Enabling access to scholarly engineering education practices

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Academic Development and its Practitioners

A View from the Inside

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Abbreviations

APQ	Academic planning and Quality Assurance
BLC	Blended learning coordinator
CHE	Council for Higher Education
CHEC	Cape Higher Education Consortium
CLT	Centre for Learning Technologies
CoP	Community of practice
CTL	Centre for Teaching and Learning
DHET	Department of Higher Education and Training
DLTE	Division for Learning and Teaching Enhancement
DRD	Division for Research Development
ECAs	Early Career Academics
FIGs	Focused Interest Groups
FIRLT	Fund for Innovation and Research in Learning and Teaching
FMF	Fees Must Fall
FYA	First-Year Academy
GAs	Graduate Attributes
HE	Higher Education
HEIs	Higher Education Institutions
HELTASA	Higher Education Learning and Teaching Association of Southern Africa
HEQC	Higher Education Quality Committee
HoD	Head of Department
ICT	Information and Communications Technology
LC	Language Centre
LCT	Legitimation Code Theory
NAA	Newly appointed academics
NRF	National Research Foundation
PASS	Professional and Administrative Support Services

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PGDip	Postgraduate Diploma in Higher Education
PL	Professional learning
PREDAC	Professional Educational Development for Academics
REEP	Recommended Engineering Education Practices
SAHEI	South African Higher Education Institution
SAS	Student Academic Support Services
SoEL	Scholarship of Educational Leadership
SOTL	Scholarship of Teaching and Learning
STEM	Science, Technology, Engineering & Mathematics
SU	Stellenbosch University
T&L	Teaching and Learning
UBC	University of British Columbia
UniEd	Division of University Education

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Enabling access to scholarly engineering education practices

Karin Wolff

1 Introduction

The national mandate in South Africa to significantly increase the numbers of students in Higher Education (HE), particularly those in Science, Technology, Engineering and Mathematics (STEM) is driven – partially – by the urgent need to address critical Sustainable Development Goals (NPC, 2011) in our emerging/developing economy. Although there has been significant expansion in the HE system, challenges in retention, attrition and throughput are pervasive, as are employer complaints about practical and professional graduate skills. Against a history of segregation and differential access to equitable forms of education, numerous academic support initiatives have been implemented over the past 30 years, initially focused on enabling 'previously disadvantaged' students to achieve greater success in HE, from academic literacy and study skills support to dedicated funding for Extended Curricula initiatives. More recently, attention has been focused on better equipping academic staff to meet the needs of increasingly massified and diverse classes in the face of 21st century demands. As such, one finds support staff – variously termed academic development practitioners or Teaching and Learning (T&L) advisors – being appointed into dedicated HE institutional units or specific discipline-based faculties and charged with the responsibility of assisting academic staff in their teaching roles (Winberg, et al., 2019).

AD initiatives range from practical classroom tips to increasingly theorised approaches to teaching and learning, under the broad framework of Scholarship of Teaching and Learning (SOTL). The theories, methodologies and discourses associated with SOTL are often regarded as blurry (Boshier, 2009), not located in a particular disciplinary tradition (Miller-Young, 2015), and can alienate STEM academics (Auret & Wolff, 2018). A review of the literature on professional development initiatives for STEM academics reveals that most of these are at best generic workshops intended to be applied across faculties and that few initiatives foreground STEM disciplinary knowledge (Winberg, et al., 2019). One reason for this is the predominance of non-STEM-based academic development practitioners (Henderson, et al., 2011), but perhaps a more relevant factor in STEM academic resistance to generic, Humanities-orientated or SOTL-based teaching and learning support is the significant difference between the communities, forms of knowledge and associated practices on either side of the Humanities and

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Sciences divide. Professions such as Engineering are "a dynamic conglomeration of different socio-epistemic communities each with their distinct cognitive and cultural styles" (Muller, 2015:410). In terms of STEM, Engineering combines Science, Technology and Mathematics in its utilisation of natural resources, scientific knowledge and technological possibilities *in service of society* (UNESCO, 2010). As a field, therefore, engineering offers an ideal context in which to examine approaches to the forms of curriculum, teaching, learning and assessment practices which ultimately straddle the Humanities and Sciences.

The focus of this chapter is academic development in a research-intensive university's engineering faculty with academic staff members whose disciplinary specialisations lie across the STEM fields. Building on a previous study on the impact of Writing Retreats on SOTL development among non-educational academics (Winberg, et al., 2017), as well as an international collaborative project focusing on capacitating engineering educators (Wolff, 2019), this chapter examines the relationship between different kinds of *knowledge* and *knowers* (Maton, 2014) in the academic development-STEM academic support system, where both have a mutual interest in improving educational practices for the benefit of successful student learning.

Using Activity Theory (Engeström, 1999) as a conceptual design framework, this study contrasts the activity systems associated with academic development work, engineering education and the engineering profession in three distinct fields: i) The Field of Scholarship of Teaching and Learning (SOTL); ii) The Field of Engineering Education; and iii) The Field of Engineering Practice. The purpose of the analysis and comparison is to demonstrate the opportunities for constructively mediating the development of scholarly teaching practices in engineering education. The core features of an activity system can be summarised as those entailing forms of *knowledge* and kinds of *knowers*, in particular 'communities of practice' (Wenger, 2009). The Legitimation Code Theory (LCT) dimension of Specialisation (Maton, 2014) enables the analysis and differentiation of knowledge practices in terms of the relative strengths of epistemic relations (between practices and their object) and social relations (between practices and their subject). In other words, used in conjunction, LCT Specialisation can illuminate the nature of knowledge and knowers in the activity systems of different communities of practice.

The aim of the two primary communities in this chapter (SOTL-based academic developers and discipline-based Engineering Educators) is one and the same: To enable successful student learning. This objective can be interpreted as that of enabling 'epistemological access' (Morrow, 2009), or access to powerful knowledge (Young & Muller, 2013). We know from Barnett (2000) that the 'supercomplex' curriculum of the 21st century requires a holistic view of its epistemological, ontological and praxis dimensions (and, by extension, these dimensions are implied in pedagogy). A second LCT dimension – Semantics – can help to visualise how epistemological access can be made explicit through unpacking and repacking (Maton, 2013) classroom strategies so as to facilitate 'cumulative learning'.

The chapter begins by establishing the context of academic development work in an engineering faculty, then proceeds to expand on the conceptual, theoretical and methodological frameworks. The chapter includes data and researcher observations drawn from a number of published studies involving academic development work with engineering academics at the institution.

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The main focus of the chapter is to demonstrate the scholarly development of STEM academics through mediating strategies which acknowledge the different forms of disciplinary knowledge and practices in different Community of Practice activity systems. The chapter hopes to make a methodological contribution to the field of academic development by offering an operationalised set of theoretically-informed instruments which may aid in bridging the Humanities – Sciences divide often encountered by academic development practitioners in Science-based educational contexts.

2 Research context

The Stellenbosch University engineering faculty has demonstrated a significant increase in interest and activity in scholarly approaches to engineering education over the past 5 years. This can partially be explained by three phenomena:

- The appointment of a Teaching & Learning Vice Dean who has actively promoted scholarly engagement with pedagogical and curricular issues.
- The availability of a dedicated faculty-specific teaching & learning advisor with a background in engineering education.
- The accessibility of educational theoretical and analytical instruments which echo the semiotic nature of the field.

Academic development work in the faculty has expanded to not only assist newly appointed academics, but to continue developmental work with staff engaged in a range of funded projects designed to improve student outcomes. A number of projects are funded annually through research and innovation grants, as well as projects drawing on the financial support offered by the Department of Higher Education and Training (DHET) via teaching-focussed development and capacity-building grants. In effect, the individual grants afford academics the opportunity, equipment and human resources (such as teaching assistants) to experiment with new approaches in their classrooms. The faculty, however, has also initiated collaborative projects intended to consolidate the findings of individual and team initiatives under the broad banner of 'Recommended Engineering Education Practices' (REEP) to serve as a guideline for faculty practices.

Engineering qualifications are governed by prescribed standards aligned to the International Engineering Alliance competency profiles (IEA, 2013). Of the 10 Graduate Attributes (GAs) stipulated in the Bachelor of Engineering standard, only one specifically refers to disciplinary knowledge, and six are related to personal attributes which are shaped by sociocultural practices, such as communication and management and lifelong learning. Collectively, the intention of the GAs is to aid the development of a well-rounded engineering graduate who is able to solve sociotechnical problems. However, each attribute entails forms of knowledge, types of practices and kinds of dispositions that are acquired both independently and symbiotically. Barnett's (2000) characterisation of curricular dimensions is articulated in the South African Department of Higher Education and Training (DHET)'s stated mandate that our role as educators is to enable the development of knowledge, skills and citizenship (2013). In other words, our role is to facilitate epistemological, praxis and ontological access to the "epistemic values" shared by "communities of inquiry" (Morrow, 2009:11). For the student on a professional programme,

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the intention is access to a particular profession's 'community of inquiry'. However, for an academic hailing from said community, the academic developer's role is to enable access to the epistemic values and practices of the educational community in order to facilitate scholarly teaching practices.

Engineering education scholarship has tended to produce atheoretical 'victory narratives' (Kirshner, 2015) of small, well-resourced contexts, but there is an increasing need to theorise and interrogate the underpinning phenomena so as to better understand the *why*, *what* and *how* of educational initiatives, particularly for diverse, large class settings in resource-challenged environments. The tools with which to undertake such analyses are varied and for the most part draw on well-known educational models or typologies, such as Bigg's or Bloom's taxonomies of learning or curricular approaches such as CDIO (Conceive-Design-Implement-Operate) (Chuchalin, et al., 2015). The dilemma, however, with many educational models is their 'knowledge blindness' (Maton, 2014), in other words, a lack of focus on how the nature of different forms of knowledge impacts on approaches to teaching and effective learning. By way of example, STEM educator resistance towards student-centred, constructivist pedagogies is less a matter of resistance to the perceived fuzziness of the social sciences than the reality that "the scientific knowledge structures of STEM disciplines are complex and specialised … [of which] the acquisition …is a lengthy process" (Winberg, et al., 2019:932) requiring the expert guidance of knowledgeable others.

The diverse disciplines and practices implied in both the Fields of Educational Scholarship (SOTL) and Engineering demand a) an acknowledgement of the different systems of activity and b) a more refined and rigorous set of theoretical and analytical instruments if academics are truly to be enabled to 'see' and respond to the *why, what* and *how* of their students' learning. This chapter presents a critically reflective approach to academic development mediation work in the engineering faculty using a set of theoretically informed tools drawn from Legitimation Code Theory (LCT) (Maton, 2014) (Figure 11.1). The ensuing analyses have been enabled through the processes of "learning from and reworking experiences" (Fook, 2011) across contexts and in relation to different communities of practice.

3 Research design and theory

3.1 Activity Theory as conceptual framework

The framework for the analysis in this chapter draws on Activity Theory (Engeström, 1999) to map two disciplinary knowledge systems so as to understand how practices are shaped in fields as different as SOTL and Engineering. Originating in early Soviet psychology, Activity Theory has built on the work of Vygotsky (sociocultural theory) and Feuerstein (mediated learning experience) (Kozulin, 2002). Today, we have an understanding that learning is mediated through 'tools' or 'instruments' in relation to sociocultural environments. Graphically, an activity system is captured as sets of triangles (Figure 11.2), the upper one consisting of the relationship between a subject (actor or agent) using 'tools' (physical or mental) in order to transform an object (a 'thing' or plan or idea) into an 'outcome' (Kuutti, 1996). The subject-object relationship occurs in a particular environment – called 'community' – which has 'rules' and a form of organisation (division of labour).

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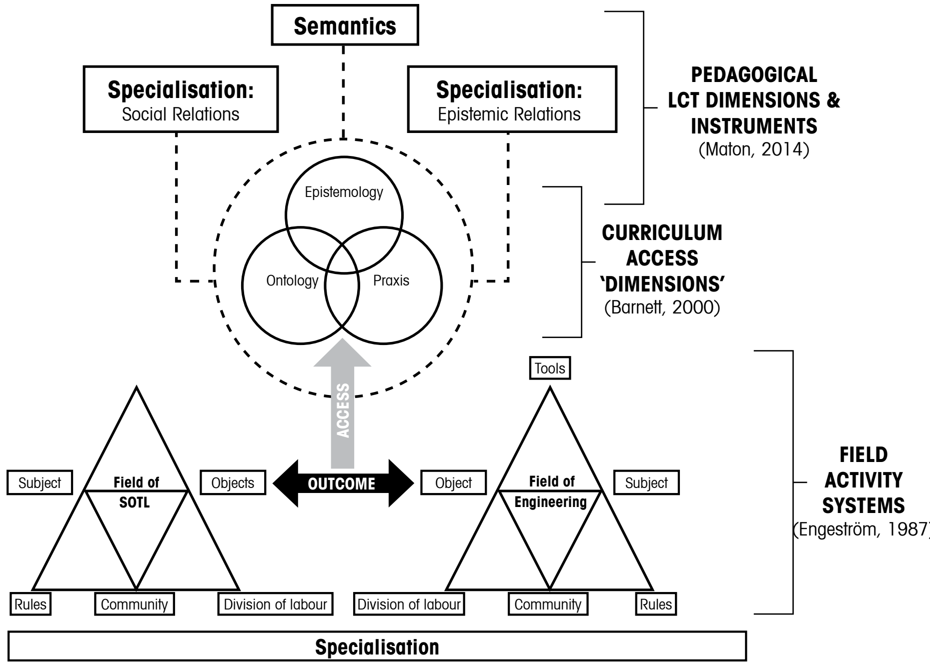

Figure 11.1 Conceptual, theoretical and analytical design framework

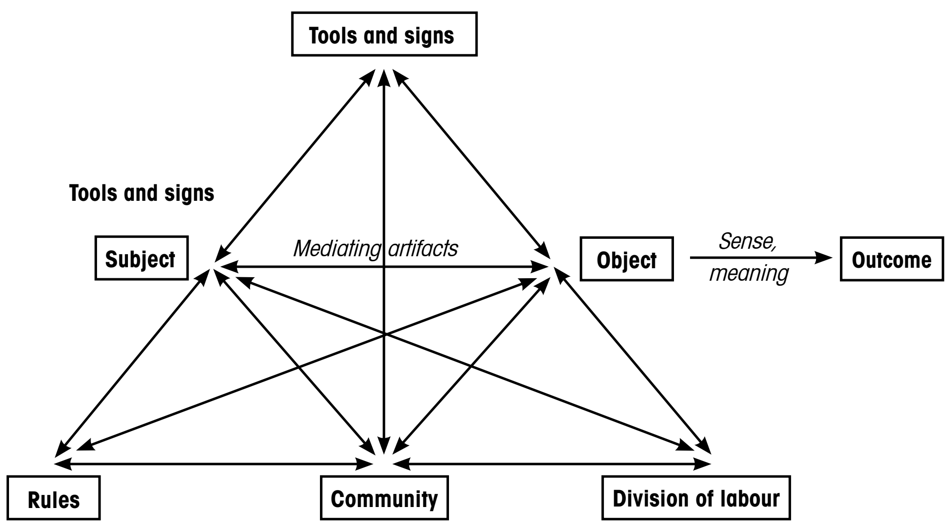

Figure 11.2 Engeström's human activity system (1987)

From a sociological perspective, understanding an activity system can be enriched by drawing on concepts such as Bourdieu's field theory (players in the field with particular forms of capital) (Wacquant, 1998) or Bernstein's code theory (the 'invisible' codes underpinning forms of knowledge, for example, and which dictate kinds of practices) (2000). More recently, LCT

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offers not only the term 'organising principles' (Maton, 2014), but the practical instruments to describe each of the features of an activity system in such a way as to illustrate, analyse and illuminate sociocultural practices. These sociological approaches or theories share the notion that practices both shape and are shaped by conditions, and that our duty as educators is to make these processes (*and* conditions) explicit.

Using the Activity Theory depiction of an activity system serves two purposes in this chapter. On the one hand, the immediate interest is in the subject-object-tool triangle – this is the active mediating space. This triangle enables the contrasting of the activity of an academic development practitioner and that of an engineering academic in relation to different tools and objects, but with the same intended outcome: Effective student learning. On the other hand, to understand why a practice is as it is, one moves to the lower half of the activity system – the 'rules' of the game in a particular community. SOTL and Engineering have significantly different 'rules of the game'. These differences can be unpacked or better understood using LCT Specialisation.

2.2 Legitimation Code Theory as analytical framework

LCT Specialisation has been used in a number of educational, professional and social contexts to analyse the basis of achievement. What is it that legitimates a particular practice? Is the legitimacy of a practice derived from the knowledge on which it is based, or the attributes of the person engaged in the practice? Set up as two axes on the Specialisation Plane (Figure 11.3, below), one can illustrate the relationship between the strengths of epistemic relations (between practices and their object – *knowledge*) and social relations (between practices and their subject – *knowers*). In studies of curricula, for example, we find researchers using LCT Specialisation to demonstrate how some fields foreground the knowledge base, for example, engineering design (Carvahlo, et al, 2009) and others with a greater knower orientation, such as the primary school music curriculum (Maton, et al., 2016). Where both *what* is known and *who* knows it are significant, we speak of an 'elite code'; where neither seems to matter or be evident, we use the term 'relativist code'. The LCT Specialisation plane enables not only the location of an orientation to knowledge and/or knowers, but the tracking of change or shifts over time. Given that learning is about transformation, the ability to interrogate and illustrate how this happens (or should happen) is invaluable to an educator.

Engineering qualifications are governed by the Engineering Council of South Africa, whose specifications for qualification achievement are internationally aligned and described in terms of 10 broad Graduate Attributes (Figure 11.3, above). An engineering academic group exercise as part of an internationally collaborative engineering educator enhancement project (Wolff, 2019) saw participants allocating the different attributes (also known as outcomes) of an engineering programme across the Specialisation plane (Figure 11.3). This exercise enabled the academics to realise that the qualification actually requires a greater focus on 'knower dispositions' than the ubiquitously assumed 'knowledge' code as a basis of achievement.

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Engineering Graduate Attributes (Outcomes)	
1	Apply **engineering principles** …
2	Apply **knowledge of mathematics**, **natural science** and **engineering sciences** …
3	Perform procedural and non-procedural **design** …
4	Conduct **investigations** …
5	Use appropriate **techniques**, resources, and modern engineering tools …
6	**Communicate** effectively …
7	Demonstrate knowledge and understanding of the **impact** of engineering activity on the society, economy … environment
8	**Demonstrate knowledge and understanding of engineering management principles** …
9	Engage in **independent and life-long learning** …
10	Comprehend and apply **ethical principles** …

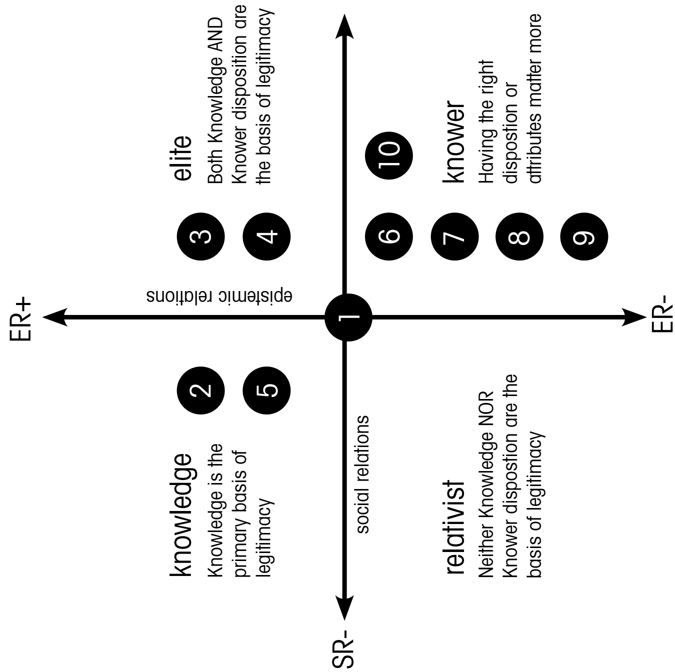

Figure 11.3 Engineering graduate attributes on the specialisation plane

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A study exploring the role of Writing Retreats in building knowledge and knowers in the field of Higher Education Studies (Winberg, et al., 2017) used LCT Specialisation to analyse and explain the relationship between different kinds of knowers (disciplinary academics) and the associated knowledges (disciplines) when inducted into HE academic writing. The study found that the presence of and collaboration with knowledgeable others (knowers) facilitated access to SOTL practices. In other words, strengthening the social relations (SR↑) enables a strengthening of epistemic relations (ER↑) to scholarly forms of knowledge. Seen in the context of an activity system, one could argue that the Writing Retreat focused on the lower half of the activity system by establishing a 'community' in which the 'rules' and 'division of labour' followed the organising principles of SOTL practices as opposed to those of the various 'subject' disciplines (the different academics' areas of expertise).

This chapter takes the position that although collaboration between Academic Developers and disciplinary specialists is an essential element in the creation of a 'transdisciplinary collective' (Jacobs, 2007) who share an interest in improving student success, there is a layer of potential 'collaboration' beyond the creation of a 'community' (in other words, beyond the strengthening of social relations SR↑), one in which mediating 'tools' of the activity system draw on features of the academic's disciplinary knowledge (disciplinary ER+) to enable improved epistemological access to educational knowledge (SOTL ER↑).

4 Activity systems in context

The role of the engineering academic (subject) is to enable students to develop and achieve the graduate attributes (outcome) by way of engineering teaching (object) (Figure 11.4), which may range from "Transmissive/Authoritarian on the one hand to Constructivist/Democratic" (Trowler & Cooper, 2002:233). He/she uses mediating artifacts (or tools) such as a curriculum, forms of natural, mathematical and engineering sciences, engineering models and systems, as well as physical artifacts such as equipment and computers. The focus is very much on the knowledge base, in other words, strong epistemic relations (ER+). However, each of the engineering sub-disciplines, such as mechanical or electrical or chemical engineering, has specific forms of natural and mathematical sciences which lead to highly specialised applications. As such, one sees particular forms of mathematics and natural science in one engineering discipline and not another, for example, Maxwell's equations in electromagnetism or Navier-Stoke's equations in fluid-mechanics.

Although drawing on similar alphanumeric syntactical devices, the underlying organising principles of the concepts in question are significantly different, as are the physical instruments of application. When regarding the engineering academic 'community', although multidisciplinary and natural-science-based knowledge orientated, the division of labour sees individual, mono-disciplinary, specialised experts who generally share the principles of quantitative, empirical and deductive approaches (rules) to their work. The strength of the social relations to the engineering knowledge base is relatively weak (SR–), in other words, it does not matter 'who' you are.

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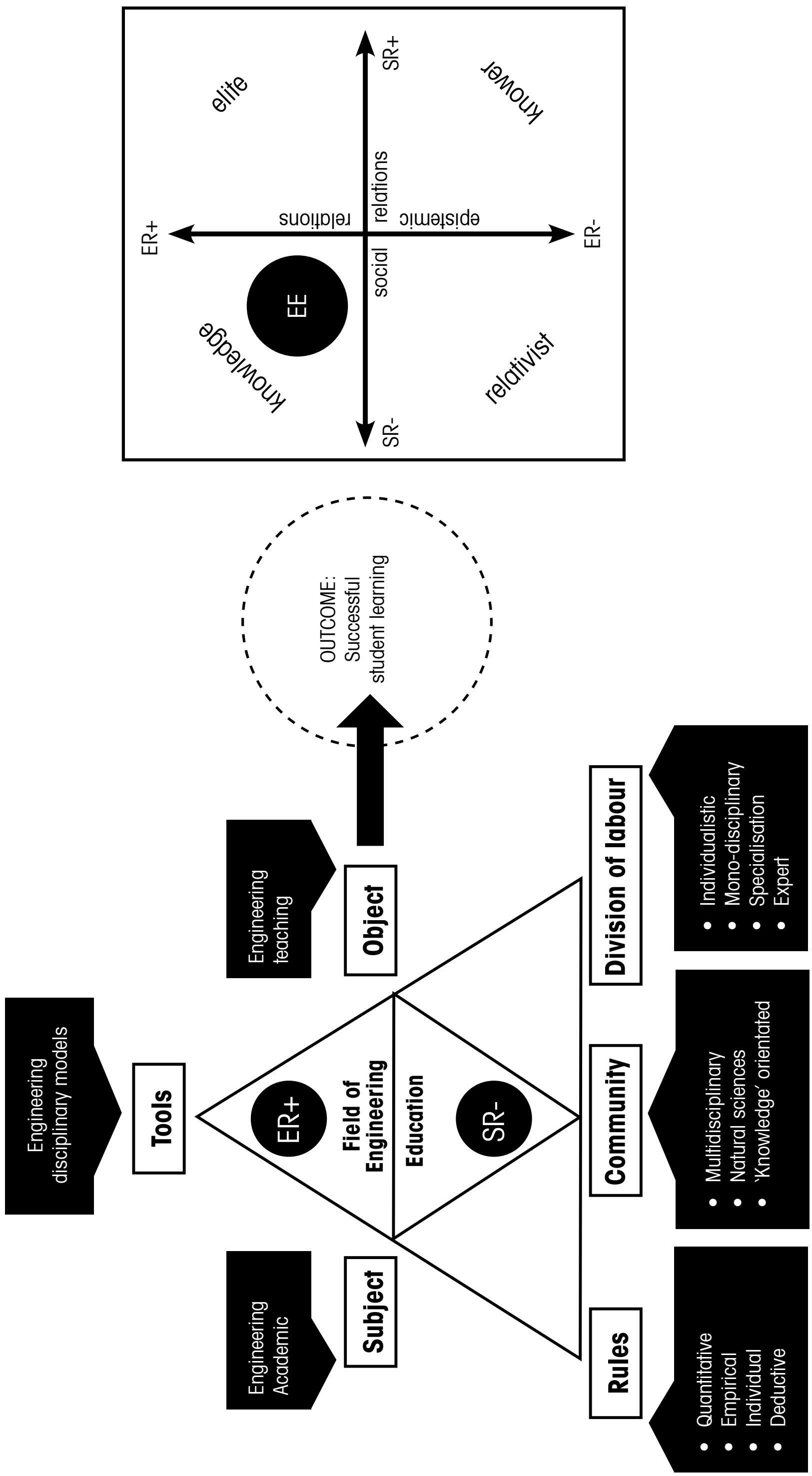

Figure 11.4 **The engineering education activity system**

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In contrast, the academic development practitioner (subject) (Figure 11.5) finds him/herself in a large, collaborative community of multidisciplinary *knowers* – often hailing from a range of social sciences such as linguistics and education – "united by their deep interest in student learning" (Winberg, et al., 2018). Given the range of social contexts in which academic development practitioners work with disciplinary academics, the 'rules' are usually interpretative, qualitative and have tended to adhere to social constructivist approaches to learning, demonstrating strong social relations (SR+). The theories of learning (tools) guiding scholarly teaching (object) in the interest of facilitating successful student learning (outcome) range from untheorised notions around the use of active learning strategies and technology to highly theorised concepts of knowledge production and reproduction. Of particular concern though is the persistent disciplinary knowledge-blindness (ER–) of much academic development work in which student-centredness is promoted regardless of discipline (Trowler & Cooper, 2002), as well as concepts such as 'reflective practice'.

It is not hard to see why engineering academics might find SOTL discourses alienating and confusing. They appear to stand in diametrical opposition to the rules and practices of STEM communities of inquiry, as visualised on the contrasting *specialisation plane* figures. Often, the term 'SOTL' means different things to different people, not having the 'steady foundation' (Boshier, 2009) of the natural sciences, and being difficult to 'operationalise' (ibid.). So, how does one bridge this divide?

The professional engineer occupies a different activity system from that of the engineering academic (Figure 11.6). In reality, engineers work collaboratively as teams in interdisciplinary communities solving problems that require an understanding of BOTH knowledge (ER+) AND knowers (SR+). My postgraduate research had revealed significant differences in engineering professional ways of working on precisely the same problems as a result of contextual differences (Wolff, 2018), not as a result of the knowledge practices or disciplinary basis of the problem itself, rather as a result of the *knowers* in the problem-solving system. Successful engineering problem solvers manage to navigate the forms of disciplinary and social practices appropriate in different sociotechnical contexts – this is called 'code-shifting' (Maton, 2014). This research experience facilitated my access in an academic development capacity to the engineering faculty, in that I could see that it provided me with a bridge between academic development and engineering education discourses. In terms of the nature of the community, its division of labour and rules, *engineering practice itself bridges the Engineering Academic/ SoTL divide* in being more collaborative and context-specific (hence, potentially requiring interpretative approaches).

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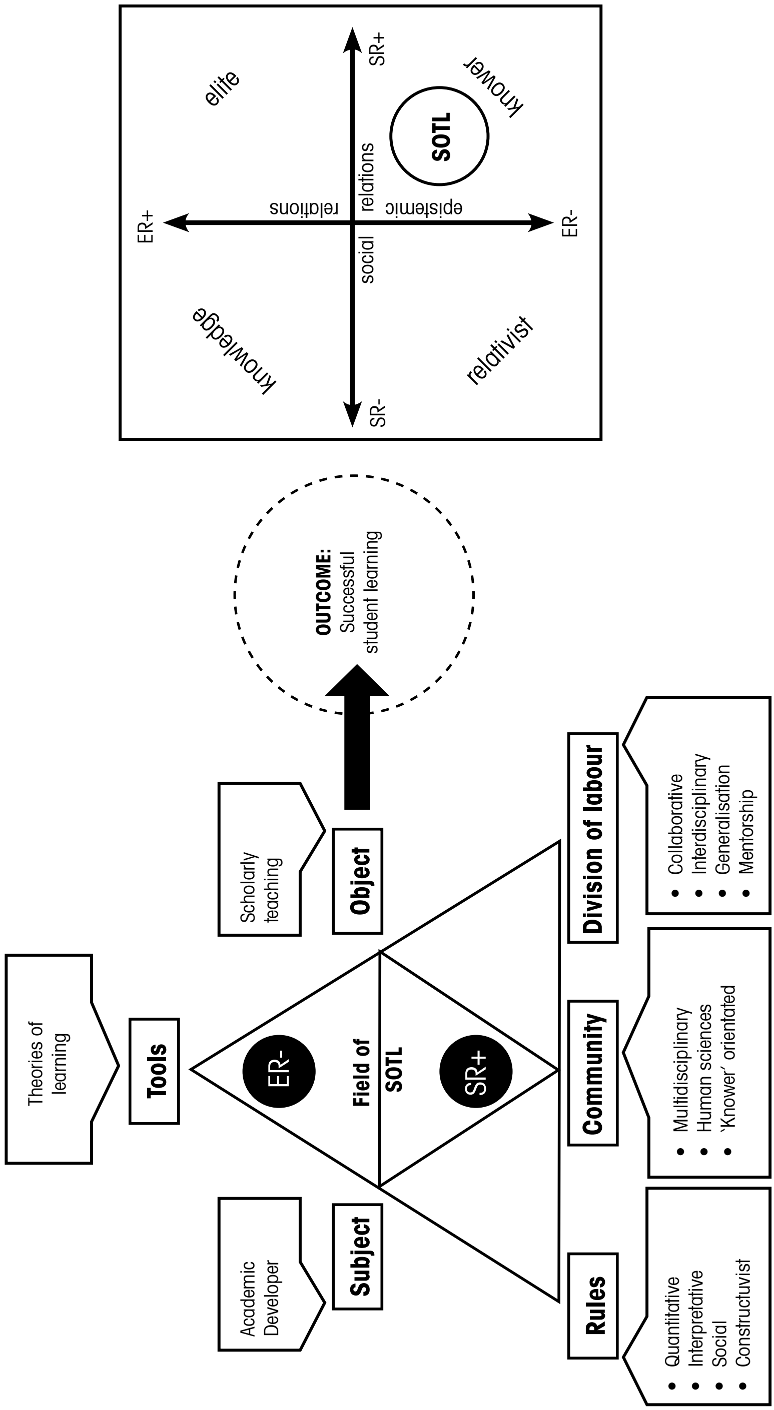

Figure 11.5 The academic developer in the SOTL activity system

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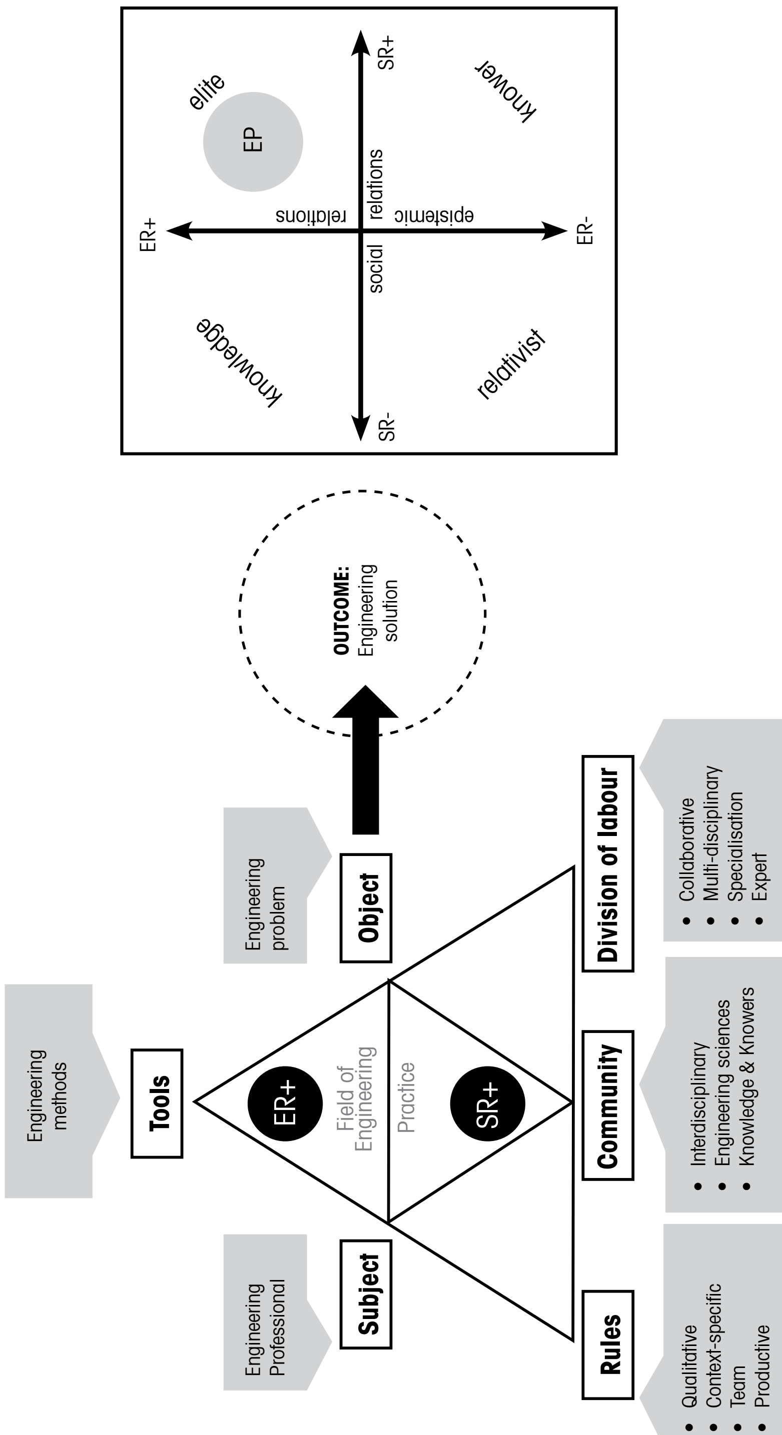

Figure 11.6 The engineering practice activity system

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5 Using engineering and LCT tools to mediate scholarly educational approaches

5.1 Enabling epistemological access

The first point worth making here is that engineering discourses are predominantly alphanumeric, graphic and schematic representations of material, energy and information. Entering the faculty in question armed not with the 'fuzzy SOTL-speak' (as academic development work is routinely characterised), but with a set of instruments (the tools of the SOTL activity system) such as those used in LCT, made a significant difference to the perception of SOTL. The initial instruments used were drawn from Semantics, which enable the graphic depiction (in wave form) of shifts between conceptual and contextual learning over time – in other words, the practical building of cumulative epistemological access. The terms 'gravity' and 'density' are immediately accessible to engineering educators, as they are of the most fundamental concepts in physics and chemistry. In LCT, "*Semantic gravity* refers to the degree to which meaning relates to its context" (Maton, et al., 2016:15), while "*semantic density* refers to the condensation of meaning" (ibid.). The 'wave' is a fundamental semiotic instrument in engineering. Engineers regularly 'parse' waves – they convert them from analogue to digital, they transform them, they break them into signal levels. Using a *semantic wave* with different levels of conceptual/contextual 'gravity' as a metaphor for teaching made it easier for engineering staff to interrogate the different 'tools' – concepts, artefacts, strategies and visualisations – they use in their teaching. Engineering staff in the faculty have begun to develop wave taxonomies (*semantic ranges*) that are discipline-specific, but which share the overarching principle of illustrating the stages between what is defined as 'theory' and what constitutes 'practice' in context (Table 11.1). This effort to demystify the vague and ubiquitous term 'theory-practice divide' in a discipline- and context-specific manner has resulted in numerous co-publications in the faculty: See for example, (Pott, et al., 2017), (Dorfling, et al., 2019).

5.2 Enabling praxis access

Perhaps the most significant tacit mediating strategy (albeit discursive) is the use of engineering process terminology, such as 'design review' for 'reflective practice', and familiar engineering design methodologies, for example, the DMADV of Six Sigma to design 'process improvement' teaching interventions:

- D = Define the problem you or your students are facing.
- M = Measure all the variables (student numbers, resources, conceptual difficulties, etc.).
- A = Analyse the relationships between the variables.
- D = Design an intervention to addresses the problem, taking into account your analysis.
- V = Verify the intervention by trialling it.

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Table 11.1 Discipline-specific engineering examples of the semantic range

Semantic range		Engineering case study examples			
Levels of meaning		**Civil**	**Process**	**Mechanical**	**Chemical**
Weak semantic gravity	**Principle**	Structural forces determining bracing	Conservation of mass & energy	Principle of projection	Lectures & Theory across modules
(Abstract/ Theoretical)	**Formula & Calculations**	$C_r = \varnothing A f_y (1+\lambda^{2n})^{-1/n}$	Mathematical expressions of process control	First and third angle projection	Research Project
	Representation	Technical schematic drawings	Block diagram schematic of process control	Orthographic drawing showing different views of an object	Design Project
	Model	3D/simulations of structural behaviour	Software simulation system	CAD model of the object (orthographic views derived from the model)	Problem-based research projects
Strong semantic gravity (Context-bound; Concrete/ Practical)	**Real**	Physical structure (real building)	Physical process control systems	Physical object	Context-embedded real-world processes

However, the most overt mediating tool in the activity system is that of types of engineering systems. Engineering offers a plethora of systems frameworks, which, contrary to popular belief, are not necessarily technicist or positivist in nature. 21st century engineering systems are particularly dynamic and complex. There is nothing quite like a graphic depiction of a dynamic system to warm an engineering educator's heart! One of the most successful interpretations is that of Dr Lydia Auret (Auret & Wolff, 2018) from Process Engineering who developed a Control Systems Framework for reflective practice (Figure 11.7) so as to be able to better understand the 'disturbances' in her teaching context and to design better 'feed-forward' strategies based on 'feedback' by way of 'sensors' such as grades, interviews and questionnaires (Figure 11.8).

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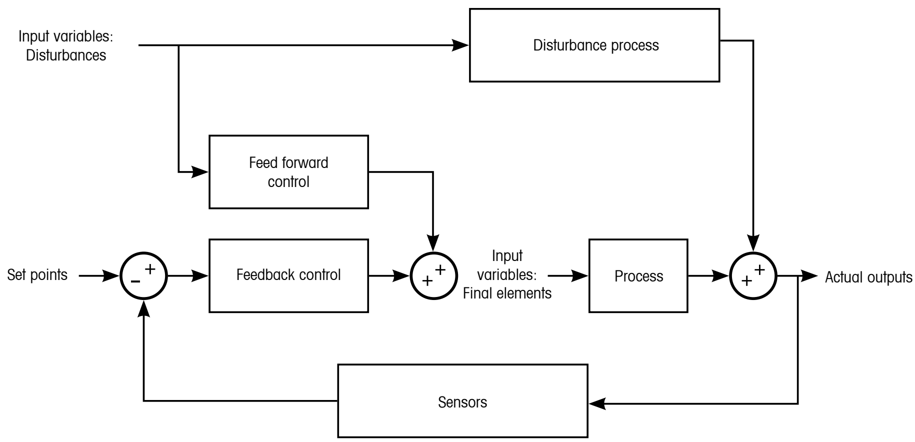

Figure 11.7 The control system framework

Source: Auret & Wolff, 2018

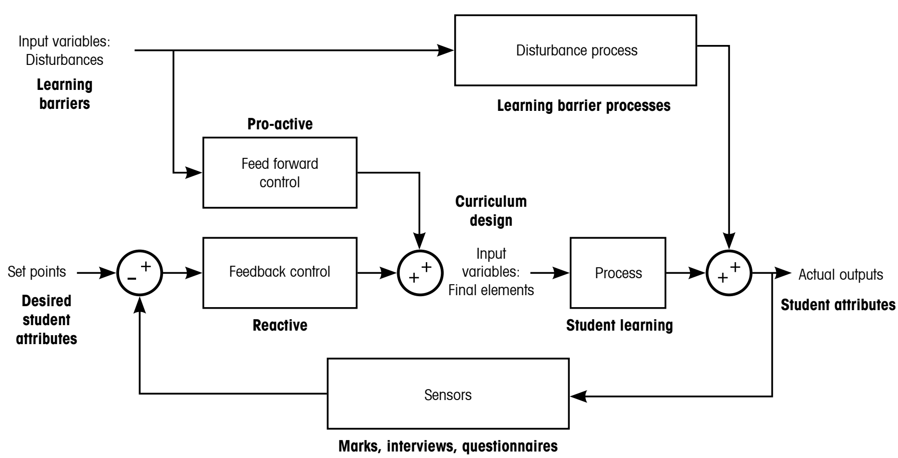

Figure 11.8 The CSF reflective system

Source: Auret & Wolff, 2018

This analysis of the process engineering curricular and pedagogic environment, using an engineering systems metaphor, led to the redesign of the curriculum using Semantics (Auret & Wolff, 2017). The 'feedback' from previous student grades, observations and questionnaires enabled the academic to pinpoint a particular 'disturbance' as occurring in the shift down the *semantic range* from decontextualised mass and energy balances into the interpretation of an actual simulated system. The curriculum redesign focussed on contextualising the theoretical concepts and creating multiple smaller semantic waves across the semester (Figure 11.9).

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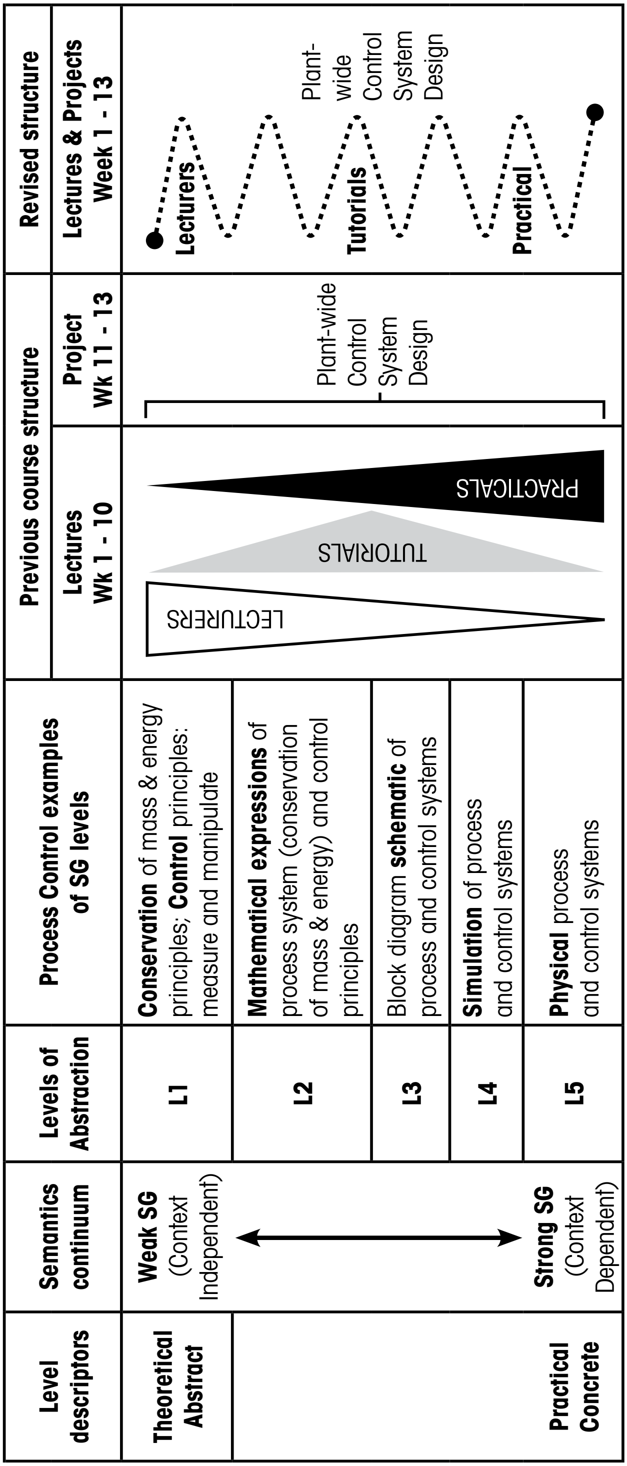

Figure 11.9 Restructured process control curriculum using semantics

Source: Auret & Wolff, 2017

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5.3 Enabling ontological access

In a climate of increasing awareness of diversity and an institutional shift towards learning-centredness, the use of a common scientific schematic – the Cartesian plane – as a means to graphically depict the relationship between *knowledge* and *knowers* in curricula and pedagogy more easily facilitated the discussion of the social aspects in STEM education. Firstly, as different subjects in our respective activity systems (the academic development and the engineering academic), our communities of practice (with their inherent divisions of labour and rules) have both shaped and been shaped by differing strengths of what we claim as *knowledge* and who we are as *knowers*. Our legitimacy tends to be based on the former in engineering (as illustrated in Figure 11.4) and the latter in the social sciences (Figure 11.5).

To use the Specialisation plane as a metaphor for the approach to enabling ontological access (for myself as an academic developer into the engineering academic space, and for my engineering academics into SOTL-informed ways of thinking), I have deliberately sought semiotic mediating tools to navigate between a knower (ER-, SR+) space and that of the engineering academic world (ER+, SR-). These tools being 'scientific' in nature (Cartesian planes and waves) mean that I have been strengthening the epistemic basis (ER↑) of SOTL-speak by drawing on STEM discourses. This shared language has enabled the strengthening of our collective social relations (SR↑) – it has ultimately enabled engineering academics to more comfortably access discourses and knowledge practices outside of their activity system. Staff feedback highlights the opportunity LCT has provided "to gaze underneath the workings of my classroom" and another speaks of having "embraced the innovative environment, implementing new ideas with confidence".

If the academic developer-engineering academic relationship in this context has been mediated by the physical or conceptually illustrative 'tools' that have been described, then further ontological access has been enabled through the "social context of the activity" (Hasan & Kazlauskas, 2014:10). Situated in a supportive faculty and institutional context, with multiple opportunities for engagement and practice-sharing, the emerging engineering academic community has increasingly turned to theorised approaches to understanding and improving knowledge practices for the purpose of a shared outcome: Facilitating holistic student learning. Essentially, the mediating academic development strategy is designed as a shift towards an *elite* code (Figure 11.10), where knowledge, practices and dispositions are valued, precisely as is expected by the field of engineering practice.

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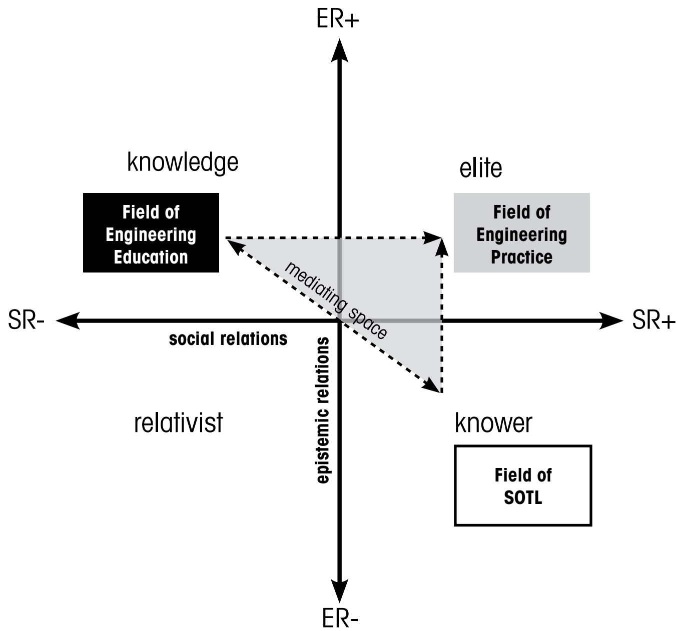

Figure 11.10 A code-shifting approach to mediating SOTL-based engineering education

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