Article

Curriculum Inquiry as a Contextualised Social Practice within an Activity System

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Abstract

In educational literature, ample curriculum models adopt product-oriented approaches based on linear, sequential design, review and renewal processes. Correspondingly, managerialism perspectives imposed by external and internal stakeholders, national policy frameworks and quality assurance mechanisms emphasise the technicalities of curriculum inquiry within a bureaucratic system as a means to an end. This paper aims to reposition curriculum inquiry as a contextualised social practice within an activity system. To this end, the six core elements of Engeström's second-generation Activity Theory were used as an analytic lens to examine the activity system of a coursework-based master's degree programme in a specialised field of study. This academic programme is a unique offering at a large research-intensive university, contributing to the 'green' economy in South Africa. Within this activity system, the existing curriculum of this academic programme constituted the unit of analysis. Curriculum documentation was used as the primary data source. The curriculum data was analysed using the semantics dimension of Maton's Legitimation Code Theory (LCT). The results and findings of this analysis revealed tensions and contradictions within the activity system of this coursework-based master's degree programme that constrain its inherent potential to equip students with professional expertise in climate change and sustainable development.

Keywords: curriculum inquiry; Activity Theory; green economy; semantics; knowledge building.

Introduction

The 21st-century knowledge society relies heavily on knowledge-based assets such as research and development, design, software, and human and organisational capital. Practitioners in knowledge-based occupations globally face volatile, uncertain, complex and ambiguous (VUCA) challenges associated with the Fourth Industrial Revolution

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(4IR) (World Economic Forum, 2020) and the *2030 Agenda for Sustainable Development* (United Nations, 2015). In terms of the latter, this paper relates to how universities should prepare students for the needs of a green economy and contribute to the wider sustainability agenda by improving human well-being and social equity while significantly reducing environmental risks and ecological scarcities (Nishimura and Rowe, 2021; Wals and Corcoran, 2012).

As the 4IR unfolds, technological advances, including robotics, artificial intelligence, high-speed mobile internet, widespread adoption of big data analytics, cloud technology, climate change and environmental technologies, e-commerce and digital trade, encryption and cybersecurity and other new technologies, significantly impact the labour market and on higher education (Penprase, 2019; World Economic Forum, 2023). These technological advances increase the need for practitioners to possess critical and analytical thinking, innovation, creativity, originality, resiliency, flexibility and agility, motivation and self-awareness, curiosity, initiative and lifelong learning, dependability, technological and digital literacies, complex problem-solving abilities across disciplines, systems analysis and evaluation, and social influence and leadership skills (World Economic Forum, 2023).

Higher education qualifications and programmes act as pathways, equipping graduates with the discipline-based theoretical knowledge, practice-based skills and attributes defined in this paper as professional expertise needed for the evolving world of work and lifelong learning (Bester, 2022). Amid rapid technological advancements and other influences, higher education curricula must be responsive and relevant (Menon and Castrillón, 2019). Brennan (2022, 86) contends that "curriculum must be re-oriented and re-purposed with a focus on the present and future," suggesting a departure from instrumentalist approaches to curriculum decision-making that prevailed for many years in South Africa. Moreover, Guile and Unwin (2022) argue that a static view of knowledge fails to address the professional expertise required in today's society, supporting Treem and Leonardi’s (2016, 7) view that professional expertise should be understood as “the capacity to act with the best or right knowledge”.

By adopting a socio-cognitive approach to developing expertise, Hakkarainen et al. (2004, 8) postulate that the focus shifts away from the technicalities of curriculum to advancing knowledge, transforming social practices and developing networked expertise through collective problem-solving in communities of practice that resemble the challenges of today’s dynamic workplace environment. In keeping with this view, Engeström (2018, i) suggests that “collaborative and transformative expertise” resides in object-oriented collective activity systems mediated by cultural means.

Problem Statement

As a practitioner-researcher in higher education curriculum studies for many years, I have observed that curriculum decision-making concerning the design of new programmes or the renewal of existing programmes often results in the adoption of a logic model consisting of inputs, activities, outputs, and outcomes arranged as sequential steps of a "rational" process (Knight 2001, 372). Figure 1 outlines a typical model of curriculum inquiry used in higher education. Emphasis is placed on the "mechanics" of curriculum inquiry and the adoption of a "technicist approach" (Kelly 2004, 1).

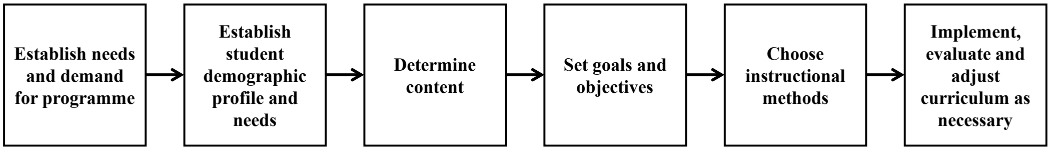

Figure 1: Typical model of curriculum inquiry (Adapted from Diamond 2008, 10)

However, designing or renewing an academic programme is rarely determined in this logical, sequential manner. It is typically a complex and contested space of competing discourse unfolding in an iterative and sometimes messy way. Curriculum decision-making is influenced by ideological perspectives (Schiro, 2013), disciplinary considerations (Shay, 2013) and several contextual factors. These factors include national legislative and policy requirements, stakeholder expectations, professional body stipulations, institutional strategic imperatives, needs and expectations of diverse student bodies, flexible modes of delivery and provision using learning technologies, as well as educational priorities of creating transformative student experiences (Bitzer and Costandius, 2018).

Unfortunately, the managerial perspectives of national agencies, professional bodies and quality assurance mechanisms imposed on higher education strengthen the technicalities of curriculum decision-making, primarily serving academics' technical and practical interests in the curriculum (Fraser and Bosanquet, 2006). However, given the VUCA challenges that graduates face in contemporary society, curricula should be future-oriented (Brennan, 2022), problem-based and learning-centred (Markauskaite and Goodyear, 2017), allowing students to develop networking expertise (Hakkarainen et al., 2004) and become co-creators of knowledge (Bereiter and Scardamalia, 2014) in communities of practice.

With these considerations in mind, I support Grundy's (1987) and Warren's (2016) point of view on curriculum inquiry, regarding it as a contextualised social practice that develops through the dynamics of collaborative curriculum decision-making and reflection rather than a set of clearly defined plans to implement and steps to follow. Therefore, I decided to use Engeström's second-generation Activity Theory (AT) (2001) to examine the six core elements of the activity system of a coursework-based master's degree programme at a research-intensive university in S.A. This research project forms part of an extensive study into the different facets and dimensions of expertise and how professional expertise can be developed in higher education curricula (Bester, 2022).

Activity Theory as an Analytical Lens for Curriculum Inquiry

Activity Theory (AT) is grounded in sociocultural theory and practice, as illustrated by the scholarly contributions of its founders, Vygotsky, Luria, Leont'ev, Davydov and others in the early 20th century. These scholars viewed "practice as the epistemological source of knowledge", so they turned to observations of concrete life situations to understand higher mental functions (Sannino, Daniels and Gutiérrez 2009, 7). AT explains that cultural artefacts (i.e. tools, instruments, etc.) mediate the relationship between subjects (i.e. humans) and their objects within their environment.

These mediating artefacts shape how humans interact with reality, but they also reflect the experience of others who have previously tried to solve similar problems by inventing or modifying artefacts. As a result, these mediating artefacts contain cultural-historical connotations that represent the accumulative efforts of those involved, which are made visible through the structural properties of these artefacts and how these artefacts are used in practice (Kaptelinin and Nardi, 2006).

Second-generation AT is based on Vygotsky's model of the mediated act, consisting of the subject (individual, pair or group), tools or mediating artefacts (instruments or tools) and object (that contains the motives that give rise to the particular way of acting) which leads to the outcome (Engeström, 2001). In second-generation AT, the focus is on the whole activity system positioned within a broader context in the form of a community (i.e. all groups interested in the object) with its own explicit and implicit rules, norms, routines, habits, values and conventions, and its division of labour which influence how the subject acts on the object. As depicted in Figure 2, the relationship between subject and object is mediated by instruments or tools, rules mediate the relationship between subject and community, and the division of labour mediates the relationship between object and community. Second-generation AT also represents the processes of production, exchange, consumption and distribution, hence offering the possibility of analysing a multitude of relations within the triangular structure of the activity. Figure 2 depicts the core elements of the activity system, which were adapted to analyse the master's degree programme in an area of specialisation in the 'green' economy within an academic department aimed at developing professional expertise.

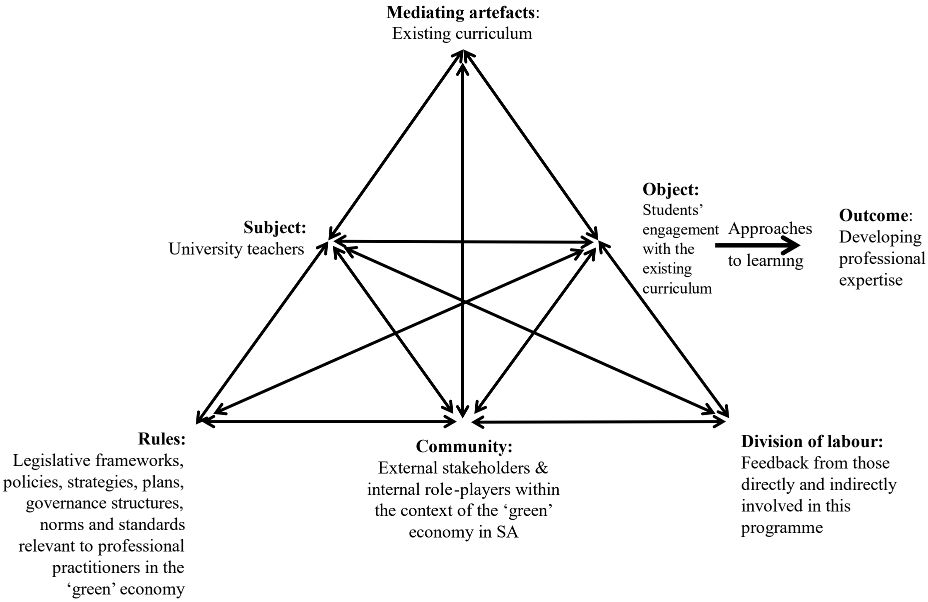

Figure 2: Second-generation Activity Theory (AT) (Adapted from Engeström 2015, 63)

Table 1 outlines the core elements of the activity system and provides research questions relevant to the selected academic programme. The primary purpose of this investigation was to understand how the existing curriculum of this academic programme, as the mediating artefact, seeks to develop students' professional expertise in this specialised field of study and to determine tensions and contradictions in the activity system.

Table 1: Core Elements of the Activity System of Curriculum Inquiry Within an Academic Department

Core elements of the activity system of curriculum inquiry	Relevant research questions applicable to this activity system
Subject: The subject was the university teacher(s) who teach the academic programme modules.	Who should be involved in this curriculum inquiry? What were the university teachers' conceptions and orientations towards curriculum, teaching, learning and assessment in this programme? How was the curriculum of this programme taught and assessed by university teachers?
Object: The object was students' engagement with the existing curriculum of the academic programme in order to develop professional expertise.	Who were the students enrolled in this programme, i.e. demographics? What were students' views on their engagement with the existing curriculum in order to develop professional expertise?
Mediating artefact: The mediating artefact was the programme design, delivery, and provisioning through the existing curriculum, as well as teaching, learning, and assessment practices, to develop professional expertise. It allows for an externally oriented (i.e. factors impacting the curriculum) and internally oriented (i.e. students' mastery of professional expertise through the curriculum) investigation.	What was the purpose, aims, and outcomes of this programme? How was the curriculum of this programme structured? To what extent were the different contexts, forms of knowledge, and socio-cognitive learning processes prevalent in this programme?
Community: The community was divided into two groupings: External stakeholders such as professional organisations, employers and alumni. Internal role players such as programme leader(s) and coordinator(s), professional academic support staff, including instructional/learning designer(s), academic administrators, administrative and technical support staff, internal, and external examiners and moderators.	Who were the internal actors or groups who shared an interest in this curriculum inquiry? What were the views of these internal actors or groups of the curriculum? Who were the external stakeholders who shared an interest in this curriculum inquiry? What were the views of these external stakeholders on the curriculum?

Core elements of the activity system of curriculum inquiry	**Relevant research questions applicable to this activity system**
Rules: The rules included legislative frameworks, policies, strategies, plans, governance structures, theoretical perspectives, principles and theories relevant to climate change and sustainable development in S.A. Institutional policies pertaining to curriculum inquiry and theoretical perspectives on developing professional expertise were also considered.	At the time of the research, what rules were imposed by national and policy frameworks, policies, strategies, plans, and governance structures on climate change and sustainable development education in S.A.? Which institutional policies and other relevant documents had a bearing on this curriculum inquiry? What counted as evidence of knowledge building and creation in this programme? What enabled and/or constrained the development of professional expertise in this programme?
Division of labour: The division of labour included the role(s) and responsibilities of those involved in the programme.	What were the roles and responsibilities of those involved in this programme? How did the division of labour enable or constrain the development of professional expertise in this programme?
Outcome: The outcome was the students' development of professional expertise.	What was the desirable outcome of this programme? How did this outcome relate to the different dimensions of professional expertise?

The Activity System

The existing curriculum as the unit of analysis in this paper is located within the activity system of a coursework-based master's degree programme in sustainable agriculture as a specialised field within the 'green' economy in South Africa. This activity system was purposefully selected for this study based on the interdisciplinary nature of the academic programme and its significance within the institutional, higher education and national contexts. Sustainable agriculture is nested within a complex sustainable agro-ecosystem, as depicted in Figure 3, consisting of:

- **Socio-economic considerations** encompass input/output prices, funding and market access, investment choices, risk variations, transport costs, market control, and market conditions that constrain farmers, producers, traders, and consumers in the value chain. Social factors also relate to income generation, professional practice, cultural enrichment, national traditions, leisure and recreation, healthy lifestyle promotion, and food safety.

- **Political and legislative frameworks**, including governance structures, policies, and regulations, impact land ownership, intellectual property rights, and funding for science and technology that enable or constrain agriculture. The economics of agriculture, including food supply and demand, affect all farmers who produce products for commercial purposes.

- **Environmental and ecological considerations** pertain to climate change, including rising temperatures and ozone depletion, water scarcity, soil fertility, crop nutrition related to the availability of nitrogen and potassium, and the incidence of pests, diseases, and weeds that influence agricultural and food production.

- **Agricultural science and technology** allow humans to grow crops for food, fuel, fibre and forage for animals by managing the interaction between crop genotypes or livestock breeds and their immediate physical and biological agro-environment. At the same time, it also provides employment and a way of life for many people.

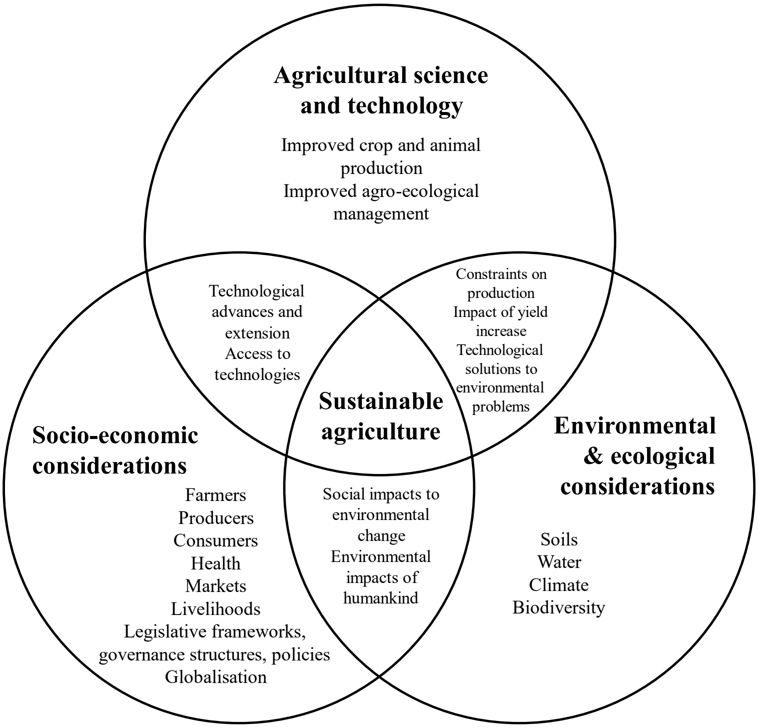

Figure 3: A sustainable agro-ecosystem: complexities and interrelatedness (Adapted from The Royal Society 2009, 5)

This coursework-based master's degree aims to "train researchers in understanding and working within sustainable agriculture" by adopting "a systems approach to agriculture as a point of departure" (SU 2021, 86). By adopting systems thinking, multiple levels and interdependencies are explicitly acknowledged within the curriculum logic of this programme with the underlying rationale that identifying the effect of a specific intervention in the system requires an understanding of how the system functions. The programme consists of coursework, a research project and a credit-bearing workplace-based learning component offered jointly by several academic departments that "actively seek to integrate scientific methods across disciplines to advance sustainability in spheres where agriculture interacts with natural, social and economic factors" (SU 2021, 86).

Research Design and Methodology

Data Generation

As a recognised qualitative data generation method, document analysis was used to critically analyse the existing curriculum as the mediating artefact within this activity system. This qualitative research method, nested within a constructivist-interpretivist paradigm, portrayed the richness of the context and contributed to a deeper understanding of the complexity (Simons 2009, 63). Programme- and module-specific documents in printed and electronic form were made available by teaching staff and retrieved from the university's learning management system. This documentary evidence included programme, module and/or study guides, project/assignment briefs, marking criteria, prescribed book lists and other reading material, workplace-based learning assignments and reports, learning materials and presentations. Additionally, minutes of meetings, student satisfaction surveys, and other relevant sources, such as dissertations completed by students, were also considered.

Data Analysis

I used one of five dimensions of Maton's (2014) Legitimation Code Theory (LCT), namely Semantics, consisting of two semantic codes, semantic density (SD) and semantic gravity (SG), to analyse the data of the existing curriculum. This dimension of LCT explores the context-dependence and complexity of knowledge practices. Semantic density (SD) describes the internal relations of knowledge practices and relates to the degree of condensation or complexity of meanings (Maton 2011, 66). The stronger the semantic density, the more complex the meanings; the weaker the semantic density, the less complex the meanings. Semantic gravity (SG) describes the external relations of knowledge practices, defined as "the degree to which meaning relates to context, whether that is social or symbolic (Maton 2011, 66). The stronger the semantic gravity, the more context-dependent meanings and practices; the weaker the semantic gravity, the more context-independent the meanings and practices. Combining these varying strengths of semantic density and semantic gravity creates the semantic plane consisting of four principal semantic codes, as depicted in Figure 4. Each quadrant within the semantic plane, as depicted in Figure 4, represents a different semantic code or set of organising principles for knowledge practices.

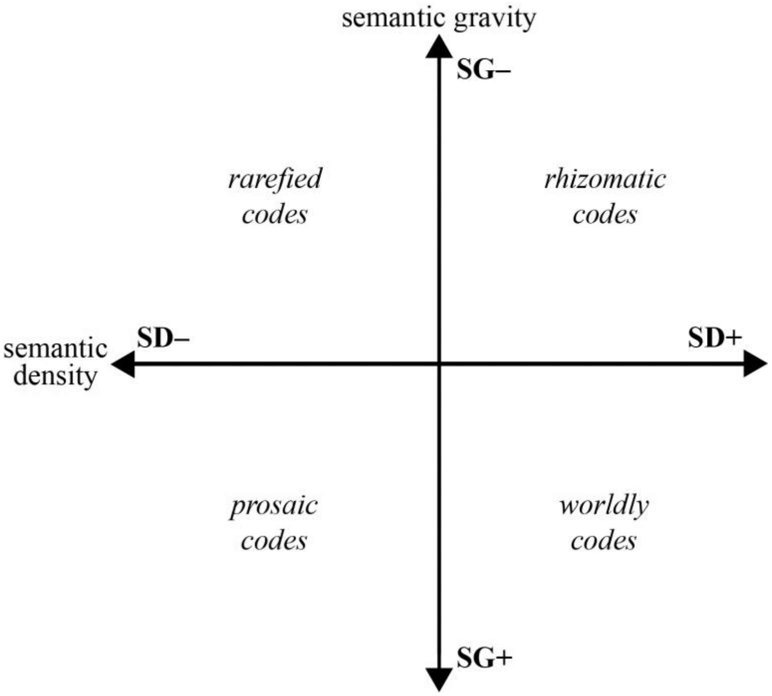

Figure 4: Semantics plane consisting of four semantic codes (Source: Maton 2014, 131)

The four principal modalities, expressed as semantic codes in Table 2, relate to theoretical, practical, professional, and generic forms of knowledge (Shay, 2013). These forms of knowledge are prevalent to a lesser and greater degree in professionally oriented higher education programmes.

Table 2: Four Principal Modalities Within the Semantic Plane

Modalities	Semantic codes[1]	Maton's description of semantic codes	Shay's description of forms of knowledge
Rhizomatic codes	SG–, SD+	Rhizomatic codes are where the basis of achievement is comprised of relatively context-independent and complex stances.	**Theoretical knowledge**: This form of knowledge is context-independent (SG–) with a strong condensation of concepts (SD+). Theoretical or 'formal' knowledge is 'abstract and general' in character and cannot be applied directly to problems of work and practice.
Prosaic codes	SG+, SD–	Prosaic codes are where legitimacy accrues to relatively context-dependent and simpler stances.	**Practical knowledge**: This form of knowledge is context-dependent (SG+) with less condensation of concepts (SD–). Practical knowledge is closely associated with a particular job or occupational task and trapped within the context of its application.
Worldly codes	SG+, SD+	Worldly codes are where legitimacy is accorded to relatively context-dependent stances that condense various meanings.	**Professional knowledge**: This form of knowledge is strong in semantic density (SD+) and strong in semantic gravity (SG+). The principles of professional knowledge are derived from the foundational understanding of abstract concepts derived from theory and practical knowledge that is firmly embedded in practice.
Rarefied codes	SG–, SD–	Rarefied codes are where legitimacy is based on relatively context-independent stances that condense fewer meanings.	**Generic knowledge**: This form of knowledge is described as "pseudo-practical knowledge" since it is not embedded in specific practice (SG–) but is more generic in nature. This form of knowledge is not codified (SD–) and is more tacit in nature, often described as generic competencies or 'soft' skills.

Source: Maton (2016a, 16) and Shay (2013, 567–572)

1 The prescribed format to indicate the semantic codes consisting of semantic density (SD) and semantic gravity (SG), without full stops between letters, followed by an indication of the relative strength (+) or weakness (-) of each of these codes, is used in this paper (Maton 2016b, 241).

The data analysis of the curriculum documentation consisted of four iterations of data coding, as depicted in Figure 5 and described in more detail below.

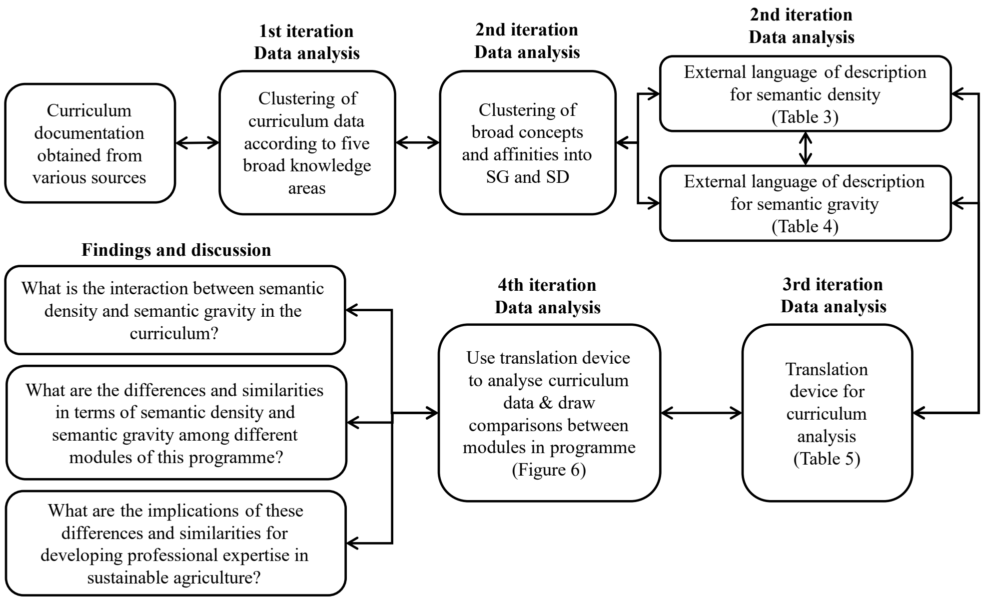

Figure 5: Five iterations of analysis of curriculum data

During the **first iteration**, data were coded using descriptive and in vivo coding to summarise segments of data resulting in a clustering of the curriculum data into five broad knowledge areas: (1) conceptual framework informed by systems thinking; (2) biophysical farm environments including soil, plant and animal production; (3) sustainability aspects including ecological, sociological and economic perspectives; (4) methods, applications and analytical tools including systems analysis and simulation and quantitative data analysis and finally, (5) the research project.

During the **second iteration**, using pattern coding, the curriculum data from the five broad knowledge areas were clustered into semantic density (i.e. complexity of the concepts) (SD) and semantic gravity (i.e. affiliation to contexts) (SG). To bridge the "discursive gap" (Bernstein 2000, 209) between theory and data analysis, a "translation device" (Maton and Chen 2016, 31) as an external language of description was used. Table 3 describes the translation device for analysing semantic density, where stronger semantic density (SD+) indicates more significant condensation of meanings into specialised terms and weaker semantic density (SD–) indicates that fewer meanings are condensed.

Table 3: Translation Device for Semantic Density

SD+/SD-	Indicators	Example from curriculum data
SD++	Highly abstract concepts and/or structures in interaction with other concepts/structures to extend knowledge through generalisation	Students must explain how systems approaches can be applied in crop, soil, and animal science and their usefulness in evaluating options for improved systems management.
SD+	Relatively abstract concepts and/or structures in interaction with others to shape a distinctive frame of reference in a discipline with acknowledgement of multiple realities	Students are expected to evaluate cropping systems concerning sustainability indices (e.g. soil quality, water and nutrient productivity, input-output ratios, biodiversity, and landscape).
SD	More complex yet functional structures and concepts with some interrelatedness between them and others form an integrated whole.	Students must evaluate sustainable land use in specific case studies using quantitative analysis of land use systems (QUALUS).
SD–	More complex concrete functional structures and/or concepts with some interrelatedness between them	Students are expected to appreciate the complexity of the relationship between soil, including soil organisms, plants and cultivation practices.
SD– –	Basic concrete structures and/or concepts with relatively simple or common meanings	Students are expected to interact with a client, set the goals of a project, formulate tasks and draft a project plan using their knowledge, skills and abilities as a group.

Table 4 describes the translation device for analysing semantic gravity, where stronger semantic gravity (SG+) indicates that more meaning is dependent on its context, and weaker semantic gravity (SG–) indicates that less meaning is dependent on its context.

Table 4: Translation Device for Semantic Gravity

SG+/SG–	Indicators	Example from curriculum data
SG++	Practical methods, techniques and/or procedures to address the context-specific problem(s) or situation(s) in a practical context(s)	Students are required to interview farmers and other stakeholders to obtain data using a social sustainability index.
SG+	Methods, techniques and/or procedures to address the well-defined problem(s) or situation(s) in bounded context(s)	Students are required to evaluate crop production systems with respect to sustainability indices (e.g. soil

SG+/SG–	Indicators	Example from curriculum data
	using specialised knowledge relevant to field/discipline/practice	quality, water and nutrient productivity, input-output ratios, biodiversity, and landscape).
SG	Methods, techniques and/or procedures to consider the interrelatedness of aspects within the problem(s), situation(s) or system(s) using prevailing knowledge and skills relevant to field/discipline/practice	Students must explore the diversity of plant species, vegetation types and habitats in South Africa in general and the Fynbos biome in particular, using a multi-media platform called SynBioSys Fynbos that includes a geographic information system (GIS).
SG–	Context-independent methods, techniques and/or procedures based on general understandings relevant to the field/discipline/practice to consider common problem(s), situation(s) or system(s)	Students are required to appreciate the basics of typical farm modelling as a farming system planning tool.
SG– –	Context-independent interventions based on universal principles from the body of knowledge relevant to the field/discipline/practice aimed at modelling solutions in a broader context	Students are required to use simulation models relevant to complex agroecosystems.

During the **third iteration** of curriculum data analysis, the differentiation of stronger and weaker semantic density and semantic gravity presented in Table 3 and Table 4, respectively, was used to develop a translation device for analysing the curriculum of the chosen programme, expressed in terms of the semantic codes presented in Table 2. Table 5 outlines the translation device used for curriculum analysis of this activity system.

Table 5: Translation Device for Curriculum Analysis Used in this Study

Rhizomatic code (theoretical/abstract knowledge)	**Prosaic code (practical knowledge)**	**Worldly code (professional knowledge)**	**Rarefied code (generic knowledge)**
SG–, SD+	**SG+, SD–**	**SG+, SD+**	**SG-, SD–**
Highly abstract concepts and/or structures in interaction with other concepts/structures to extend knowledge through generalisation using appropriate interventions within a complex system(s) drawing on abstract principles from the body of knowledge appropriate to the field or discipline or practice	More complex concrete functional structures and/or concepts with some interrelatedness between them using practical context-specific methods, techniques and/or procedures to identify and/or analyse a problem(s) or situation(s) in practical context(s)	Relatively abstract concepts and/or structures in interaction with others to shape a distinctive frame of reference in a discipline with acknowledgement of multiple realities using specialised knowledge relevant to the field/discipline/ practice to address well-defined problem(s) or situation(s) in bounded context(s)	Basic concrete structures and/or concepts with relatively simple or common meanings using general understandings relevant to the field/discipline/practice to address the common problem(s), situation(s) or system(s).

During the **fourth iteration,** the semantic codes (SG+/–; SD+/–) shown above in Table 5 were used to code curriculum data of each module in this programme in terms of the semantic codes: rhizomatic, prosaic, worldly and rarefied. The curriculum data used were extracted from various programme- and module-specific sources of the chosen programme and comprised 70 statements of the 11 modules and the research project and reports, coded in terms of SG+/SG– and SD+/SD– on a scale of 10 to 0 to -10. The total average score of each module in terms of SG+/SG– and SD+/SD–, respectively, was then converted to a percentage and presented in the semantics plane, as seen below in Figure 6. Semantic gravity (SG) and semantic density (SD) are conceived as axes within the semantic plane (Maton 2016a, 16), the organising principles of which are expressed as semantic codes. The modules were grouped according to the broad knowledge areas: Conceptual Framework (CF), Biophysical Farm Environment (BFE), Sustainability Aspects (SA), Methods, Applications and Analytical Tools (MAAT) and Research Project, including a report (RP), each indicated with a circle in different shades of grey. These circles in the semantic plane, as depicted in Figure 6, differ in size based on the credit value assigned to the module or component (i.e. research project and report) in the programme design.

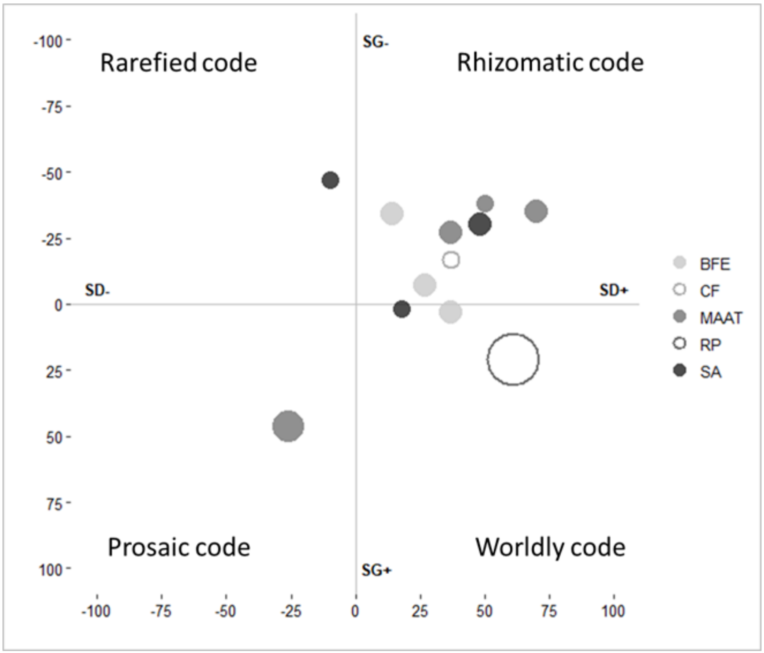

Figure 6: The semantic plane of curriculum data in this study

Findings and Contradictions in the Activity System

The different modules and components are spread across the four semantic codes, with the majority being located in the rhizomatic code (top right quadrant), with some modules in the worldly code (bottom right quadrant) and only one module in each of the prosaic (bottom left quadrant) and rarefied (top left quadrant) codes. The modules, excluding the research project and report (RP) located within the rhizomatic code, constitute 58.69% of the total credit value assigned to the coursework in this programme. The rhizomatic code (top right quadrant) resembles theoretical knowledge that is context-independent (SG–) with stronger condensation of concepts (SD+), of which the knowledge structures are hierarchically organised as the foundational principles are derived from theory. Work-integrated learning is located in the prosaic code (bottom left quadrant). It is based on practical knowledge emerging from engagement with real-life problems/situations in the workplace executed by students as a group project. The research project and report (RP) are in the worldly code (bottom right quadrant) based on the recontextualisation of both theoretical knowledge (SG–, SD+) and practical knowledge (SG+, SD–), in other words, drawing on concepts from both the rhizomatic and prosaic codes.

These research projects and reports, completed by students individually under the supervision of a university teacher, mirror the ‘facing-both-ways’ phenomenon (Barnett 2006, 153), which has three important implications for professionally oriented higher education curricula.

- Sustainable agriculture draws on different disciplines, namely agriculture science and sustainability science, which can be subdivided into different fields of study or focal areas. These disciplines bring to mind different knowledge structures: agriculture science as ‘hard’ science predominantly resembles a hierarchical knowledge structure, whereas sustainability science as ‘soft’ science resembles a horizontal knowledge structure (Bernstein, 2000).

- These research projects and reports involve a double recontextualisation process by firstly involving the translation of disciplinary knowledge into curriculum, defined by Barnett (2006, 145) as “pedagogic recontextualisation”, and secondly, it also requires that disciplinary knowledge be translated to solve particular work-based problems.

- The existing curriculum of the chosen programme is also explicit about forming a particular kind of knower. According to the purpose statement of this programme, it aims to train “researchers in understanding and working within sustainable agriculture” by adopting “a systems approach to agriculture as a point of departure” (SU 2021, 86). This ‘facing-both-ways’ phenomenon of being a “subject expert” (Winch 2010, 1) with a reservoir of scientific knowledge rooted in agriculture science whilst also applying sustainability science in problem-solving activities within different contexts causes tension in the curriculum and a blurred conception of agency.

The curriculum data analysis revealed several contradictions within the activity system, as depicted below in Figure 6. The dotted line in Figure 6 indicates the lack of coherence among clusters of the different elements of the existing curriculum. These clusters consist of the different modules and their subject content. Three ‘fault’ lines, as depicted in Figure 6, are evident, namely:

- Polarised perspectives regarding conventional versus sustainable agriculture manifest among the three key elements, namely the pillars of sustainability, systems thinking, and biophysical farm environment, which influence the modules linked to these elements.

- There is a lack of coherence between the work-integrated learning component and the research project.

- There is a lack of coherence between the analytical tools, methods, and applications used to equip students for research projects and their practical application in students’ projects.

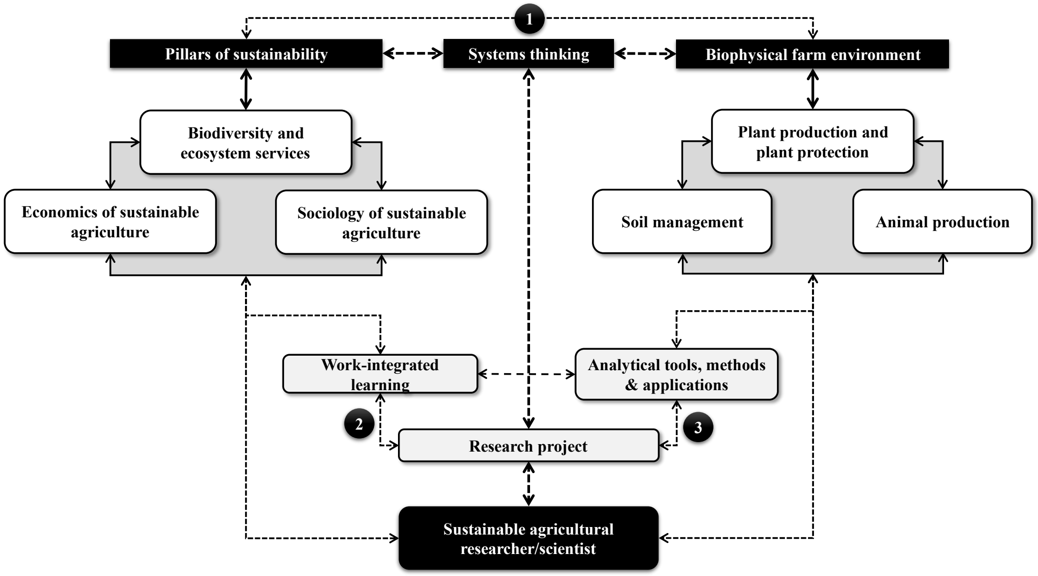

Figure 6: Tensions in the existing curriculum of the activity system under investigation

Three major contradictions within the activity system of the chosen programme have emerged from the core elements of the activity system, as described in Table 6.

Table 6: Contradictions within the Activity System of this Curriculum Inquiry

Element of the activity system	Key findings
Rules **Community** **Mediating artefact**	The first major contradiction indicated that the boundaries defining green occupations are blurry, confusing and underdeveloped in S.A., with curriculum implications regarding academic and career pathways for graduates. Additionally, the indistinctiveness of professional expertise associated with the role and responsibilities of agricultural scientists and consultants poses a significant curriculum challenge for higher education institutions.
Rules **Community** **Subject** **Object** **Mediating artefact**	The second major contradiction, related to the first contradiction, revealed polarised perspectives. On the one hand, the conventional agriculture paradigm, with its roots in scientific knowledge of agriculture science and on the other hand, the alternative agricultural paradigm, with its roots in sustainability science, have turned the existing curriculum into a contested space. Additionally, the organising principles that underpin the different knowledge structures of 'hard' versus 'soft' sciences amplify these tensions.
Subject **Object**	The third major contradiction, related to the second contradiction, emerges from the tensions in the curriculum as a contested space which plays out in terms of curriculum incoherence, poor programme

Element of the activity system	Key findings
Mediating artefacts **Outcomes**	coordination among those involved in the programme, inadequate inter-professional relations among university teachers and students' unsatisfactory learning experiences. These constraints scupper the rich potential inherent in this interdisciplinary programme to address complex agroecological and sustainable development problems relevant to our times.

Conclusion

Compared to curriculum inquiry approaches based on a logic model, second-generation Activity Theory provides a holistic perspective to uncover complex relations and interactions within the curriculum and its context. AT recognises that curriculum decision-making involves contradictions, conflicts and tensions, allowing for a deeper understanding of the complexities and challenges within the curriculum, which could result in improvement. Examining the activity system in which the curriculum is situated allows for deeper insight into the roles and relationships of the various stakeholders and roleplayers, the tools and technologies used, and the underlying cultural and societal influences. AT also encourages researchers to consider the underlying theories, assumptions, and historical, cultural and societal influences that have shaped the curriculum. By understanding the dynamics of the activity system, curriculum inquiry can identify areas of enhancement, address challenges and conflicts, and propose changes that could result in an improved outcome. Overall, AT offers a comprehensive framework for curriculum inquiry, allowing those involved to delve into the complexities of reviewing, re-designing and renewing an existing programme in higher education aimed at quality improvement.

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