistemological bridging or a synthesis of disciplinary concepts and modalities, two quite different outcomes. As part of our methodological work we theorise this as a continuum of 'integration' with 'functional integration' at one pole and 'principled' at the other depending on what understandings of knowledge is driving the curricular design. Our aim is to develop a means to make visible the underlying principles at work in actual curriculum making, as distinct from the general claims made for interdisciplinarity in the literature. We have highlighted our process to date, particularly the methodological development of a translation device.

Underpinning our process theoretically we note the importance of an analytical framework and the development of a translation device as an 'interpretative interface, or the means of dialogue between the agency of enactments and the generating language of the model' (Bernstein, 2000, p. 133). It is as Moss (2001) points out, the generative possibilities of this model that offers the researcher the means to examine the claims made for the outcomes in a given research context. Drawing on our own research in the context of curriculum design in secondary education in the UK and New Zealand we have illustrated and exemplified the notion of a translation device for evaluating attempts to combine and integrate school subjects. This methodological approach offers us a way of examining the epistemic outcomes of the interdisciplinary curriculum and to separate the degree of access to apposite disciplinary, conceptual knowledge, from generic, skills-based instrumentalism. Ultimately, it will assist teachers and school leaders to determine whether their efforts to engage students through new forms of curricular organisation are well founded in strong claims for cumulative knowledge building.

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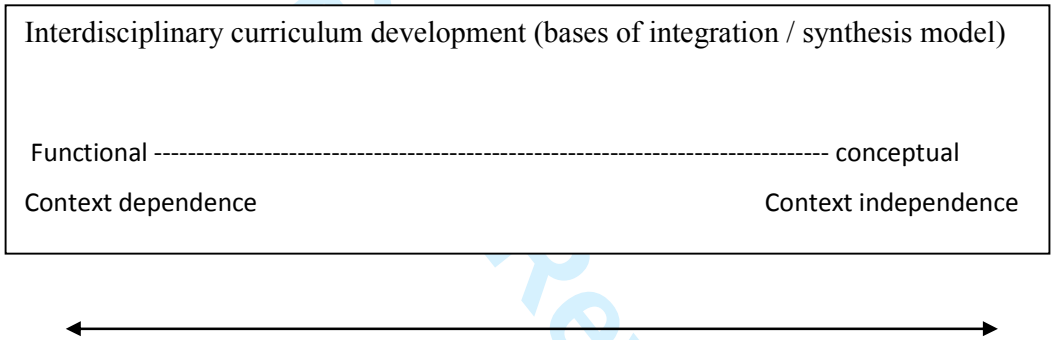
Figure 1: A continuum of integration in interdisciplinary curriculum design



Interdisciplinary integrative path	Conceptual orientation	How the integration varies	Outcomes
Path 1 (disciplinary conceptual models)	Internal	Weaker integration (functional / pragmatic)	Disciplinary knowledge (Meta-skills / knowledge)
Path 2 (interdisciplinary conceptual models that are emergent or yet to exist)	External	Stronger integration (conceptual /principled)	Novel insights, new knowledge (Meta-skills / knowledge)

Table 1: A typology of (inter)disciplinary curriculum design integration