Promoting epistemic and learning-context access in a science foundation course: Supporting student learning.

Key words
Student access, science curricula, transformative pedagogies, Legitimation Code Theory

Abstract
Provision of specially designed foundation courses are a recent government-funded initiative aimed at supporting student learning to enable access and success in the higher education context in South Africa. This paper examines the efficacy of the Introduction to Science Concepts and Methods (ISCM) foundation course at Rhodes University in promoting such access. It draws on Legitimation Code Theory to characterise ISCM curriculum and pedagogic practices. The findings indicate that two forms of access are legitimated: epistemic access which represents access to the theoretical or 'powerful' knowledge of specialised discourses, and learning-context access which is about becoming a particular kind of learner in an academic context. It is argued that since these forms of access are mutually dependent, transformative pedagogies that better develop learning-context knowers whilst still focussing on epistemic science knowledge are needed in most higher education science curricula today which are serving students from diverse social and educational backgrounds.

Theoretical framework
Legitimation Code Theory (LCT) is an explanatory framework that 'enables knowledge practices to be seen, their organising principles to be conceptualised and their effects to be explained' (Maton 2014, p3). This layered approach to analysis indicates that a critical realist depth ontology serves as an underlabourer to LCT. In a project spanning more than a decade, Maton has, with others, developed theory around knowledge, practices, and actor's dispositions. Central to his work, is the concept of legitimation. In this regard, when an actor engages in a practice they are, either explicitly (through actively advocating a position) or tacitly (through routinized or institutionalised practices), making a claim for the legitimacy of the practice, and more specifically, for the organising principles that underpin that practice. Practices can thus be understood as *languages of legitimation* and the underpinning principles of the practice are regarded as *legitimation code* (Maton 2014, p24). The legitimation code is thus the currency used or proposed by actors that define the practice. Maton proposes a number of dimensions of legitimation codes useful for understanding practice and the one used in this paper is that of Specialisation.

Specialisation is based on the premise that any practice is oriented towards *something* and by *someone*, which means they involve relations to *objects* and to *subjects* (Maton 2014, p29). The Specialisation dimension therefore uses two concepts for analysing the organising principles of any practice: epistemic and social relations. Epistemic relations (ER) refer to relations between knowledge claims and the object of study – in other words *what* can legitimately be claimed as knowledge (Maton 2014, p29). Social relations (SR) refer to relations between knowledge claims and the subject (person) – in other words who can legitimately claim to be producing knowledge (Maton 2014, p29). Epistemic and social relations can be strongly or weakly emphasised and when considered together this gives rise to one of four Specialisation codes as represented by the two-dimensional diagram below.

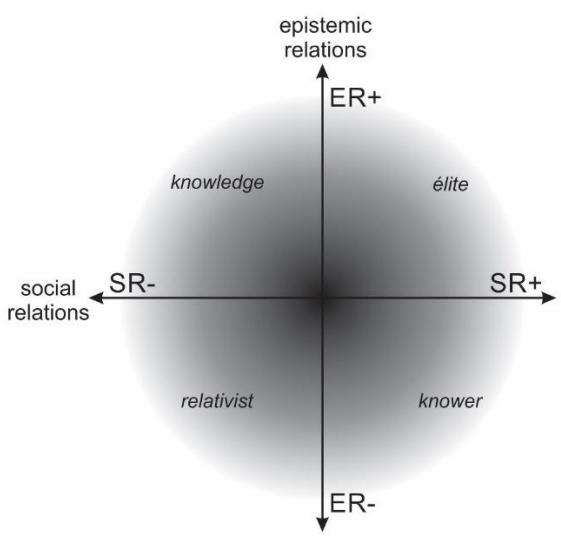

Figure 1: The specialisation plane: Topology of four specialisation codes based on epistemic and social relations (source Maton 2014, p30)

If epistemic relations are strongly emphasised in a practice but social relations are not, the practice has a *knowledge code* which is represented by ER+/SR-. Educational practices of science and science disciplines are considered to have knowledge codes This means that the basis for specialisation and legitimacy in these practices depends on the possession of the right scientific knowledge, practices and procedures rather than depending upon on the disposition or 'gaze' of the knower (Maton 2014, p86). In contrast, if social relations are strongly emphasised in a practice but epistemic relations are not, the practice has a *knower code* which is represented by ER-/SR+. Here the disposition or gaze of the person is more important than the knowledge – which can be common in the humanities and associated disciplines. Practices can also emphasise both epistemic and social relations (ER+/SR+) giving rise to an *elite code*, and when neither are emphasised (ER-/SR-) the practice has a *relativist code.*

Analysing educational practices using the Specialisation dimension allows for identification of underpinning codes. Difficulties experienced by students can suggest code clashes (disparity between the code characterising how one thinks and acts and the code that underpins the basis for success in the current context; Lamont and Maton 2008) or competing code demands.

Methodology

To examine educational practices in the ISCM course in terms of epistemic and social relations, data from curriculum documents (course outlines, resource materials, tutorial worksheets, practical manuals, lecture handouts) as well as interviews (staff and students), observations and critical reflections associated with pedagogic interactions were analysed by developing 'external languages of description' (Bernstein 2000). External languages of description serve to bridge the gap between the abstract, dense code theory (categories of epistemic and social relations), and the detailed, everyday data and in this study they emerged through iterative processes of movement between data and theory.

Typically, empirical studies examining curricula based on epistemic relations use a broad brush knowledge categorisation with theoretical (disciplinary) knowledge having relatively strong epistemic relations (ER+) and everyday or practical knowledge relatively weak epistemic relations (ER-). However, most curricula exhibit more nuanced knowledge differentiation and in this study four main categories of epistemic relations are identified: disciplinary knowledge (ER++; e.g.

understanding chemical equilibrium; learning to do a titration), scientific literacies knowledge (ER+; e.g. understanding the basis for knowledge claims; writing a laboratory report; using a scale bar on a diagram), general academic practices knowledge (ER-; e.g. developing own understanding, consolidating lecture material; independent study), and everyday knowledge (ER--; e.g. drawing on familiar practices in a research project).

Analysis of social relations reveals two main categories of knowers. The first category is based on epistemological concerns in which an epistemic knower (or scientist) is being legitimated, where students are expected to develop practices and knower dispositions based on scientific epistemic values linked to knowledge generation and claim-making, such as being rigorous, curious, reliable, critical, and objective; working accurately and precisely; estimating appropriately; observing carefully; seeking simple solutions; and thinking analytically. The second is based on axiological concerns in which a learning-context knower (or science learner) is being legitimated, where students need to develop practices and learner dispositions that are appropriate for learning in a higher education science context and include dispositions such as being independent, engaged, critical, reflective, confident and responsible for their own learning: in other words becoming and being autonomous science learners. Although social relations were are not visible in the curriculum documentation they are strongly emphasised in pedagogic interactions and therefore received SR+ categorisations.

A semi-quantitative analysis of ISCM practices based on the external languages of description categories allowed for identification of Specialisation codes for ISCM.

Findings and implications

Since ISCM affords equal importance to epistemological and axiological concerns, two codes are identified. Based on *epistemological concerns* of developing students as scientists, ISCM legitimates an epistemic-context *knowledge code*. If students produce the legitimated epistemic-context scientific 'text', they have attained *epistemic access*. Based on *axiological concerns* of the learning context, ISCM also legitimates a learning-context knower code. By producing the legitimate learning-context 'text' of an autonomous, self-regulated science learner, students demonstrate they have attained *learning-context access*. The study shows that both forms of access are key for student success in ISCM (and in mainstream courses), and we argue that, combined, they constitute epistemological access.

The study indicates that when epistemological access is not attained in ISCM it is likely due to both a code clash at the learning-context level (between the school learning practices students bring with them and those required at university) and competing code demands between epistemic-context and learning-context concerns (by students focussing on science knowledge to the exclusion of developing appropriate learning approaches). We argue that immersion, socialisation and apprenticeship are required for students to 'take on' the appropriate epistemic and learning-context social practices. We further argue that this will require far-reaching transformative pedagogies in our current higher education science curricula and should include, amongst other things, a weakening of epistemic relations to create space for a strengthening of learning-context social relations. This is *not* a suggestion to move away from a science knowledge code, which we argue is based on powerful knowledge to which all students must gain access, but instead a shift in emphasis to better support previously educationally disenfranchised students. In light of the recent disruptive and angry student calls for decolonisation of the curriculum, this is an urgent imperative in the South African context, but equally important in higher education in science in general.