

Exploring curriculum coherence and professional knowledge

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Chapter Title: Exploring curriculum coherence and professional knowledge

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Abstract: The debate across nations around the purpose of the curriculum, and teachers' agency in designing it, has raised the importance of coherence in the curriculum and the professional knowledge to achieve it. While there is recognition that knowledge is central to coherence there is uncertainty about how this can be achieved. There is divergence on whether this is best done via evaluation or by means of heuristic modelling. A heuristic approach maps the curriculum as schemas, that guide practice and its development, as a form of problem-solving. Such models draw on the conceptual structure of disciplinary knowledge. The Curriculum Design Coherence Model (CDC), is a heuristic framework that aims to help teachers to focus on the process rather than the product approach. It provides a conceptual language to assert authority over their curriculum and to defend curricular decision making. This chapter draws on a longitudinal case study of the use of CDC model in schools in New Zealand and England. The findings show that the teachers increased their awareness of their subject expertise, ability to make professional judgments and to acquire greater theoretical understandings in relation to knowledge forms and types, positioning them as informed epistemic agents within national systems.

Introduction

Debates across nations concerned with the purposes of the curriculum, and teachers' agency in designing and realising them, have raised the significance of the concept of coherence and the professional knowledge required to achieve it. The term 'curriculum coherence' has been viewed as a 'broad metaphorical concept' that is 'recruited for different purposes at different times' (Muller, 2022, p.2), while also being 'conceptually ambiguous' (Becher, 2022, p. 579). However, it does offer curriculum researchers a starting point, in which there is a broad consensus among scholars that coherence is 'crucial for program design' (Becher, 2022, p. 577). Coherence in this chapter is considered in relation to school-based curriculum design, with a particular focus on the role of teachers. In order to analyse the different ways that coherence can be articulated, first a consideration will be made of the purposes of school curricula and the ways that different articulations of the curriculum shape differing relationships with knowledge. Next the concept of coherence will be examined in more depth, before taking a particular focus on epistemic coherence and its relationship with equity, recognising that the quality of the curriculum has a profound impact on the life-chances of children and young people. In this chapter, therefore, epistemic coherence is taken to mean the construction of reasoned, logical and examined selections of knowledge, specialised and organised through disciplinary means in order to open up productive and accountable educational potential for learners (Swift, 2023). Teachers' knowledge about knowledge, their appreciation of epistemology, it is argued, is a fundamental tenet in relation

to achieving epistemic coherence. Consequently, the focus on disciplinary architecture and its relationship with the recontextualisation of school subjects is what discerns teachers' practices in designing the curriculum from the related and more often referenced capacity for teachers to merely make it.

While curriculum design capabilities have often been assumed, but not necessarily prioritised in teacher-education, such presumptions have impacted negatively on teachers' curriculum ambitions (Sinnema, Nieveen & Priestley, 2020). Indeed without recourse to the development of such systematic professional knowledge, confusions, conflation and omissions can occur, reducing the epistemic quality (Hudson, 2018) of curriculum design. While systematic knowledge can be distinguished from common-sense knowledge, these forms of knowledge serve different purposes and have different effects on the formation of professional knowledge. Orchard and Winch (2015) argue that teachers 'need a conceptual framework within which to think about education' (p. 6) as 'without transparent, clear and authoritative sources on which to base classroom decisions, teachers' conflicting common-sense judgments are difficult, if not impossible to resolve' (p.13). The sufficiency and effectiveness of current teacher education programmes will therefore be discussed, including an analysis of the different forms of evidence used to justify the varied positioning of teachers' professional agency in curriculum design endeavours.

A focus will then be taken on one particular heuristic framework to exemplify some of the challenges and dilemmas associated with realising ambitions for epistemic coherence in curriculum design. The Curriculum Design Coherence (CDC) model (Rata, 2019, 2021), first developed and subsequently applied in New Zealand (Rata, 2021, Rata and McPhail, 2020; McPhail et al., 2023) has also been used in England (Pountney and Swift, 2022, Swift 2023). Various applications of the CDC model are then examined, as 'generative rather than representational' (Martin and Kamberelis, 2013: 677) cases. This longitudinal study exemplifies some of the practice-based dilemmas associated with teachers' ambitions to secure epistemic coherence in curriculum design. The discussion is informed by the illuminatory insights gained from the teachers' use of the model, and concludes with considerations of how to enable epistemic coherence through teacher agency in order to design effective and equitable curriculum solutions. In order to evaluate the quality of such curriculum propositions, first the purpose and value of the curriculum needs to be established.

The Purpose(s) of Curriculum Articulations

Stenhouse (1975) suggested that: '[d]efinitions of the word curriculum do not solve curricular problems; but they do suggest perspectives from which to view them' (p.1). Such perspectives include the educational purposes that a curriculum is intended to serve so that the curriculum is realised in 'such a form that it is open to critical scrutiny and capable of effective translation into practice' (Stenhouse, 1975: 4). In order to develop, or interpret, a curriculum document teachers need to be cognisant of both its purpose and its status, and the ways in which the agency of teachers is articulated within the curriculum design process. Articulating the purpose(s) of education is complex work as 'what is special and most likely unique about education is that it is not oriented towards one purpose, such as medicine's orientation toward (the promotion of health) or the legal profession's orientation toward (the pursuit of) justice' (Biesta, 2020, p. 92). It has been argued (Biesta, 2020) that education serves at least three distinctive 'domains of purpose': one being 'the making available of 'knowledge and skills'; another the '(re)presentation of cultures, traditions and practice'; and the third purpose is to have impact 'on the student as an individual, either by enhancing or restricting capacities and capabilities' (p. 92). Biesta (2020) states that whilst the knowledge and skills function of education is an important task, it is not the only function of schools, and that, consequently, how such knowledge is positioned in curriculum documentation carries with it the values which that particular jurisdiction, organisation or institution attaches to educational endeavours. In other words, not only does it carry such values, but the form in which knowledge is expressed in curricular documentation has real effects on the professional education and practice of teachers. As Deng recognises what makes a practice become educational 'has to do with the transformative impact that the imparting of knowledge brings about on the understanding, capabilities and dispositions of students' (2023, p. 10). Therefore, how curriculum documents are written down and interpreted by teachers matters.

Regarding the learner, Young (2009) argues that a curriculum should foreground the central purpose of schooling in helping students gain access to 'powerful disciplinary knowledge that they cannot acquire at home' (REF). Wheelahan (2023) suggests that the task of curriculum is 'to help students enter different systems of meaning and make sense of them' (p.89). These different systems of meaning 'give students the epistemic tools they need to gain access to the social and natural worlds and to participate in debates about what our society should be like' (Wheelahan, 2023, p.89). Deng (2023), drawing on the concept of Bildung

and the formation of the individual, contends that the purpose of providing access to such disciplinary knowledge is 'inextricably intertwined with another more fundamental purpose, the formation of independent and responsible individuals through the cultivation of human powers (understanding, capabilities and dispositions' (p. 12). The essential task of the teacher is then to use their knowledge of knowledge 'as a tool for unlocking the educational potential of curriculum content' (Deng, 2023, p.14), in order that teachers can create the time and space in the curriculum for students to gain access to and interact with knowledge.

Seeking Curriculum Coherence

Coherence in the curriculum can be broadly understood in terms of purpose, shared vision, and consistency and stability in the decision-making (Sahlberg, 2011). A contrast can be made here between superficial alignments and coherent connections. Alignment is often used as a term to highlight consistency between assessment and curriculum approaches. It can also be used to analyse the fidelity between policy expectations and practice, to analyse policy-practice gaps (Sundberg, 2022). Passive alignment of practices with official policy expectations can lead to 'widespread perceptions of curriculum as (merely) an official test designed by government official authorities to be faithfully implemented and passively "received" in schools' (Priestley et al, 2021, p. 1) .

However, constructive alignment (Biggs, 2003) remains the basis of most approaches to planning the curriculum and for ensuring its coherence. This perspective emphasises the structure, coherence, and integrity of the students' formal academic programme to depend substantially on the curriculum plans created, and "how tightly they prescribe what students should study, and how well they communicate their plans to students" (Stark et al 1997: 100). This approach to curriculum **ensign** is essentially evaluative, carried out as a form of mapping in which links are made between learning outcomes and the learning activities designed to bring them about as a form of enhancement (Oliver et al., 2010), achieved through a function of management (Finley, 2000), and as a 'commitment to efficiency' (Knight, 2001: 378). These criticisms of rational curriculum planning challenge the idea that curriculum planning is reducible to precise statements that can specify outcomes. Knight suggests that teachers are more likely to call upon 'lessons-in-memory' as remembered fragments of past practice that have worked well at other times: 'Here, outcomes are *not* habitually used for planning, but as checks that the plans are as good as they seem.' (Knight, 2001: 374 original emphasis). Creativity in the curriculum, he argues, depends on there being 'slack, spaces or spare capacity' in the system (ibid.). Moreover, teachers' preoccupation with the need to deliver lessons tends to lead them to neglect attention to

curriculum design, in which their curriculum making activities are dominated by a pedagogic imperative (Pountney, 2020).

In contrast, when curriculum work is taken to involve ‘highly dynamic processes of interpretation, mediation, negotiation and translation across multiple layers or sites of education systems’ (Priestley et al, 2021, p.1), a more nuanced appreciation of curriculum coherence is needed, one that is more likely to have a directly positive influence on student achievement by enhancing student academic engagement and learning (Pountney and McPhail, 2019) and teacher agency (Priestley et al., 2011). Muller (2022), drawing on neo-Bernsteinian, social-realist scholarship, uses the term ‘curriculum coherence’ to refer to the ‘*governing logic* in curricula, which includes but goes beyond alignment’ (p.2 original emphasis). Coherence in this sense requires curriculum designers to be guided by an organisational logic. Schmidt et al (2002), in Oates’s (2011) international comparisons of curriculum frameworks, suggests that a curricular feature of high performing countries was that they sequence their mathematics and science curricula in a way that corresponded to the hierarchical structure of the discipline. Coherence here is achieved at the system level, and was used to underpin the National Curriculum in England (2014) by paying attention to the conceptual architecture of the discipline, enabling the school curriculum to be designed in a logically connected sequence, maximising opportunities for student understanding. Coherence is achieved when ‘the national curriculum content, textbooks, teaching content, pedagogy, assessment and drivers and incentives are all aligned and reinforce one another’ (Oates, 2011: 138-139). In order to achieve such a form of coherence, curriculum control is also necessary, but **that** such control can be enacted in very different ways, ‘some systems emphasise high levels of teacher qualification, others emphasise, tightly controlled curriculum materials and so on’ (Oates, 2011, p.126). Such control mechanisms involve grappling with dilemmas which bring to the fore both agentic and epistemic concerns. Heuristic modelling can offer the means to seek coherence to guide teachers work, recognising that agentic teachers ‘do not require protocols setting out in detail what to do in every conceivable situation. Rather, a set of guiding principles is developed and agreed over time’ (Orchard and Winch, 2015, p.18)

There exists, however, an unresolved tension between product and process approaches to the curriculum and the dominance of ‘rational curriculum planning’ (Tyler, 1949) in which the curriculum is designed as a product, an approach that has held sway for several decades and whose influence is still felt. The product approach focuses on defining goals, establishing corresponding learning experiences and evaluating outcomes. Stenhouse (1975) led a response to Tyler’s ideas on the curriculum offering an alternative – the

'process approach' (Eisner, 1985; Knight, 2001), advocating principles for selecting content, developing teaching strategies, and assessing students' strengths and weaknesses. The process curriculum aimed to do away with the 'behavioural objectives and hierarchical learning tasks' of the curriculum as product, in which the success or failure of the curriculum was based on predefined changes in the learner's behaviour (Howard, 2007, p.2). The mechanistic approach to learning was challenged by a model of the curriculum as a shared idea of the common good, and the goal of informed and committed action (Stenhouse, 1981). However, there remains considerable sympathy for an approach, such as Tyler's, that sets the curriculum developer tough questions about the 'effective curriculum' (Posner, 1995).

The focus of these two different models, one that emphasises plans and intentions (the product model) and one that emphasises activities and effects (the process model) can be seen to affect how curriculum development is understood and treated, especially in the early stages of planning (Neary, 2003, p.39). Where there is a preference for the process approach this is roughly based on its perceived superiority to an 'outcomes-led rational approach', in which coherence in the curriculum is realised as a form of 'a spiral of repeated engagements to improve and deepen skills, concepts, attitudes and values and extend their reach' (Knight, 2001, p.371). These competing approaches, one which emphasises product leading to a focus on evaluation, and the other on process, emphasising heuristic modelling, will now be further discussed.

Achieving curriculum coherence through heuristic modelling.

Heuristic modelling, therefore involves a mapping of the curriculum but the focus is on concepts and learning rather than the delivery of the course itself. Curriculum materials are considered to be coherent if they illustrate and model integrated understanding: that is, they are based on an understanding of how students connect ideas and apply them to new contexts (knowledge integration). This draws on Bruner's (1995, p.333) concept of the need to 'grasp the relatedness of knowledge' and how experts have richly inter-related concepts that novices are less likely to possess. Significant in these studies is the emphasis on coherence of learning itself rather than on the efficiency of its management. Curricular coherence in this perspective is the desired quality of the curriculum materials that present a complete set of interrelated ideas and make connections among them explicit.

This reflects a view of alignment that goes beyond the simplistic matching of one set of content with another to consider the logical and hierarchical sequencing of concepts,

including their 'horizontal' and 'vertical' coherence (Wilson and Bertenthal, 2005). A curriculum is considered to be horizontally coherent if its instruction and assessment are aligned with, and **target** the same goals for learning as, 'standards'; vertical coherence exists if standards at one level build on those at previous levels (Squires, 2009); and a curriculum is considered developmentally coherent if it takes into account the content knowledge, abilities and understanding that are needed to progress at each stage (Wilson and Draney, 2009: 7). While the use of the language of 'standards' with regard to vertical coherence might be associated with coherence as evaluation and the efficiency model of the curriculum it actually has its roots in Bruner's (1960: 334) conception of the curriculum as the search for a visible 'depth and continuity in our teaching'. The goal is to give students an emerging and progressive sense of the curriculum (Schmidt and Prawat, 2006) as opposed to (merely) providing a means by which this can be managed.

In distinguishing between a evaluative and a modelling coherence it can be seen that the aim in an evaluative approach is to seek coherence as a conclusion based on a systematic study and judgement of 'curricular dimensions' (Cuevas et al., 2009), depending substantially on the plans that schools create, and how tightly they prescribe what students should study (Stark et al., 1997). A modelling approach, on the other hand, heuristically maps the curriculum as mental maps, or schemas, that guide practice and its development, as a form of problem-solving. The basis of these schemas is disciplinary in nature, drawing on the conceptual structure of disciplinary knowledge. Curricular coherence in this perspective is the desired quality of the curriculum materials that present a complete set of interrelated ideas and make connections among them explicit. This attention to knowledge and its structuring is referred to in this chapter as seeking epistemic coherence and is now discussed.

Epistemic Coherence

Central to epistemic coherence is a social realist understanding of knowledge, whose different forms have effects for intellectual and educational practices (Maton and Moore, 2009), contrary to the reduction of knowledge to "social relations of power and the often-incommensurate standpoints of different groups of knowers" (Hoadley et al, 2019, p.99). Social realists build on the work of Durkheim (1912/2008) who distinguished between the sacred (i.e., conceptual, systematic or substantive knowledge) and the profane (i.e. knowledge about how to live in the everyday world, knowledge acquired by experience).

Systematic and everyday knowledge should be differentiated as being structurally dissimilar. Systematic knowledge takes professionals beyond the contexts of individualised experiences by providing access to the enduring (but not fixed) forms of knowledge that specialise, organise and hold to account (in an evaluative sense) the distinctive nature of the profession. Such knowledge has powers of abstraction that enable knowledge-building through evaluation and connection across different times and spaces. Systematic knowledge therefore 'constitutes a "disturbance" to an individual's subjective ways of understanding the world as they acquire the means to think objectively and, perhaps most significantly, to be critical of the social order in order to improve it' (Rata, McPhail, and Barrett, 2018, p.164). From the perspective of epistemic coherence, therefore, a coherent curriculum is a coherent subject curriculum. Such a curriculum is informed by epistemic quality (Hudson, 2018) and enables epistemic access (Morrow, 2009) and epistemic ascent (Winch, 2013). Epistemic quality relates to a concern about both what learners are able to do with knowledge, **epistemic access** relates to ensuring that all learners have access to systematic knowledge rather than arbitrary selections. In terms of epistemic **ascent** which Winch (2013) argues is a 'key element in curriculum design and that failure to get the sequencing right can have adverse pedagogical choices' (p.134), it is important that progression within a subject is appreciated by teachers, with negative effects on curriculum quality, effectiveness and equity, if such coherence is not paid attention to. Muller (2022) contrasts the term curriculum coherence with curriculum incoherence, suggesting that incoherence occurs when a lack of logical sequencing disrupts 'the hierarchical flow of learning and slowed it down or impeded it' (p.2) . Incoherence can also occur when concepts and contexts are mixed ' in an unprincipled, un-sequenced way' (Muller, 2022, p.3). Coherence in school curricula therefore needs to be underpinned by principles.

The rationale for a coherent subject curriculum

Such principles involve being able to state and recognise the difference between a generic concept, such as "total" and a subject concept, such as "addition" in mathematics, and how the latter specialises a discipline, requiring the ability to differentiate between knowledge and skills and to recognise how they are related and the degree to which they are interdependent. This willingness and capacity to attend to the knowledge structure of the discipline, or school subject, prior to selecting content for learners, can be realised through the development of teachers' curriculum thinking, or curricular mindfulness, as a metacognitive activity.

While metacognition is often referred simplistically as 'thinking about thinking' (EEF, 2018), it is a 'complex and dynamic process', concerned with 'monitoring and controlling your thought processes' (Mannion, 2018, p.67, drawing on the work of Flavell, 1979), in which thinking has a focus on something. In order to monitor and control their curriculum thinking, therefore, teachers need access to a language that they can use to both attend to and critique the principled coherence of their work. Language in this sense is a form of symbolic communication and as 'concepts can only be known through their form as symbols' (Rata, 2021, p. 451), the notion of coherence in curriculum design becomes highly significant as a concept to inform professional discussions and deliberations that can be oral in nature.

It has been acknowledged that 'talk can make a crucial difference for teachers' agency' (Biesta, Priestley and Robinson, 2015, p.52). Therefore enhancing the 'discursive resources' of teachers 'remains an important avenue towards a more agentic teacher profession' (Biesta, Priestley and Robinson, 2015, p. 52). Indeed it 'is the social reality of unobservable concepts that gives them power relative to our common-sense concepts and enables them to transcend the specific instances and circumstances of everyday life' (Young, 2008, p.43). Deliberations concerning concepts such as coherence have arguably been under-appreciated in teachers' professional education for curriculum design. Yet they provide the means for teachers to 'cluster, classify and categorize experience, seeing certain things as similar or different in a particular way. Conceptualization is the beginning of theoretical description and organization' (Swanwick, 1988 cited by McPhail 2021 p.146). Concepts allow teachers to compare, abstract, and reason. It is by accessing concepts that the process of objectification and generalisability can be unlocked. The ability to generalise represents the means 'to connect the material and immaterial, the known and the unknown, the thinkable and the unthinkable, the here and the not here, the specific and the general, and the past, present and future' (Wheelahan, 2007: 2).

In order for teachers to develop their own conceptualisations of coherence, in a coherent way, they need to reference, orally, in writing and in practice, theoretical or systematically organised knowledge. Consequently teaching is a both 'a practical and deliberative practice' (Deng, 2023, p.7). As such it is challenging for teachers to develop an expansive appreciation of the significance of coherence in curriculum design simply by paying attention to observed practices or by immersing themselves in the immediacy of the classroom. Coherence is a concept that can be appreciated in both it attenuated and more expansive form. In its reduced articulation, understanding is limited, and this is when alignment can masquerade as coherence. In order to recognise when such a substitution occurs, teachers

need access to systematic knowledge. Without the deliberative means to enter into such systems of meanings, 'what teachers need to know are typically prefaced by stipulations about what teachers actually do' (Kennedy, 2016, p. 46).

Engagements in professional discourses and debates enables teachers to give reasons for their curriculum design judgements by drawing on professional knowledge bases, such as their understanding of how coherence can be achieved and why it is significant in their curriculum work, rather than relying on idiosyncratic or individual perspectives. Concepts articulated through a professional form of specialised language are therefore a key resource for teachers as curriculum designers. Teachers use concepts such as coherence to be deliberative and metacognitive about the design process, but they also use disciplinary concepts within the design process itself to enable coherence for their learners. In order to access disciplinary concepts, teachers draw on knowledge that exists beyond the immediacy of their classroom or institutional context.

Both professional and school curricula benefit from access to principled systematic knowledge. Such theoretical or conceptual knowledge exists both within and beyond individuals and particular institutions. As Stenhouse (1975) recognised, 'the school is a distributor of knowledge rather than a manufacturer and this implied reference points outside of the school for the subjects that it teaches' (p.10). As such a curriculum that has stronger subject coherence has a principled structure (Pountney and McPhail, 2019) in which the sequencing of concepts, and the connections between them, is non-arbitrary. The design of this curriculum and the learning activities associated with it pays careful attention to progression and/or knowledge building (Winch, 2013), and regards knowledge and skills as interrelated, but treats them separately. This promotes the careful selection of content based on the conceptual structure, and avoids the opportunistic choice of learning material based purely on factors such as context and the need to motivate learners.

In terms of the possible outcomes of stronger subject coherence for learners, the potential is increased for supporting them to conceptualise and deepen their learning, reducing the likelihood of misconceptions and blocks to future learning. Learners might, therefore, be better able to talk about their learning, without being limited to mere factual recall and struggling to elaborate on their learning. They might also be able to state when they studied the subject unit previously and to recall any important key ideas without prompting. Importantly, it raises the possibility of learners being able to answer the question, 'why this, why now?' in relation to the curriculum subject unit they are studying. These characteristics of curriculum subject coherence can be developed into a set of principles or conditions for

teachers including sufficient subject knowledge to be able to identify subject concepts and to be able to compose them into accurate subject statements or propositions.

The CDC model was therefore attractive as it offered not only a means to explore the use of disciplinary concepts to connect and cohere different forms of knowledge within curriculum design solutions, it also presented a framework for professional deliberations. It offered the potential for teachers to develop a conceptual language to reason and justify their curriculum decision-making through discourses accountable to the principles of epistemic coherence.

Curriculum Design Coherence: A longitudinal case study

The CDC model is but one example of a heuristic framework, which offers the means for teachers to operationalise the different forms of knowledge in order to realise curriculum coherence. Its selection in this chapter is to provide a focus for the ideas set out above regarding the importance of epistemic coherence to teachers' curriculum design, rather than an evaluation of the model itself which is available elsewhere (Rata, 2021; Rata and MacPhail, 2020; Pountney and Swift, 2022; Swift 2023). It is shared here as a generative longitudinal case-study, drawing on four phases of work that have taken place across England and New Zealand, 2018 - 2023. The first phase involved researchers in each jurisdiction in becoming familiar with the realist epistemology that underpins the model, the second phase involved teachers in generating theoretical applications of the model, whilst phase three focused on practical realisations. Phase four involved the CDC model being used as an analytical framework in New Zealand and as a framework to generate additional insights in England.

The CDC model itself consists of four inter-related yet distinctive elements (figure 1)

Insert figure 1 here

The circularity of figure 1 is significant, whilst teachers start with Element 1 and move to Element 2, each element is connected to and builds on the previous one, in an iterative rather than linear manner, until a curriculum design solution is settled upon. No design will ever be 'perfect', but a key aim of the CDC model is to enable teachers to focus on the logic of the coherence evident in their deliberations. It does this by continually requiring teachers to 'design their programmes, courses and topics, according to the epistemic structure of academic knowledge' (Rata, 2021, p. 465). In Element 1, a proposition statement is created

that includes by name the disciplinary concept(s). For example in geography a proposition statement could be, 'water use is affected by location', location being the disciplinary concept. The statement asserts what the programme being designed is concerned with, it frames the design and this framing offers coherence by referencing the concept and its associated meanings. The CDC model can be applied to a sequence of lessons or to programmes within and across year groups. In Element 2 the previously selected concept(s) are used to organise the content selection. This organisation is cohered through justification. The CDC model requires teachers to draw on three justifying criteria. The first asks teachers to consider the content that might best realise or materialise the subject concept (s), recognising that coherence is in the logic of the relationship. There are multiple ways that concepts can be materialised, but once the connection is established, the content will be viewed through the articulated relationship. In this way the specific content is both specialised and organised. Secondly attention is paid to the selection of the context and thirdly teachers are asked to consider how and why their selection helps the learner in relation to their role within society.

In Element 3 the same disciplinary concepts are used to specialise the competencies to be developed, these are both performative (practice) and judgement (reasoned). In this way, both procedural and propositional competencies are positively constrained by the identified conceptual purposes that discipline the subject content. The term "know-how-to" is used to refer to competencies in order to make clear that competencies are not knowledge. They are the application of knowledge.

Element 4 requires the teachers to specify how the competencies will be evaluated, prioritising the concept-content-competencies connections relationally, ensuring that fragmentation and atomisation does not occur. The CDC Model asks the teachers to differentiate between three forms of evaluation, all of which are significant. These are the evaluation of content recall, the evaluation of skills and techniques and the evaluation of 'judgement know how to knowledge.

The CDC model's coherence mechanism works by connecting disciplinary concepts to subject content through these four elements. In order to realise the four elements in practice, teachers need to be familiar with the knowledge about knowledge. Grappling with epistemology was a key element in the first phase of the CDC model's application in both England and New Zealand. Whilst the principles of the framework remained consistent, the contextual differences of each nation's curriculum requirement ensured that these were realised differently.

Phase One (2018 – 2020)

In England, the first phase involved senior leaders from a group of fourteen primary schools based in the West Midlands, working with researchers from both New Zealand and England to familiarise themselves with the requirements and expectations of the CDC model. The CDC model had already been used successfully in New Zealand, and whilst both national contexts are significantly different, the school-leaders were motivated to find out more about curriculum design. In England there has been some recognition that knowledge is central to coherence there is uncertainty about how this can be achieved. For example, Ofsted, the schools inspection service re-energised debates about the form and function of knowledge within the curriculum, stating that the ‘curriculum is the progression model’ (Spielman, 2018). This seemingly seductively simple statement caused confusion amongst teachers as it lacked any reference to the theoretical underpinnings that inspired it. The leaders recognised that their colleagues had much to gain by accessing the scholarship that would enable them to to unpack such a condensed statement.

Like for many jurisdictions, teachers in England are allowed time for ‘planning, preparation and assessment’, this equates to 10% of their normal working week, but the focus is often on the visible tasks of lesson planning, rather than being given time and space to engage with the complexities of epistemology. It was therefore important for the teachers to know that their senior leaders had acknowledged that such work is challenging and time consuming . In England, whilst the development of teachers’ curriculum design capabilities has been recognised as being ‘an expert skill’ and a ‘challenge remaining’ (DfE, 2022, p.26) the official solutions to this dilemma involved providing published curriculum solutions and lesson plans via a ‘new arms-length national curriculum body’ (DfE, 2022, p. 27). Arguably such an approach limited teachers’ access to the systematic knowledge used by others to craft such products. The schools involved were therefore eager to explore whether an investment in a process approach was more likely to increase curriculum coherence, and this concern formed an essential aspect of the study’s second phase.

A focus on the quality of the curriculum design process was also a key motivation for teachers in New Zealand to explore the potential of the CDC model. At this time, teachers in New Zealand were grappling with an outcomes-based curriculum, which lacked specificity in terms of content, and so they were required to develop their own local solutions by both selecting content, deciding contexts as well as to design the curriculum. The CDC model

potentially offered the means to help the teachers to specify content and contexts in a conceptually coherent and non-arbitrary way at the school level.

Phase 2 (2020 – 2022)

In New Zealand, three individual teachers used the CDC model to reach local solutions. These included a head of science who attended several workshops during which teachers presented and discussed their designs created using the CDC model. Consequently the teacher decided to use the framework to review the vertical coherence of areas of science across five years of secondary schooling. The following evaluation questions were generated using the model:

- Is there an appropriate sequence of a topic over five years?
- Does a concept build as the years progress?
- Do we scaffold students enough or over burden them each year?

In this case, the CDC model enabled the teacher to know more about the epistemic structure of their subject. This alerted them to the principles that underpin coherence and progression. These principles were also drawn upon by a group of teachers working in the primary phase (ages 5-11) in England.

Each teacher in England who drew on the CDC model, had a subject leadership role for either geography or physical education. Geography was selected as it is one of a group of subjects deemed to be foundation rather than core in England and so does not benefit from the same curriculum status as English, mathematics and science; consequently, less time is invested in both curriculum design and professional learning. Physical education (PE) was chosen as often schools employ external coaches, rather than teachers to organize pupils' learning (AfPE, 2023), resulting in a paucity of curriculum design research.. Physical education has the potential to positively affect children's health and given the concerns of the human epoch, often referred to as the Anthropocene, the role of geography in the curriculum should not be under-estimated. It therefore felt significant to generate research evidence in relation to coherent curriculum design so that pupils could benefit from teachers who could:

- Increase their awareness of different forms of knowledge.
- Explore how to draw upon different forms of knowledge in curriculum design.
- Grapple with the significance of coherence in curriculum thinking.
- Appreciate the inter-relationships between pedagogy, curriculum, assessment, and teaching activities.

It was therefore significant that the CDC Model has a strong theoretical underpinning, so that through their research, teachers could engage in the theorizing of knowledge, the teachers recognized that fragmented content without conceptual connections limits coherence and potential progression for the pupils. The teachers found their use of the CDC Model to be productive, enjoyable, and challenging, whilst many found that *'the process of writing propositions is challenging'* This initial investment of time did however pay dividends as another teacher commented that they *'found the propositions helpful for sharing the curriculum with colleagues, they open up communication and provide a shared language'*. Therefore whilst being very demanding, the tight control demanded by the proposition in its specificity of concept selection guarded against curriculum programmes, courses or units being dominated by loosely selected concepts, by a content list approach, or driven by outcomes as measured by competencies.

This phase of work in both countries showed the effectiveness of the CDC Model as a curriculum design tool. The case has been made that the model is effective because it works by expressing the epistemic structure of a school subject and makes the significance of this knowledge explicit for teachers. However in this phase neither group of teachers tested the claim that there may be a direct link between a coherently designed curriculum and pupil attainment.

Phase 3 (2022 – 2023)

In phase three, a small group of three teachers continued their engagement with the framework (Swift, 2023) . One of the key tenets of the CDC Model that this project was particularly eager to explore was the claim that there is a 'direct connection between...logically structured knowledge and the development of a logically organised mind' (Rata 2020, p.31). This phase of work was very modest, occurring over nine months and involving only three classes (ages 7-11) The findings must therefore be contextualised in the small-scale nature of the investigation. The concept of sustainability was prioritised by all three teachers, and the pupils were asked to generate a mind map to illustrate their conception of sustainability pre and post project (Swift, 2023) as a means of revealing whether or not their understanding had progressed. An analysis of each classes' mind maps indicated that by paying attention to the concept in curriculum design, teachers sequenced the curriculum in a way that pupils were enabled to apply the concept of sustainability to different contexts. Their post project mind maps shared a wider range of content and context connections, including some from the pupils' beyond school experiences. This phase of work therefore offers a small empirical contribution to the claim that by accessing disciplinary

concepts in their curriculum design process, teachers can unlock the process of objectification and generalisability for their pupils.

In New Zealand, during this phase, the CDC model was used in a whole school context. Given the absence of a curriculum with prescribed content (Rata, 2021) the teachers of English in one school needed to design their entire curriculum. Their initial questions took them to the very heart of their subject as they asked: 'What does English consist of? How do we organise it in order to design it? Their next task was to write the proposition for the subject as a whole, before refining this for aspects of the subject. The subject proposition statement generated was as follows: *The school subject English is the study of the written, spoken visual and digital language and literature in the English language that functions as instruments of thought and means of communication.* This was then developed into a programme proposition for each aspect of English. The following is the example created for grammar across all year groups. *Grammar is the syntactical organisation of phrases, clauses, and sentences using word types such as nouns, verbs and adjectives to create meaning and the effects of style and tone.* This proposition was then further refined for each year group, two examples are offered below:

- Example of a Topic Proposition in the Grammar Programme (the Sentence for Year 1 and 2 pupils) *Sentences have a subject, verb and predicate to express ideas logically.*
- Example of a Topic Proposition in the Grammar Programme (Year 12 and 13 students) *Syntactical organisation is the selection and crafting of grammatical word types and voice syntax to achieve an intended style and tone.*

The examples show that writing propositions puts a clear boundary around what it to be known so that the teachers could see that a topic serves as a bounded unit. This provides a marker to build a cumulative course to be taught throughout the year or in a programme for teaching across several years. The work in this phase has begun to demonstrate the premise that by paying attention to the structure of disciplinary knowledge, productive affordances for both sequencing the curriculum and enhancing cognitive development can be facilitated through coherent curriculum design. The development of teachers' curriculum design capabilities remains ongoing and in both jurisdictions is now entering a new phase.

Taking Curriculum Coherence Further (Phase Four).

In New Zealand a curriculum 'refresh' is taking place (2022-2026) following the previous expectations that left it to teachers to select content related to broadly stated achievement objectives (McPhail et al, 2023). The 'refresh' represents ' a shift to greater recognition that there is content knowledge which is valuable for students to understand and know (McPhail et al, 2023, p. 511). The principles evident in CDC model have been used by McPhail et al., (2023) as an analytical rubric to examine both the identified purpose of the refresh and the concept of learning progressions (Ministry of Education, 2023) which underpin the proposed changes. The research team conclude that the refresh is 'epistemologically confused' leading them to doubt that it will 'assist teachers in clarifying their knowledge of epistemology to assist them as curriculum makers in providing the coherence and logic required for deep learning' (McPhail et al, 2023, p. 523)

In England, an independent review of the impact of the Department for Education's focus on teachers' professional development (May 2023) has suggested that 'staff's understanding of planning and designing the curriculum remained limited' (Ofsted, May, 2023,n.p.). So whilst Ofsted stated that when 'considering the curriculum as the progression model, what pupils are to know needs to be identified precisely and sequenced clearly' (Ofsted, 2021, p.23) and that when ' planning the curriculum, the nature of the discipline should inform content and activity choices' (Ofsted, 2021 p. 7) , It has also been acknowledged that there are a lack of mechanisms available for teachers to realise such curriculum design expectations (Ofsted, 2021). The currently solution of outsourcing of curriculum design is therefore not yet having the desired impact.

These insights contrast with the evaluation of the work that the teachers involved in phase three contributed. The teachers acknowledged that their engagement with a heuristic framework, rather than being positioned as passive recipients of curriculum products, enabled them to consider the importance of:

- curriculum design as opposed to lesson design
- sharing the principles with other teachers
- reflecting on the successes of the curriculum
- using concepts to shape a curriculum to focus on the key learning
- using the model as a cycle to consistently evaluate the success of teaching and learning within the designed curriculum
- designing a curriculum based on the connection between the disciplinary concepts and specifically selected content and contexts

These insights have been shared via a project report (Swift 2023) which in a modest way aims to offer a different form of curriculum research, to that which has been used to justify the creation of an arms-length curriculum body. Whilst England is not a unique case, it

perhaps represents a particular case where evidence and practice are othered and policies are based on the notion that evidence is waiting to be 'brought in' (Lancaster and Rhodes, 2020), alignment rather than coherence. It has been acknowledged that 'very little policy impact or innovation has emerged out of the work of teachers or teacher educators themselves' (Loughran and Mentor, 2019. P. 219). Consequently 'politics, economics and ideology has driven many government initiatives rather than knowledge derived from scholarship in teacher education' (Loughran and Mentor, 2019, p.219). Heuristic models which position teachers as co-researchers, offer professional development opportunities that contrast with those founded on a 'linear processual epistemic basis that is represented by the belief that doing A will lead to B then C etc.' (Evans, 2023, p. 4) . This phase of the case-study has generating a responsibility to make explicit 'alternative sets of theoretical perspectives that question and challenge mainstream assumptions and beliefs' (Evans, 2023, p.5). As without making such insights public 'the failure of educationalists to develop a shared multi-disciplinary and multi-method research agenda' (Tatto, 2021, p.27) would continue. The longitudinal case study is an example of curriculum research that can 'challenge the epistemological and methodological divide that has resulted in strong critiques and marginalisation of educationalists' produced research' (Tatto, 2021 p.21) by sharing teacher voices and creating opportunities for teacher agency within a system of coherent curriculum design. In this way such research 'becomes part of the critical discourse' (Stenhouse, 1981, p.111) of education, such that the development of teachers curriculum design capabilities is seen to be informed by both practice and deliberation.

This phase of the case-study therefore signifies both the importance of coherence in curriculum design, and the need to make explicit the professional means of doing so. It echoes Stenhouse's (1975) insight that 'curriculum development must rest on teacher development and that it should promote it and hence the professionalism of the teacher' (p.24) in that teachers' knowledge and agency are increased when their curriculum design expertise is developed, drawing on theories of knowledge and the associated capacity to discern between different forms of knowledge and the different means that these offer in relation to achieving epistemic coherence. In order to discern, teachers benefit from professional development that enables them to be meta-cognitive about their work, an insight that is further considered in the next section.

Discussion and Conclusion.

For Oates (2011) both curriculum coherence and curriculum control were key concepts in relation to enabling a high-quality and equitable national education system, one in which 'all

elements of the system (content, assessment, pedagogy, teacher training, teaching materials, incentives, drivers etc) should all line up and act in a concerted way to deliver public goods' (p. 126) . Such strong inter-relationships can be facilitated through means of sharing a curriculum product, against which outcomes are evaluated or by means of a curriculum design process, within which a conception of coherence, including epistemic coherence is an integral part. The case-study illustrates that when teachers are given agency through heuristic modelling, they gain sustainable transformative professional insights, including access to disciplinary knowledge rather than being seen as servants of pre-established protocols.

The OECD recognised that 'the opportunity to acquire disciplinary knowledge is also fundamental to equity' (OECD, 2019, n.p.). This is because disciplinary knowledge offers a structure to cohere, connect and sequence other forms of knowledge. Such equity is important for both teachers and their learners. For learners, this is achieved through curriculum design mechanisms that foreground epistemic coherence, for teachers, it is enabled through heuristic frameworks which foreground access to the principles or governing logic that can be drawn upon to generate, reason and justify coherent curriculum design solutions. Such frameworks increase teachers' epistemic agency through the development of their understanding of conceptions of curriculum coherence.

The effort, time and space required to facilitate such agency is not to be under-estimated, but nor is its significance in realising curriculum ambitions. Whilst it has been recognised that a 'lack of professional knowledge about curriculum design concepts continues to impact on implementation' (Sinnema, Nieveen & Priestley, 2020, p. 186), it has also been shared that a process model is 'far more demanding on teachers and thus far more difficult to implement in practice' (Stenhouse, 1975, p. 96 -97). This conundrum is clearly evident in both England and New Zealand for different reasons. In New Zealand, teachers were gifted curriculum freedom without the professional development that would enable them to make principled choices. In England, there is the illusion of curriculum freedom, but a conflation between curriculum design and lesson planning has meant that teachers have found it challenging to respond to a focus on curriculum design that extends their gaze beyond their institution of classroom, limiting their agency. England is an example of a jurisdiction where limits on teacher's curriculum agency are being further extended through external organisations that proffer pre-designed curriculum solutions, including lesson plans. These offer teachers alignment, passed off as coherence, seductively packaged in a way that claims to reduce their workload, arguing that this will increase the quality of the learner experience, 'so

teachers can concentrate on delivering lessons, creating new resources, only when there's a reason to do so' (DfE, 2022, p. 27).

Whilst the reduction of workload is often cited as a justification for the provision of pre-published curriculum solutions and lesson plans, such articulations reduce teachers to being technicians, dependent on protocols rather than as professions concerned with key educational dilemmas such as curriculum coherence. As Stenhouse (1975) recognised ' it seems off to attempt to minimise the use of the most expensive resource in the school' (p.24) when it is teachers who can bring about coherent epistemic access for their learners, when they benefit from appropriate frameworks.

The current evidence base used to justify 'teachers as theoretically innocent' (Stenhouse, 1981, p.11) excludes research that is 'immersed in the day-to -day tasks of teaching or learning...that is needed to inform policy and practice by and for the teaching profession (Tatto, 2021, p. 28) . Indeed teachers' lack of epistemic agency and autonomy have been cited as factors in their decision to leave teaching (Perryman and Calvert, 2020). Nurturing the intellectual elements of teachers' professionalism is therefore an important aspect of developing the status of the profession and its impact on society, through the provision of coherent curriculum solutions. So whilst a process model is demanding, 'it offers a higher degree of personal and professional development' (Stenhouse, 1975, p. 97)

One set of such illuminatory insights relates to questioning the assumption that curriculum design and lesson planning are one and the same thing and so can be conflated. Curriculum design, and lesson planning capabilities are both essential, but different. Lesson planning is a specific activity which references learning materials and particular lesson objectives achievable within a short period (Lambert and Morgan 2010). As illustrated in the case study above, careful attention to the design of the curriculum and its epistemic coherence, informs curriculum making, in which the latter is not a proxy for the former.

Curriculum design is about accessing systems of meanings offered by the disciplines. Such conceptual architectures offer epistemic access to the natural and social worlds (Young, 2013). In curriculum design the relationship which is being foregrounded is between a discipline's conceptual architecture and content selection for sequencing the curriculum. Once the design has been created then the curriculum can be made.

Curriculum design knowledge encourages teachers to resist the pedagogic imperative (Pountney 2020) by focussing on disciplinary or epistemic knowledge structures. In order to commit to this endeavour, teachers need to be knowledgeable about knowledge, so that

they can intentionally differentiate between the different forms of knowledge and the different capacities that each form carries in and for curriculum design.

This chapter has shared how teachers can benefit from knowing about curriculum coherence, including epistemic coherence. However it has also shown that a high degree of specialised expertise based on epistemological understanding is involved in curriculum design if coherence and progression are to be achieved. There is evidence to suggest that learners have much to gain from teachers who benefit from such opportunities, making the case for curriculum design to be included in all forms of teacher education.

References

- AfPE (2023) The Future of Physical Education
https://www.afpe.org.uk/page/afPE_Taskforce
- Becher, A. (2022). When context meets knowledge in university professional education: organizational factors influencing coherence in teaching and social work. *Higher Education*, 83(3), 577–595. <https://doi.org/10.1007/s10734-021-00680-0>
- Biesta, G. (2020). *Educational research: An unorthodox introduction*. Bloomsbury Publishing.
- Biesta, G., Priestley, M., & Robinson, S. (2015). The role of beliefs in teacher agency. *Teachers and teaching*, 21(6), 624-640.
- Biggs, J. (2003). Aligning teaching and assessing to course objectives. *Teaching and learning in higher education: New trends and innovations*, 2(4), 13-17.
- Bruner, J.S. (1960) The process of education. Harvard University Press, Cambridge MA
- Bruner, J.S. (1995) Retrospective: On learning mathematics. *Mathematics Teacher*, 8(4), 330–335. (Reprinted from *Mathematics Teacher*, 53, 610–619, December 1960)
- Cuevas, N.M., Matveev, A.G., and Feit, M.D. (2009) Curriculum mapping: an approach to study the coherence of program curricula. The Department Chair, Summer 2009, (23–26)
- Deng, Z. (2023). Practice, pedagogy and education as a discipline: Getting beyond close-to-practice research. *British Educational Research Journal*.
- Department for Education [DfE]. (2022) Opportunity for all: strong schools with great teachers for your child. Available at:
<https://www.gov.uk/government/publications/opportunity-for-all-strong-schools-with-great-teachers-for-your-child>
- Durkheim, E. (1912/ 2008). *The elementary forms of the religious life*. (Trans. Swain, J.W.). Massachusetts: Courier Corporation.
- Education Endowment Foundation (2018) *Metacognition and Self-Regulated Learning: Guidance Report*. London: EEF. Available at: <https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/metacognition>
- Eisner, E. (1985) The educational imagination (2nd ed.). New York: Macmillan.
- Evans, L. (2023), “The emergence of a distinctive European scholarship of professional development; challenging mainstream conceptualisations, consensus and causality

- claims”, *European Journal of Teacher Education*,
<http://doi.org/10.1080/02619768.2023.2289857>
- Finley, S. J. (2000) *Instructional coherence: The changing role of the teacher*. Austin; Texas, Southwest Educational Development Laboratory SEDL
- Flavell JH (1979) Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist* 34(10): 906–911
- Hoadley, U., Sehgal-Cuthbert, A., Barrett, B. and Morgan, J. (2019). After the knowledge turn? Politics and pedagogy, *The Curriculum Journal*, 30:2, 99-104.
<https://doi.org/10.1080/09585176.2019.1601844>
- Howard, J. (2007). Curriculum development. Elon University, Center for the Advancement of Teaching and Learning. [online:
<http://efaidnbmnnnibpcajpcgglefindmkaj/https://ocw.tudelft.nl/wp-content/uploads/Article-Judith-Howard-on-Curriculum-Design.pdf>]
- Hudson, B. J. (2018). Powerful knowledge and epistemic quality in school mathematics. *London Review of Education*, 16(3), 384–397. <https://doi.org/10.18546/LRE.16.3.03>
- Kennedy, M. (2016), “How does professional development improve teaching?” *Review of Educational Research*, Vol. 86 No. 4, pp. 945-980.
<https://doi.org/10.3102/0034654315626800>
- Knight, P. T. (2001). Complexity and curriculum: A process approach to curriculum-making. *Teaching in higher education*, 6(3), 369-381.
- Lambert, D., & Morgan, J. (2010). EBOOK: *Teaching Geography 11-18: A Conceptual Approach*. McGraw-Hill Education (UK).
- Lancaster, K., & Rhodes, T. (2022). The thing we call evidence: Toward a situated ontology of evidence in policy. In *Evidence in Action between Science and Society* (pp. 145-164). Routledge. <https://doi.org/10.4324/9781003188612-11>
- Loughran, J. and Menter, I. (2019) The essence of being a teacher educator and why it matters, *Asia-Pacific Journal of Teacher Education*, Online pp. 1-14.
<https://doi.org/10.1080/1359866X.2019.1575946>
- Mannion, J. (2020). Metacognition, self-regulation and self-regulated learning: What's the difference. *Impact*, 8, 66-69.
- Maton, K., & Moore, R. (Eds.). (2009). *Social realism, knowledge and the sociology of education: Coalitions of the mind*. A&C Black
- Martin, A.D. and Kamberelis, G. (2013), “Mapping not tracing: Qualitative educational research with political teeth”, *International Journal of Qualitative Studies in Education*, Vol. 26 No. 6, pp. 668-679.
<https://doi.org/10.1080/09518398.2013.788756>
- McPhail, G. (2021), “The search for deep learning: a curriculum coherence model”, *Journal of Curriculum Studies*, Vol. 53 No. 4, pp. 420-434,
<https://doi.org/10.1080/00220272.2020.1748231>
- McPhail, G., Ormond, B., & Siteine, A. (2023). Knowledge and the New Zealand curriculum “refresh.” *Journal of Curriculum Studies*, 55(5), 509–526.
<https://doi.org/10.1080/00220272.2023.2256010>
- Ministry of Education (2022) *Aotearoa New Zealand Histories in the New Zealand Curriculum* <https://www.education.govt.nz/our-work/changes-in-education/aotearoa-new-zealands-histories-and-te-takanga-o-te-wa/>

- Morrow, W. E. (2009). *Bounds of democracy: Epistemological access in higher education*.
- Muller, J. (2022). "The shadows of 'boundary' remain": curriculum coherence and the spectre of practice. *Teaching in Higher Education*, 27(8), 1027–1041. <https://doi.org/10.1080/13562517.2022.2114339>
- Neary, M. (2003) *Curriculum studies in post-compulsory and adult education: A teacher's and student teacher's study guide*, Cheltenham, UK, Nelson Thornes Ltd.
- Oates, T. (2011). Could do better: using international comparisons to refine the National Curriculum in England. *Curriculum Journal (London, England)*, 22(2), 121–150. <https://doi.org/10.1080/09585176.2011.578908>
- OECD. (2019). *Conceptual learning framework: Knowledge for 2030 concept note*. https://www.oecd.org/education/2030-project/teaching-and-learning/learning/knowledge/in_brief_Knowledge.pdf [Google Scholar] https://doi.org/10.1007/978-3-030-26068-2_3
- Office for Standards in Education, Children's Services and Skills [Ofsted]. (2021). *Research review series: geography*. <https://www.gov.uk/government/publications/research-review-series-geography/research-review-series-geography>
- Office for Standards in Education, Children's Services and Skills [Ofsted]. (2023). *Independent review of teachers' professional development in schools: phase 1 findings*. <https://www.gov.uk/government/publications/teachers-professional-development-in-schools-phase-1-findings/independent-review-of-teachers-professional-development-in-schools-phase-1-findings>
- Oliver, B., Ferns, S., Whelan, B., & Lilly, L. (2010). Mapping the curriculum for quality enhancement: Refining a tool and processes for the purpose of curriculum renewal. *Proceedings of AuQF 2010. Quality in Uncertain Times.*, 80-88.
- Orchard, J. and Winch, C. (2015) *What training do teachers need? Why theory is necessary to good teaching*, *Impact No. 22. Philosophical Perspectives on Education Policy*. Wiley.
- Perryman, J. and Calvert, G. (2019), "What motivates people to teach, and why do they leave? Accountability, performativity and teacher retention", *British Journal of Educational Studies*, Vol. 68 No.1, pp. 3-23. <https://doi.org/10.1080/00071005.2019.1589417>
- Posner, G.J. (1995) *Concepts of curriculum and purposes of curriculum study*. In *Analyzing the curriculum* (2nd ed.), New York: McGraw-Hill: pp. 3–33
- Pountney R (2020) *Curriculum makers and thinkers: The case for curriculum studies in teacher education*. BERA British Curriculum Forum online event. Available at: www.bera.ac.uk/media/curriculum-makers-and-thinkers-the-case-for-curriculum-studies-in-teacher-education
- Pountney, R., & McPhail, G. (2019). Crossing boundaries: Exploring the theory, practice and possibility of a 'Future 3' curriculum. *British Educational Research Journal*, 45(3), 483–501. <https://doi.org/10.1002/berj.3508>
- Pountney, R., & Swift, D. (2022). Teachers' use of the curriculum design coherence model in the primary school. *Impact: Journal of the Chartered College of Teaching*, 1(14), 50–52.
- Priestley, M., Alvunger, D., Philippou, S., & Soini, T. (Eds.). (2021). *Curriculum making in Europe: Policy and practice within and across diverse contexts*. Emerald Publishing Limited.

- Rata, E. (2019), "Knowledge-rich teaching: A model of curriculum design coherence, *British Educational Research Journal*", Vol. 45 No. 4, pp. 681-697.
<https://doi.org/10.1002/berj.3520>
- Rata, E. (2020). The CURRICULUM DESIGN COHERENCE MODEL, New Zealand Association for Research in Education (NZARE), 26: 29-35
<https://doi.org/10.26686/nzaroe.v26.6855>
- Rata, E. (2021), "The Curriculum Design Coherence Model in the Knowledge-Rich School Project", *Review of Education*, Vol. 9 No. 2, pp. 448-495.
<https://doi.org/10.1002/rev3.3254>
- Rata, E. and McPhail, G. (2020), *Teacher professional development, the knowledge-rich school Teacher education in globalised times*. Springer, Singapore.
https://doi.org/10.1007/978-981-15-4124-7_17
- Rata, E., McPhail, G. and Barrett, B. (2018). An engaging pedagogy for an academic curriculum. *The Curriculum Journal*, pp.162-180.
<https://doi.org/10.1080/09585176.2018.1557535>
- Sahlberg, P. (2011). The fourth way of Finland. *Journal of Educational Change*, 12(2), 173-185. doi:10.1007/s10833-011-9157-y.
- Schmidt, W., Houang, R., & Cogan, L. (2002). A coherent curriculum: the Case of Mathematics. *American Education*, 26(10), 1-18.
- Schmidt, W. H., and Prawat, R. S. (2006) Curriculum coherence and national control of education: issue or non-issue? *Journal of Curriculum Studies*, 38(6): 641–658
- Sinnema, C., Nieveen, N., & Priestley, M. (2020). Successful futures, successful curriculum: What can Wales learn from international curriculum reforms? *Curriculum Journal (London, England)*, 31(2), 181–201. <https://doi.org/10.1002/curj.17>
- Spielman, A. (2018). HMCi commentary: curriculum and the new education inspection framework. <https://www.gov.uk/government/speeches/hmci-commentary-curriculum-and-the-new-education-inspection-framework>
- Squires, D. A. (2009) *Curriculum Alignment: Research-based strategies for increasing student achievement* Thousand Oaks, CA: Corwin Press
- Stark, J.S., Lowther, M.A., Sharp, S. and Arnold, G.L. (1997) Program-level curriculum planning: An exploration of faculty perspectives on two different campuses. *Research in Higher Education* 38(1): 99–130
- Stenhouse, L. (1975), *An introduction to curriculum research and development*. Heinemann, Oxford.
- Stenhouse, L. (1981), "What counts as research? *British Journal of Educational Studies*", Vol. 29 No. 2, pp.103-114. <https://doi.org/10.1080/00071005.1981.9973589>
- Sundberg, D. (2022). 6 Curriculum Coherence. Explaining the Intended and Enacted Curriculum in Different Schools. In *Equity, Teaching Practice and the Curriculum. Explaining Differences in Access to Knowledge*, edited by N. Wahlstrom, 76-89, Routledge. London.
- Swift, D. (2023). *Towards curriculum design coherence in primary geography education for sustainability*. <https://www.bera.ac.uk/publication/towards-curriculum-design-coherence-in-primary-geography-education-for-sustainability> BERA, London.

- Tatto , M. T. (2021), “Developing teachers’ research capacity: the essential role of teacher education”, *Teaching Education*, Vol. 32 No. 1, pp. 27-46, <https://doi.org/10.1080/10476210.2020.1860000>
- Tyler, R. W. (1949) *Basic principles of curriculum and instruction*. Chicago, University of Chicago Press
- Wheelahan, L. (2007, June). Beyond the Contextual: The importance of theoretical knowledge in vocational qualifications and the implications for work. In *4th International Conference, Centre for Research in Lifelong Learning, 'The Times they are a-changin—researching transitions in lifelong learning'*<http://hdl.handle.net/10072/18718>.
- Wheelahan, L. (2023). Realism and theorizing curriculum—the role of knowledge. In: Tierney, R.J., Rizvi, F., Erkican, K. (Eds.), *International Encyclopedia of Education*, vol. 7. Elsevier, pp. 85–95. <https://dx.doi.org/10.1016/B978-0-12-818630-5.03012-8>.
- Wilson, M., & Bertenthal, M. (2005). Systems for state science assessment. Board on Testing and Assessment. *Center for Education, National Research Council of the National Academies*. Washington, DC: National Academies Press.
- Wilson, M., & Draney, K. (2009, August). On coherence and core ideas. In *Paper commissioned for the NRC Board of Education meeting*.
- Winch, C. (2013). Curriculum design and epistemic ascent. *Journal of Philosophy of Education*, 47(1), 128–146. <https://doi.org/10.1111/1467-9752.12006>
- Young, M. (2009) What are schools for? In H. Daniels, H. Lauder & J. Porter (Eds) *Knowledge, values and educational policy*. Routledge, London.
- Young, M. (2008), *Bringing knowledge back in: From social constructivist to social realism in the sociology of education*. Routledge, London.