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Curricula at the boundaries

Suellen Shay[1]

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Abstract The growing demands on higher education have placed an unprecedented external pull on universities. Bernstein (Pedagogy, symbolic control and idenity: theory, research, critique, Rowman & Littlefield Publishers Inc., Lanham, 2000) refers to this "outward" pull of the late twentieth century as the "regionalization of knowledge". One of the consequences of this "facing outward" is contestation over curriculum and what should be privileged. Should it privilege knowing, doing or being? Should it foreground formative training in the basic sciences or applied problem-solving? Is its priority educating the mind or preparing for a vocation? These questions can set up a series of "false choices" about the purpose of higher education, what it means to be educated and what our priorities should be in curriculum reform. The aim of this paper is to move the discourse beyond these polarities by making visible the "stakes" in the curriculum reform debate illustrated in the Muller thinkpiece (High Educ 70(3):409–416, 2015). The paper offers a conceptual framework for understanding current curriculum contestation and applies the framework in an illustrative manner to a particular higher education curriculum reform initiative in South Africa. The framework shows how "what does it mean to be educated?" will vary depending on the different types and hence purposes of curriculum.

Keywords Curriculum · Higher education · Professional curriculum · LCT · Knowledge · Regionalization

Introduction

Clark (1998) in his seminal work on transforming higher education writes of the disjuncture between the demands on universities and their capacity to respond, what van Vught (2013) refers to as "mission overload" (p. 25). This includes the demands from a

✉ Suellen Shay
suellen.shay@uct.ac.za

[1] Centre for Higher Education Development (CHED), University of Cape Town, 310 Hoerikwaggo Building, Rondebosch 7701, South Africa

greater number and diversity of students, a labour force calling for more highly specialized graduates, government requiring "more with less". Most importantly, Clark argues, are the demands for the expansion, specialization and reconfiguration of knowledge in order to solve complex contemporary problems. This echoes Muller (2015) who notes that the increasing specialization of knowledge is the defining condition for educators, especially in the Science, Technology, Engineering and Mathematics (STEM) areas.

This "cross-fire of expectations" (Clark 1998, p. 6) has placed an unprecedented pull on universities from external constituencies with the effect of weakening the boundaries that historically demarcate university autonomy. Bernstein (2000) refers to this increasing "outward" pull of the late twentieth century as the "regionalization of knowledge" (p. 9). Regionalization refers to the process whereby "singulars" (the disciplines) are put to work, so to speak; they are deployed for the purposes of some external problem. "Regions" emerge at the interface between intellectual disciplines and external practices, for example the rise of many of the STEM areas such as engineering and medicine, and more recently fields such as information and computer sciences. Thus, many STEM fields have inherited the tensions of multiple accountabilities: on the one hand, to disciplines and inter-disciplinary fields of scholarship, and on the other hand, to industry, professions and wider society (Winberg et al. 2013).

One of the consequences of this multiplicity of accountabilities is more pressure on the educational mission of universities, in particular the curriculum. This enlarged mission has been characterized in a number of ways. The Kings-Warwick Project (2010) surveying curriculum reform initiatives around the globe notes, "it is not simply that the educational triangle has widened or stretched, it has simply become a larger pyramid" (p. 25). Another concept that appears in curriculum reform discourse is that of the T-shaped student (SUES 2012) or the T-shaped curriculum, a reference to the growing demand on curricula to both broaden and deepen the knowledge and skill base of the graduate of the twenty-first century. Underlying these analogies, however, are heated contestations about curriculum and what should be privileged. Which is more important—depth or breadth? Should curricula privilege knowing, doing or being? (Barnett and Coate 2005). Should it foreground Mode 1 or Mode 2 (Gibbons 2000), in other words, formative training in the basic sciences or application through problem-solving? Is it about educating the mind or preparation for a vocation? (Nussbaum 2010). Is it, as Walker (2015) argues, about developing "human capabilities" or as Muller (2015) argues, about knowledgeable practice?

In this paper, I argue that how we answer these questions will depend on what we understand the broad purposes of the curriculum. Underlying these discourses of polarity is contestation about these purposes (Shay 2014). In order to engage sensibly in the debate about "what it means to be educated?" we need to understand this contestation. In the language of Legitimation Code Theory (LCT) we need to understand the basis of legitimation. While there is contestation in all curricula, the focus here is on what I refer to as "curricula at the boundaries", that is the curricula of regions that straddle the demands of the academy and the profession or workplace. The focus is on the curriculum reform tensions for professional and vocational curricula.

The paper seeks to address the following questions: how might we better understand the competing demands on these curricula, with a particular focus on STEM curricula? Secondly, what are the implications of these understandings for curriculum reform, what gets privileged and why? I begin by describing a particular case of a university of technology in South Africa grappling with "competing demands". I then move to offer a set of theoretical and analytical tools for exploring this contestation, an emerging framework for

curriculum inquiry. Finally, in the concluding comments, I return to engage further with Muller's (2015) key arguments in his thinkpiece for this issue in terms of the priorities for curriculum reform in higher education.

Rationale for curriculum inquiry

These multiple accountabilities set up particular challenges for universities in the developing world—and the specific context for this paper is South Africa. Like all universities, those in the developing world face the challenge of staying on the cutting edge of knowledge production, producing both knowledge but also the future generation of knowledge producers where the playing field is uneven—both globally and locally. Van Vught (2013) notes that one of the ways in which governments steer higher education systems through these competing demands is through policies that regulate some form of institutional differentiation, for example, through the creation of binary systems. In South Africa, pre-2004, this binary system took the form of traditional universities that focused on general formative and professional education and technikons that focused on vocational- and career-oriented education (Oosthuizen 2014). Post-apartheid South Africa has experienced a series of HE "diversification policies"—a series of arguably contradictory de-differentiation and redifferentiation policies that have shifted the sector from a "binary" system to a more complex arrangement. The new government's priority has been to establish a single nationally co-ordinated system with three different institutional types—traditional universities, universities of technology (the ex-technikons) and comprehensive universities that are a result of the merger of traditional universities and technikons.

Alongside this institutional restructuring in 2007, a Higher Education Qualifications Framework (HEQF) was promulgated which reaffirmed a unified higher education system but stressed differentiation in terms of different qualification pathways: general formative, professional and vocational. At the same, there has been a de-coupling of institutional type and qualification pathway. Historically, the old technikons could only offer the 3-year vocationally oriented diploma as their primary undergraduate offering. The 3-year formative degree was the preserve of the traditional universities. The new HEQF has now made it possible for universities of technology to offer degrees. For universities of technology, compliance with the new framework has amounted to massive curriculum reform raising all kinds of questions about institutional identity and mission, curriculum orientation and graduate identities. Indeed, at the heart of the debate is the question, what does it mean to be educated? In STEM curricula? In South Africa? In a nationally and globally competitive landscape? In responding to this reform opportunity, the universities of technology are likely to feel the competing pulls more acutely than their traditional university counterparts; they are likely to be more vulnerable to curriculum reform discourses of polarity.

The debate around these difficult curriculum choices is the subject of a recent local publication (Rip and Garraway 2013) of the Cape Peninsula University of Technology (CPUT) where the interface between university, curriculum and society is explored through curriculum case studies. The pressing question running through the edition is whether the university should be offering a diploma and/or a degree as their primary undergraduate qualification. The difference between these is typically characterized as the degree is theoretical and the diploma is practical: "While having some theoretical knowledge, (diplomas) are primarily vocationally focused towards industrial applications",

whereas the degree has "a stronger theoretical base which can be applied to a variety of contexts" (Garraway 2013, p. 3). "Diplomas prepare graduates with field specific skills and knowledge… degrees prepare student for a broader field of practice" (Maqutu and Kleyn-Magolie 2013, p. 21). While this nomenclature and indeed the relevance of the question may be particular to South Africa, there are echoes of these concerns in the global curriculum debates noted above. What does it mean to be educated in the context of a knowledge society? Should higher education privilege formative theoretical foundations? Or should higher education privilege applied theory, problem-solving for innovation? These are some of the questions underlying the degree versus diploma debate.

To illustrate the kinds of tensions experienced by these curricula at the boundaries, two cases from the paradigms edition are offered: programmes in Environmental Management and Apparel and Textile. According to Maqutu and Kleyn-Magolie (2013), the Environmental Management programme at CPUT is experiencing pressure to convert their current diploma offering to a degree. There is pressure from its home faculty, the faculty of Applied Science, to strengthen the theoretical scientific foundations. Surveys of various stakeholders—students, alumni, industry, academics and environmental organizations—indicate preference for a degree. The perceptions of the stakeholders are that a degree has more status and that degree graduates are better prepared. However, this push towards a degree raises a number of critical issues for the conveners. Environmental Management is a multi-disciplinary field of study that draws on both sciences and the social sciences. Its orientation is towards a field of practice; it is organized around projects that relate directly to the workplace. Choices have to be made about what is better: graduates who are generalists or specialists. There is also a differentiated job market requiring graduates skilled at different levels. Finally, given that the admission requirements for diplomas is lower than those for degrees, to not offer a diploma may deny access to a whole sector of young people who have very few alternatives. This would appear to run contrary to the mission of universities of technology to cater for work-related learning at a range of entry levels.

The Apparel and Textile curriculum is a case of a curriculum caught between global shifts in modes of production. The story begins in China. Millar and Hovgaard (2013) describe the crisis of the South African clothing and textile industry as a result of cheaper, legal and illegal, imports from the East, and the consequential loss of approximately 100,000 jobs in the past 10 years as factories have had to close their doors. This industry is one of the backbones of the South African economy. Not only is this a problem to the economy, but it raises serious challenges for higher education institutions that have produced graduates for this industry. The result is unemployed graduates of the old paradigm and a serious skills shortage for the needs of the new paradigm. This raises all kinds of questions about what kinds of curriculum and what kind of graduate. The authors point to the necessity to prepare students for "an uncertain, fluid workplace of the twenty-first century. Are we preparing students for a neoliberal world, or is there a possible alternative scenario where we could prepare students to operate in a new workplace that functions as 'worker ecosystem'?" (Millar and Hovgaard 2013, p. 15).

These two cases illustrate the conundrum that curriculum on the boundaries found themselves in. However, the diploma versus degree debate masks deeper issues about what is special about the knowledge base of "outward-facing" curricula. In order to explore these issues, I offer a set of theoretical and analytical tools—a framework for curriculum inquiry.

A theoretical framework for curriculum inquiry

Bernstein (1975) states simply "curriculum defines what counts as valid knowledge" (p. 85). In this framework, curriculum is conceptualized as a *knowledge* practice. According to Bernstein, it is *recontextualized* knowledge. Bernstein's (2000) pedagogic device models the way in which knowledge moves across different fields—between the field of production (where knowledge is produced), the field of recontextualization (where knowledge is translated into curriculum) and the field of reproduction (where knowledge is transmitted through pedagogy). Thus, knowledge is de-contextualized from its site of production—whether this is a research publication, scientific laboratory, a newsroom, a design studio or a factory floor—and recontextualized into a curriculum. This relocation requires choices about selection, sequence, pacing and evaluation. Selection choices include, for example, which disciplines are most important in an Environmental Management programme. Sequence choices include, for example, whether the theory precedes the practice or vice versa. Pacing choices include, for example, how much time and credit should be allocated to each. Evaluation raises questions about what ultimately counts for successful performance. These choices can generate contestation as differences emerge between, for example, what academics, university leadership, students, professional bodies, and employers may value. There is a struggle over the legitimacy of different types of knowledge practices and what purposes and interests these curricula need to serve. For example, in the move from an Environmental Management diploma to a degree, whose interests will be served? Students? Staff? Industry? Wider society?

The relationship between the field of knowledge production and the field of knowledge recontextualization is particularly important in trying to understand curricula at the boundaries. According to Bernstein (2000) "as the discourse moves from its original site to its new positioning… a transformation takes place…" (p. 32). Barnett (2006) argues that for vocational curricula, there are two distinct recontextualization processes—there is the recontextualization of the disciplines into academic subjects and a further recontextualization for vocational purpose. The challenges of the later process should not be underestimated. Quoting Layton (1993), Barnett writes "The 'problems' which people construct from their experiences do not map neatly on to existing scientific disciplines and pedagogical organizations of knowledge. What is needed for solving a technological problem may have to be drawn from diverse areas of academic science at different levels of abstraction and then synthesized into an effective instrumentality for the basic task in hand" (Layton 1993 in Barnett 2006, p. 147). Barnett argues that the complexity of this double recontextualization process involves a series of translations of knowledge from one field into educational knowledge of another field—this translation involves choices and inevitably contestation around choices.

In LCT, this contestation is conceptualized as a set of underlying principles that make visible what counts in the field. The curriculum inquiry framework presented in this article draws on three sets of principles from LCT: autonomy, semantics and specialization (Maton 2014a, b). Autonomy exposes broader institutional discourses of history, mission, niche, alliances, in order to understand who is in control of the curriculum and according to what or whose principles curriculum choices are made. This is similar to Bernstein's (2000) notion of "regulative discourse" or the rules of social order. Semantics inquires about the actual curriculum logic, what gives the curriculum meaning or coherence. Specialization inquires about the ideal knower in this curriculum, what knowledge, skills and values do we aspire for the graduate. In each case, the underlying principles translate

into a set of codes that enable the identification of strong*er* and weak*er* manifestations of the principle of interest. This offers a powerful set of analytical tools for mapping curriculum as a knowledge practice at three different levels of inquiry: macro, meso and micro. In previous work (Shay 2013), semantic codes are used to differentiate four curriculum modalities: practical, vocational/professional, theoretical and generic. Analysis of curriculum at this meso-level using Semantics is being tested and refined through empirical work on vocational curricula (Shay and Steyn 2015; Halliday 2015; Pinto, in progress). The limitation of this level of analysis is that it does not expose the regulative discourses that constitute these curriculum modalities, that is the macro-level. Nor does it say anything about the micro-level of the ideal knower. The emerging framework puts forward a multi-level framework of inquiry that addresses these gaps. In this paper, I only focus on the autonomy and semantic codes. Starting with the semantic codes, the analysis asks the question, what is the curriculum logic or what makes it special? I then turn to the autonomy codes which ask, who is in control and according to whose principles?

Conceptualizing curriculum logic

This level of the framework focuses on the curriculum logic. The inquiry focuses on: What is the broad purpose of the curriculum? What gives it coherence? What makes it special? Where is its strength? This last question is a particular vantage point of LCT that argues that there is always a "hierarchy", that is a recontextualizing principle, the question is simply where does it lie (Maton 2014a, b). This is an important advance as it enables descriptions of knowledge and curriculum in terms of what they are rather than what they are not. It enables a language of description that moves away from deficit characterizations of knowledge practices.

Muller (2009) offers a helpful starting point for characterizing different curriculum logics. He distinguishes between conceptual coherence and contextual coherence. In the former, the logic of the curriculum is that of the discipline. The conceptual building blocks of the discipline form the "spine" of the curriculum. In contrast, for curricula with contextual coherence Muller notes, "what matters is coherence to context, where external requirements and constituencies legitimately take a greater interest in curricular focus, content and adequacy" (p. 216). The logic is the professional or occupational requirements. On this continuum from contextual to conceptual coherence, Muller maps broad qualification routes with occupations, such as travel agents and hospitality workers, on the contextual end of the continuum, and professions, such as engineers and lawyers, on the conceptual end. Given their different logics, these curricula will draw on different knowledge bases from "largely practical knowledge" in the particular occupations pathway to "largely theoretical knowledge" in the academic pathways with various possible combinations in between. He acknowledges that the biggest challenge is precisely for those curricula in-between—curriculum at the boundaries—that face both inwards to disciplines and outwards to the field of practice. This is a helpful starting point for conceptualizing different curriculum logics. Clearly what it means to be educated will vary across this continuum.

Muller (2009) notes that this is not a "simple continuum" and indeed further empirical work revealed that a more sophisticated description of differentiation is required to account for the presence of the "conceptual" in contextual coherent curricula (Shay et al. 2011). In further refinement, Muller's one-dimensional contextual and conceptual coherence

continuum is expanded to a two-dimensional plane. Curricula are thus not *either* conceptually coherent *or* contextually coherent, but they can be both or neither. The "contextual coherence" dimension is reconceptualized as semantic gravity (SG) defined as "the degree to which meaning relates to its context" (Maton 2014a, b, p. 110). When semantic gravity is stronger (SG+) "meaning is more closely related to its social or symbolic context of acquisition or use; when it is weaker (SG−, meaning is less dependent on its context" (Maton 2014a, b, p. 110). The conceptual coherence dimension is reconceptualized as semantic density defined as "the degree of condensation of meaning within sociocultural practices (symbols, terms, concepts, phrases, expressions, gestures, clothing, etc.)" (Maton 2014a, b, 129). When semantic density is strong (SD+), more meaning is condensed within symbols; when the semantic density (SD−) is weaker, less meaning is condensed.

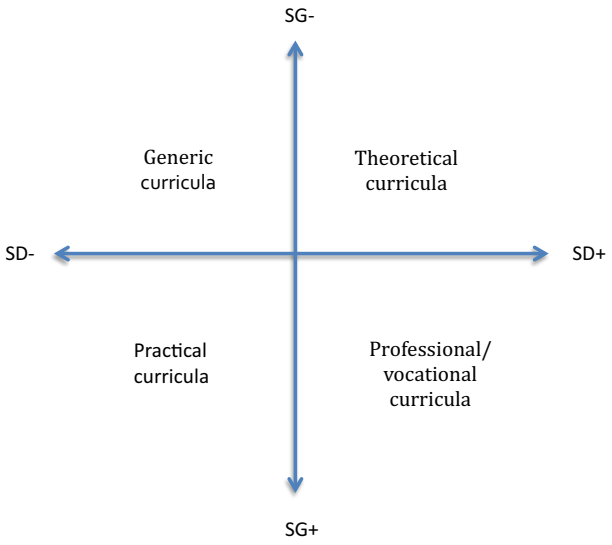
Thus, for the purposes of conceptualizing curriculum logic, semantic gravity enables a more precise description of "context" in this case the relations between the curriculum and the context of practice. Stronger semantic gravity (SG+) refers to meanings (e.g. curriculum aims, learning outcomes, content) that are more situated in, dependent upon and ordered by the world of practice or the workplace. At the other end of the continuum, weaker semantic gravity (SG−) refers to meanings that are more situated in, dependent upon, and ordered by a system of ideas, theory, discipline or multi-disciplinary fields. They are distant from the context of application.

Semantic density enables a more precise description of the conceptual dimension of curricula. Stronger semantic density (SD+) can be enacted to describe concepts that are strongly integrated into increasing levels of generality. Weaker semantic density (SD−) describes here concepts that are loosely integrated, more segmented. The condensation of meaning takes different forms depending on the kind of knowledge. For example, in a sports fitness diploma, semantic density is strengthened in the progression from single concept-based meanings (e.g. structures of bones and muscles) to the integration of these meanings through multi-disciplinary principles (e.g. biomechanical principles) (Halliday 2015).

These two axes—semantic gravity and semantic density—set up a semantic plane with four curriculum modalities defined by different strengths and weaknesses of the organizing principles (Fig. 1). The SG+, SD− and SG−, SD+ quadrants profile the curriculum modalities of "practical" and "theoretical". These are the "types" that are typically foregrounded in discourses of differentiation. However, what the semantic plane reveals are two other possible modalities: curricula where both semantic density and semantic gravity are strong (SG+, SD+) as evidenced in professional and occupational modalities and curriculum where both are weak (SG−, SD−) in what I refer to as "generic". This modality is context independent, and its concepts are relatively weak. This describes the curricula of the generic transferable skills discourse. Each of these modalities implies different notions of what it means to be educated.

The framework exposes different possible modalities for curricula on the boundaries. It is possible to have contextually coherent curricula (SG+) with weaker or stronger semantic density. Those on the weaker end (SD−) are curricula where the practical or procedural knowledge is dominant—practices from the field of knowledge production have been recontextualized and codified into a series of simple procedures or steps. On the stronger end (SD+) are curricula where the conceptual base is more pronounced where the procedures are more densely layered in meaning. Most curricula will have instances of several modalities. For example, professional curricula such as engineering and medicine start in the theoretical quadrant and move to the vocational/professional quadrant as the context of

Fig. 1 Curriculum modalities



application strengthens in the practical/clinical years. They, however, also include curricula from the practical modality as well as the generic. The latter is evident in the growing emphasis on cross-cutting, transferable attributes such as professionalism, ethical behaviour and citizenship. Thus, it would be possible to conceptualize a diploma in Environmental Management which has relatively strong conceptual foundations in the range of necessary disciplines (relatively strong SD+) but where the contextual dependency is strong (SG+) and increasingly strengthens across the 3 years. Its theoretical foundations need not be sacrificed for its outward-facing problem-oriented logic.

Further empirical work in this vocational/professional curriculum modality (SG+, SD+) provides insight into the complex relationship between theory and practice in vocational and professional curricula. For example, the analysis of a vocational design foundation course reveals how the curriculum progresses from context-reduced problems (SG−) to increasingly authentic, complex and occupationally specific problems (SG+) (Shay and Steyn 2015). This progressive strengthening of semantic gravity requires the integration of increasingly complex design concepts: that is concepts with more densely compounded meaning and descriptive power. The argument is that the increasing specificity and complexity of the context *advances* the conceptual complexity. What we see in these curricula is the way in which the nature and complexity of the problem drives up the conceptual complexity. Bailey-McEwan (2009) in his study of engineering curriculum notes that, "…where theoretically informed practice is the goal, what is required are 'integrative links' and 'relations of generality' across the disciplines" (p. 49).

Another metaphorical way of capturing this is the notion of the "semantic wave" defined by Maton (2014a) as "recurrent shifts in context dependence and condensation of meaning that weave together different forms of knowledge" (p. 181). There are echoes of this "weaving and waving" in Hordern's description (2014) of the capacity of vocational knowledge to "oscillate along a spectrum of generality as it engages with the demands of practice, and develops and validates new working concepts" (p. 28).

One of the questions that universities of technology are grappling with, as noted above, is whether to offer diplomas or degrees. The empirical analysis conducted for the purposes of the SANTED project (Shay et al. 2011) revealed a number of challenges for universities of technology and comprehensive universities grappling with these choices. The analysis revealed diplomas and degrees that were indistinguishable in terms of curriculum content. There were diplomas where the dominant curriculum modality is practical, and the question arises whether such a qualification belongs in higher education. There were diplomas and degrees that have experienced "drift": "academic drift" in the case of diplomas and "vocational drift" in the case of degrees. If the mission of universities of technology is to "drive technology relevant for national reconstruction and development", and if the university of technology's strengths lie in "its expertise and linkages with the outside world" (Winberg et al. 2013, p. 8), then their curricula should be aligned with this mission. The framework shows how it is possible to have diplomas and degrees that are contextually coherent, but will vary in terms of their conceptual loading. For curricula at the boundaries, the question is not practice versus theory, but rather, what is the relationship between the two, is the theory driving the practice or is the practice driving the theory.

Conceptualizing curriculum autonomy

The semantic codes provide insight into some of the organizing principles that constitute the coherence or logic of the curriculum. As argued above, the inquiry needs to also expose the institutional regulative discourses that constitute or influence this logic. In order to conceptualize this, I draw on LCT's autonomy codes. As with the semantic codes, the dimension of autonomy centres on two different underlying principles: positional autonomy (PA) and relational autonomy (RA), and these can be stronger (+) or weaker (−). Positional autonomy answers the question, who is in control? Maton (2005) defines PA as "the nature of relations between specific positions in the social dimension of a context or field and positions in other contexts" (p. 697). Simply put, it is the relations between different contexts or social fields. Pertinent to this discussion is the relation between the university field and other fields such as industry, the state or the market. Essentially, it asks the question, who is running higher education? If it is run by insiders, that is by academics, then PA is stronger (PA+). If it is run by outsiders, for example industry, the state, the market, then PA is weaker (PA−). This resonates with Bernstein's concept of classification where PA is the boundaries between or the degree of insulation of a particular field from other fields. In relation to the university, the question is the strength of its insulation from the world outside of the university. The university can be strongly or weakly insulated: strong insulation refers to autonomy or independence, free from interference but could also refer to distant or isolated from the community, or resistant to change. Weak insulation refers to the possibility of flow and exchange, strong synergies with other sectors, but could also mean susceptible to interference, vulnerable to political whims and market upheavals. This is illustrated in the Textile and Apparel case where the programme is highly responsive to the needs of this industry but also susceptible to its volatility. For Bernstein (2000), power lies in the spaces in between; in other words, power is what maintains or weakens the strength of the insulation. Is the power centralized in the university or is it more diffuse, dispersed or shared? For Bernstein, weakening or strengthening of classification is not inherently a good or bad thing. The important question is whose interests are

being served. So PA answers the question of *who* is in control, does the control reside inside or is it outside? These questions are increasingly difficult ones to answer. On the surface it might appear that recent policy discussed above has strengthened the university of technology's PA through, for example, the reclassification of technikons into universities of technology though this would need to be verified empirically. The picture is more complex than it appears, and to explore this complexity, we need another dimension of autonomy.

The second concept is RA which Maton (2005) defines as "relations between the principles of relation (or ways of working, practices, aims, measures of achievement, etc.) within a context or field and those emanating from other contexts" (p. 697). Relational autonomy asks, where do the principles which define the "ways of working" come from: are the principles from the inside (academe) or from outside (industry, state, market)? If the principles come from the inside, then RA is stronger (RA+). If the principles come from the outside, then RA is weaker (RA−). Maton illustrates this second dimension of autonomy by drawing on higher education policy in the UK where the academic community is in control (PA+), but increasingly the principles being drawn on are from other fields (RA−). This Maton (2005) argues creates an emerging disjuncture in higher education.

If we apply these concepts to curriculum, we can ask, who is in the control of the curriculum and according to whose principles is it being designed and implemented? In other words, who are the recontextualizing agents? Where do the recontextualizing principles come from? As with the semantic codes these two concepts are conceptualized as a plane with axes of varying strengths and thus provide four sets of codes or autonomy modalities (Fig. 2).

We can now apply these analytical tools for understanding different kinds of curricula. As noted above, Bernstein distinguishes between singulars and regions. Curricula constituted of singulars or a collection of singulars would be an example of the PA+, RA+ modality; the control is in academic hands, and the principles informing selection, sequence, pacing, evaluation are derived from "inside", from the discipline itself. Curricula of the regions in contrast may have a strong PA+ but weaker RA− as the principles

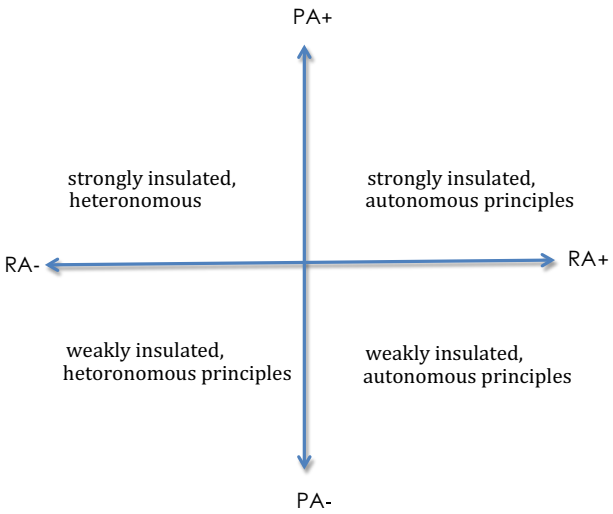


Fig. 2 Modalities of autonomy (Maton 2005, figure 1)

may be more of less influenced by the "outside". An example could be the reform of a medical curriculum where the drivers for reform are the profession (e.g. the South African health professional body calling for more doctors who are generalist rather than specialists), but the recontextualizing agents are the academics (PA+). Most vocational/professional curricula by definition have a weaker RA. In both cases—the Environmental Management and the Textile and Apparel programmes—the recontextualizing principles from outside academe powerfully shape curriculum choices. The challenge for these programmes is to maintain a relatively strong PA, in order to ensure that the academics maintain some control in the way the principles are applied.

The autonomy plane gives insight into the contestation underlying the university of technology debate about whether to offer diplomas or degrees. On one hand, it could be argued that the policies of the mid-2000 were an attempt to strengthen the PA of the university of technology sector: the reclassification of technikons as universities, the deregulation of their qualifications, the option to offer degrees. On the other hand, the effect on RA is less clear. In the shift from diplomas to degrees, a question that needs to be asked is, whose principles are informing the selection, sequence, pacing and evaluation of these new curricula? The Environmental Management case reveals an anxiety on the part of the recontextualizing agents about the price of strengthening autonomy. Rip and Garraway (2013) note that universities of technology have historically had a strategic advantage because of their close relationship with industry and professional communities; in other words, their strength is in their weaker RA. Do the universities of technology "distance" themselves from their historical alliances? Do they want to emulate the insulation of the traditional universities? The strengthening of autonomy could come at a cost to the mission of universities of technology primed as they are to be key drivers of innovation in a developing economy.

The third micro-level of inquiry is not elaborated on in this paper but uses the specialization codes to analyse what kind of knower. Who is the ideal knower or graduate who emerges from this curriculum? Is the knower specialized by what and how they know (a knowledge code), by who they are (a knower code), by both (an elite code) or by neither (a relativist code)? This issue of the ideal knower features strongly in both of the cases. The curriculum designers for the Textile and Apparel programme curriculum argue that different imagined workplace futures—whether neoliberal or worker ecosystem—will equip students differently, both in terms of what they need to know and who they need to be (Millar and Hovgaard 2013). In the Environmental Management programme, the choice is between graduates who are generalists able to work across a wide range of problems, or specialists who have a depth of knowledge in specific disciplines. We can hear strong echoes of this contestation in the employability discourse that increasingly privileges a knower code—with the emphasis on attributes and "ways of being".

Concluding comments

This paper set out to address two questions: how might we better understand the competing demands on curriculum, with a particular focus on curricula at the boundaries? And then secondly, what are the implications of these understandings for curriculum reform, what gets privileged and why?

The paper began by arguing that unprecedented demands on higher education have put significant pressure on curricula to reform. This is in part a result of an overall weakening

of RA, in other words, the recontextualizing principles coming from outside academe. These principles or drivers for reform are varied. For example, in South Africa, the major current drivers are political and economic as evidenced in the recent proposed policy for a flexible degree (CHE 2013). Other drivers come from the state for accountability and greater efficiency as witnessed in decades of various quality assurance iterations. Another driver is the market as leading universities embark on significant curriculum reform to distinguish themselves and their graduates from competitors. Most curriculum reform initiatives are driven by a combination of these factors.

Muller (2015) puts forward two "points of departure" in thinking about curricula of the future. The first is the "ineluctability of the increasing *specialisation* of knowledge in the STEM domain, driven equally by new knowledge production, new technological challenges, and new elaborations in the division of labour" (p. 410). The second is the *differentiation* of knowledge. He argues "different knowledges (disciplines and their curricular carriers) have different epistemic and social properties" (p. 410). The theoretical framework for curriculum inquiry presented in this paper affirms these points of departure. These points need to be underscored in a context where much of the current curriculum reform discourse, using Muller's (2015, p. 412) phrase, runs the risk of "pull(ing) a veil over the knowledge base". Implied in Muller's argument (2015) is a critique of curriculum reform that privileges knowers and knowing over knowledge.

Beyond these points of departure, the case study analysis offers additional insight into some of the competing demands for curricula at the boundaries and thus the complexities of reform. The framework of inquiry enables an understanding of the structural regulative discourses alongside the meso-level of curriculum logic. The key point is that curricula are specialized in different ways; in other words, their strengths (or dominant principles) lie in different places, and thus, the possibilities and constraints for reform will vary. Even across the STEM areas, there will be wide variation. These variations are subject to empirical investigation, but one could speculate that a Mathematics curriculum for Mathematics majors is likely to be context independent with a complex conceptual base (SG−, SD+) and its autonomy characterized as strongly controlled by academics with principles of curriculum logic firmly held by the academic community (PA+, RA+). In contrast to Engineering which is more context dependent, though also possessing a complex conceptual base (SG+, SD+) and its autonomy characterized as "weaker", in other words, controlled by academics but also influenced by principles from the outside, for example, the demands of professions and employers (PA+, RA−), these curriculum conditions in turn will specialize graduates in different ways. Curriculum reform which neglects these macro- and meso-conditions may find itself frustrated and ultimately ineffectual. What makes higher education "higher" is its specialized knowledge. At the very least, curriculum reform must involve a continual interrogation of these specialized disciplinary knowledges and their capacity to *enable* powerful ways of "being" and "acting" in the world.

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