Exploring Legitimation Practices in Nursing Education Curriculum: A Specialisation Code Analysis of Knowledge and Dispositions in a South African University of Technology

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Purpose:
This study explores the integration of numeracy within higher education curricula, focusing on how academic staff across faculties at a South African University of Technology conceptualise, plan for, and embed numeracy in their teaching practices. It examines this process within the broader context of curriculum transformation and widening access for diverse student populations.

Methodology:
A qualitative case study approach was adopted, drawing on Legitimation Code Theory (LCT) as the primary analytical framework. Data were collected through interviews with academic staff, analysis of curriculum documents, and planning artefacts. The study aimed to uncover both conceptual and practical dimensions of numeracy integration across disciplines.

Findings:
The analysis revealed varying levels of awareness, conceptual clarity, and pedagogical strategies among lecturers regarding numeracy integration. Key challenges included disciplinary silos, lack of shared understanding, and limited institutional support. However, the study also identified promising practices such as interdisciplinary collaboration and reflective curriculum design, which offer viable pathways for embedding numeracy meaningfully.

Originality/Value:
This study contributes to the discourse on curriculum transformation and academic literacy by proposing a framework for enhancing numeracy through deliberate curriculum planning, cross-faculty dialogue, and professional development. Its insights are particularly relevant for institutions seeking to promote equity, epistemological access, and quantitative reasoning in diverse learning environments.

Introduction

In the context of South African higher education, the integration of numeracy into disciplinary curricula has become increasingly important, particularly as institutions grapple with curriculum transformation and the imperative to widen access. Numeracy, broadly defined as the ability to apply mathematical understanding in real-world contexts, is a foundational

academic literacy that supports student success across disciplines. In professional fields such as nursing, numeracy is not only essential for clinical competence but also for developing critical thinking and decision-making skills. Blended learning—an educational approach that combines face-to-face instruction with online components—has further complicated the landscape of curriculum delivery, requiring educators to rethink how core literacies like numeracy are embedded in diverse learning environments.

Despite its significance, the integration of numeracy remains uneven across faculties and programmes. Academic staff often face challenges in conceptualising and embedding numeracy within their teaching practices, particularly in institutions serving diverse and underprepared student populations. These challenges are compounded by students' under preparedness in foundational numeracy and language, shaped by systemic inequalities in the schooling system (Boughey & McKenna, 2016). Moreover, disciplinary silos and a lack of shared understanding about what constitutes numeracy in different fields hinder collaborative curriculum planning. While some promising practices have emerged—such as interdisciplinary collaboration and reflective curriculum design—there is limited research on how academics themselves understand and enact numeracy integration. This study addresses that gap by investigating how academic staff at a South African University of Technology conceptualise, plan for, and embed numeracy in their curricula. Drawing on Legitimation Code Theory (LCT), the study aims to illuminate the epistemological and social dimensions of curriculum design and offer insights into how numeracy can be meaningfully integrated across disciplines. Based on the study's focus and methodology, this study have three key research questions that guided the investigation:

1. How do academic staff at a South African University of Technology conceptualise numeracy within their disciplinary teaching practices?
2. What strategies and challenges do lecturers encounter when planning for and embedding numeracy in the curriculum?
3. How can Legitimation Code Theory (LCT) be used to analyse and understand the legitimation practices surrounding numeracy integration in higher education?

Literature Review

Numeracy has emerged as a crucial dimension of academic literacy in higher education, particularly in the context of universities of technology where mathematical proficiency underpins many disciplinary practices. Broadly defined as the ability to reason and to apply simple numerical concepts, numeracy enables students to navigate and make sense of quantitative data within and beyond the classroom. According to Geiger, Goos, and Forgasz (2015), numeracy must be viewed as more than just mathematical ability; it is a situated social practice that varies by discipline and context. In the South African higher education sector, numeracy is increasingly recognised as a gatekeeping competency that can either support or hinder student success, especially among first-generation and historically disadvantaged students. Frith and Prince (2006) contend that universities often assume students enter with adequate numeracy skills, yet the reality is that many lack the foundational competencies necessary to cope with disciplinary numeracy demands. This disparity is exacerbated by school-

level inequalities, where under-resourced schools frequently fail to prepare learners for the academic rigour of tertiary studies.

The introduction of academic literacies approaches has shifted focus from viewing student challenges as deficits to seeing them as systemic. As Lea and Street (2006) argue, a social practices approach to academic literacy—including numeracy—acknowledges the complexity of meaning-making in academic settings and calls for pedagogy that makes these practices visible. Embedding numeracy within the curriculum rather than treating it as a standalone skill has therefore become a key area of interest. Curriculum development and planning processes that incorporate numeracy are central to addressing these challenges. Wingate (2006) advocates for an integrated model of academic literacies where support for skills like numeracy is embedded into disciplinary teaching rather than outsourced to ancillary support programmes. This shift demands collaborative planning between lecturers, academic developers, and institutional policymakers.

Institutional responsiveness is vital to the success of such models. As illustrated by Boughey and McKenna (2016), universities must critically reflect on how teaching practices and curriculum design either enable or constrain student access to disciplinary knowledge, including numeracy. Planning for numeracy should thus be conceptualised as a deliberate institutional practice, responsive to both student needs and disciplinary requirements. However, integration efforts face significant barriers. Challenges include a lack of shared understanding among staff of what constitutes numeracy in specific disciplines, insufficient professional development opportunities, and rigid curriculum structures that hinder innovation. Archer and Parker (2016) highlight the resistance some academic departments exhibit toward embedding academic literacies, often due to entrenched disciplinary norms and perceived threats to academic autonomy.

Despite these challenges, emerging practices suggest that curriculum-integrated approaches can improve student engagement and learning outcomes. For instance, Frith and Lloyd (2016) demonstrate that contextually embedded numeracy activities in science modules led to improved conceptual understanding and confidence among students. Similarly, Prinsloo et al. (2015) report positive outcomes in health sciences programmes that adopted an integrated approach to numeracy instruction. Within universities of technology, the need for responsive numeracy planning is even more pronounced due to the applied nature of many programmes. Engineering, health sciences, and business fields require students to engage meaningfully with data, measurements, and statistical reasoning. As noted by Madiba (2012), failing to integrate numeracy into such programmes risks widening the gap between graduate attributes and industry expectations.

The role of policy in supporting these efforts is also significant. National frameworks such as the White Paper for Post-School Education and Training (DHET, 2013) and the Higher Education Qualifications Sub-Framework (CHE, 2013) emphasise the development of graduate capabilities, including critical thinking and quantitative reasoning. Institutional alignment with these frameworks should translate into strategic planning for numeracy development. Finally, student voices must inform numeracy planning. Research by Clarence (2016) shows that students often perceive numeracy demands as opaque and intimidating. Transparent pedagogical strategies that demystify expectations, coupled with formative assessment and

feedback, can create more inclusive learning environments. Incorporating student feedback into curriculum review processes may enhance the responsiveness and relevance of numeracy interventions.

The role of institutional culture and leadership is also critical in driving change. As previous studies suggest, leadership commitment to epistemological access and inclusivity is vital in embedding academic literacies within the curriculum (McKenna & Boughey, 2014). This includes supporting staff development initiatives that enhance educators' capacity to teach numeracy in meaningful, contextualised ways. At the same time, student voices must be central to these processes, as they provide insights into the lived experience of numeracy learning and can inform more responsive pedagogical designs.

Theoretical Framework

This study is underpinned by two complementary theoretical lenses: Legitimation Code Theory (LCT) and the Academic Literacies framework. Together, they provide a robust foundation for analysing how numeracy is conceptualised, embedded, and legitimised within higher education curricula, particularly in the context of universities of technology. LCT, developed by Maton (2014), offers a set of tools to understand how knowledge is structured and valued across disciplines. One of its key contributions is the concept of "semantic gravity," which refers to how closely knowledge is tied to context. For example, calculating medication dosages in a nursing module has strong semantic gravity because it is highly contextual and practical. In contrast, abstract algebraic formulas in a mathematics course have weaker semantic gravity, as they are more removed from everyday application.

Another important LCT concept is "semantic density," which refers to how much meaning is condensed into a term or concept. A graph showing patient recovery trends, for instance, may carry high semantic density because it encapsulates multiple layers of data, interpretation, and clinical implications. These concepts help educators evaluate how abstract or context-bound their teaching is, and how students might struggle or succeed depending on the balance between the two (Maton, 2014). LCT also introduces "specialisation codes," which distinguish between two types of relations: epistemic relations (focused on knowledge) and social relations (focused on the attributes of the knower). In numeracy education, epistemic relations might involve mastering statistical techniques, while social relations could involve demonstrating confidence, ethical reasoning, or professional judgement in applying those techniques. Clarence (2020) notes that students' success often depends not only on what they know, but on how well they align with the values and expectations of their discipline.

For example, in a nursing programme, a student may be expected to interpret blood pressure readings (epistemic) while also demonstrating care and responsibility in clinical decision-making (social). LCT helps us see how both dimensions are necessary for students to be recognised as legitimate participants in their field. This dual focus is particularly relevant in applied disciplines, where technical knowledge and professional identity are closely intertwined. Complementing LCT, the Academic Literacies framework (Lea & Street, 1998; 2006) views literacy—including numeracy—as a set of socially situated practices. It challenges the idea that numeracy is a neutral, transferable skill and instead emphasises that it is shaped by context, audience, and purpose. For instance, a business student analysing financial data and

a health sciences student interpreting patient charts are both using numeracy, but in ways that are deeply embedded in their disciplinary cultures.

This framework also highlights the role of power and identity in shaping students' access to legitimate knowledge. Lillis and Scott (2007) argue that what counts as "academic" or "valid" knowledge is often implicitly defined by dominant groups within the academy. In numeracy education, this can mean that students from under-resourced schools or non-traditional backgrounds may struggle not because they lack ability, but because they are unfamiliar with the hidden rules of academic discourse. The concept of "curriculum responsiveness" (Wheelahan, 2007) further enriches this framework by calling for alignment between the demands of knowledge, the needs of students, and the context of practice. In planning for numeracy, this means designing learning opportunities that are relevant to students' future careers while also supporting their current capabilities. For example, using real-world case studies in health sciences or financial modelling in business can make numeracy more meaningful and accessible.

Together, LCT and Academic Literacies offer a powerful lens for analysing how numeracy is embedded in curriculum planning. LCT helps map the knowledge structures and legitimation practices that shape what is taught and valued, while Academic Literacies foregrounds the student experience and the socio-cultural dynamics of learning. This dual approach allows for a more holistic understanding of the challenges and opportunities in embedding numeracy in higher education. Ultimately, this theoretical framework supports the study's aim to explore how planning for numeracy can become more inclusive, context-sensitive, and epistemologically rich. It not only guides the analysis of curriculum documents and staff interviews but also contributes to broader debates on curriculum transformation, equity, and academic development in South African higher education.

Methodology

The study adopts a qualitative case study approach and draws on documentary analysis and staff interviews to understand how numeracy support is designed, implemented, and experienced. This enables a grounded and context-rich account of the institutional logics and pedagogical considerations that shape numeracy planning in higher education. This study employed a qualitative case study design to explore how numeracy is planned for within the curriculum at a South African university of technology. Case study methodology was selected for its strength in capturing complex phenomena within their real-life contexts (Yin, 2009). The aim was to interrogate both the explicit and implicit discourses surrounding numeracy planning, curriculum intent, and pedagogic decision-making within a specific institutional context. LCT offers tools for analysing the organising principles of knowledge practices, and it was used here to interrogate the underlying values and codes shaping numeracy in curriculum planning. This lens was instrumental in understanding how numeracy is valued and communicated through course materials and planning documents.

The study involved a total of 12 academic staff members, purposively sampled from four faculties—Engineering, Health Sciences, Business, and Social Sciences—where numeracy plays a significant role in curriculum delivery. Data collection included semi-structured interviews and eight curriculum documents, such as module guides and assessment plans. The

coding process followed Braun and Clarke's (2006) six-phase thematic analysis, beginning with familiarisation and initial coding, followed by theme development and refinement. Codes were generated inductively from the data and then mapped onto categories from Legitimation Code Theory (LCT), particularly the dimensions of Specialisation and Semantics (Maton, 2014). For instance, themes related to disciplinary norms and curriculum intent were linked to epistemic relations, while educator beliefs and pedagogical choices were aligned with social relations (Clarence, 2020).

To ensure ethical integrity, anonymity was maintained by assigning pseudonyms to participants and removing identifiable information from transcripts. Quotes were reported using generic identifiers (e.g., Participant A, Faculty X), in line with Lincoln and Guba's (1985) principles of trustworthiness and confirmability. These safeguards ensured that the voices of participants were preserved without compromising confidentiality, a critical consideration in qualitative research within institutional contexts. Data were generated through a combination of semi-structured interviews and document analysis. The primary participants were academics responsible for curriculum design and delivery in numeracy-related courses across different departments. These participants were selected using purposive sampling, ensuring representation from faculties where numeracy is a significant component of the curriculum. This strategy aligns with the recommendations of Cohen, Manion, and Morrison (2011) on purposive sampling in qualitative education research.

Interviews focused on participants' conceptualisations of numeracy, how numeracy is planned and enacted in their modules, and their perspectives on students' numeracy preparedness. Interviews were conducted face-to-face or online, recorded with consent, and transcribed verbatim for analysis. To ensure the credibility and trustworthiness of findings, member checking was undertaken whereby participants reviewed transcripts for accuracy and offered clarifications where needed (Lincoln & Guba, 1985). In addition to interviews, curriculum planning documents, module guides, and assessment tasks were analysed to identify how numeracy is embedded, framed, and communicated within formal curricular structures. The analysis sought to uncover the extent to which numeracy was made visible and whether its value was underpinned by particular disciplinary or generic assumptions.

Data analysis was conducted using the LCT dimensions of Specialisation and Semantics. Specialisation analysis examined the basis on which numeracy was legitimated—whether through knowledge-based (epistemic relations) or knower-based (social relations) attributes. Semantic analysis considered the strength of meaning condensation or abstraction in planning documents and pedagogic discourse. The coding process followed an iterative approach, moving between data and theory, and was assisted by qualitative analysis software (e.g., Atlas.ti). Triangulation of data sources—interviews, documents, and theoretical coding—enhanced the robustness of findings. This methodological rigour allowed the researcher to draw credible inferences about how numeracy is constructed and valued across different courses and departments. Peer debriefing sessions were also used to reflect critically on the interpretations and coding choices.

Ethical clearance for the study was obtained from the relevant institutional research ethics committee. All participants were provided with information sheets and gave informed consent prior to participation. Confidentiality was maintained through the anonymisation of data, and

all identifiable information was removed from transcripts and documents. Hence, the methodological approach adopted in this study allowed for a rich and nuanced account of numeracy planning in higher education. The use of LCT provided a powerful analytical framework to expose the often-hidden codes shaping how numeracy is planned, legitimated, and made pedagogically visible. This approach has significant implications for curriculum development, particularly in universities of technology where numeracy intersects with both academic literacy and disciplinary knowledge.

Results

The findings from this case study reveal both enabling practices and systemic constraints, highlighting the complex dynamics between institutional planning, curriculum design, and student learning. This section presents the findings of the study, thematically organised to reflect the key dimensions influencing the integration of numeracy in higher education. Drawing on qualitative insights from academic staff at a South African university of technology, the results reveal a complex and often fragmented landscape shaped by disciplinary conceptions, pedagogical practices, institutional structures, and policy frameworks. Thematic analysis of the data yielded five core themes: Conceptions of Numeracy Among Academic Staff, Curriculum Planning Practices and Numeracy Integration, Pedagogical Approaches to Numeracy, Institutional Challenges in Embedding Numeracy, and Policy and Support Structures for Numeracy Development. These themes highlight the multi-layered nature of numeracy development and underscore the urgent need for coherent strategies that bridge theory and practice across the curriculum:

5.1 Conceptions of Numeracy Among Academic Staff

The academic staff's conceptualisation of numeracy revealed significant variation across disciplines, underscoring both the multifaceted nature of numeracy and the challenges of embedding it meaningfully within curricula. Consistent with LCT's notion of semantic gravity, participants oscillated between context-specific understandings of numeracy and more abstract, discipline-transcendent definitions. For example, one lecturer in the sciences remarked: *"For us, numeracy is problem-solving — equations, measurements, and models. It's what allows students to engage meaningfully with experiments."* By contrast, a colleague in the social sciences explained: *"Numeracy, to me, is being able to interpret statistics and use evidence to back an argument. It's not just numbers, but how numbers shape narratives."* These contrasting accounts highlight how epistemic relations to knowledge differ across fields, reflecting discipline-specific demands (Maton, 2014).

Several participants admitted to ambiguity in their own conceptualisations of numeracy. A humanities lecturer noted: *"I sometimes struggle to see where numeracy fits in my teaching. It feels more natural to focus on writing and critical thinking than on numbers."* Such uncertainty resonates with Clarence and McKenna's (2017) observation that academics outside STEM fields often perceive numeracy as peripheral to their disciplinary practices. This weak semantic density—where meanings of numeracy are diffuse and underdeveloped—limits academics' ability to explicitly integrate numeracy into their pedagogical approaches. Participants also expressed concern that numeracy was often undervalued compared to literacy within institutional frameworks. One academic reflected: *"When we draft module outcomes, literacy*

always takes centre stage. Numeracy is there, but more as an afterthought, rarely assessed properly." This perception aligns with international findings where literacy dominates policy discourses, leaving numeracy underrepresented (Stevenson, 2017). The privileging of literacy undermines numeracy's epistemic significance, contributing to its marginalisation in curricula.

Despite these challenges, some staff articulated broader and more holistic views of numeracy, aligning it with critical citizenship. A lecturer explained: *"Numeracy is about understanding the world. Whether you're reading inflation rates or election results, you need numbers to make sense of society."* This echoes Goos et al. (2014), who argue for numeracy as a critical life skill embedded in everyday reasoning. Such perspectives demonstrate strong epistemic relations, where knowledge practices are linked to broader social and civic purposes, moving beyond narrow technical competencies. Finally, the diversity of conceptions underscores the need for institutional dialogue and shared frameworks. As one participant concluded: *"Everyone seems to have their own idea of numeracy. Until we agree on what it means, we'll all just keep doing our own thing."* This lack of coherence reflects weak social relations, as there is little collective authority shaping how numeracy is understood institutionally. Literature similarly calls for universities to develop cross-disciplinary benchmarks and professional learning communities to establish shared understandings of numeracy (Clarence, 2019; Boughey & McKenna, 2021).

In sum, academic staff demonstrated varied and often fragmented conceptions of numeracy, shaped by disciplinary traditions and institutional priorities. While some held expansive views linking numeracy to critical thinking and civic participation, others saw it as peripheral or ill-defined. Using LCT, these findings reveal a tension between strong semantic gravity (discipline-bound, context-specific conceptions) and weak semantic gravity (abstract, transferable notions), underscoring the complexity of developing a unified institutional approach to numeracy.

5.2 Curriculum Planning Practices and Numeracy Integration

Curriculum planning practices around numeracy revealed uneven and, at times, fragmented approaches across faculties. While some departments attempted explicit integration through learning outcomes and assessment strategies, others relied on implicit assumptions that students would "pick up" numeracy along the way. This aligns with LCT's distinction between epistemic relations (knowledge-focused practices) and social relations (authority and identity), showing that some disciplines strongly codified numeracy as a valued knowledge practice, while others treated it as peripheral (Maton, 2014). As one lecturer put it: *"In my department, numeracy is written into the outcomes. Students must show they can analyse data, not just describe it."* By contrast, another admitted: *"We don't state it explicitly; we just expect students to use numbers when needed. It's almost taken for granted."*

Intentional integration was often driven by individuals rather than institutional directives. For example, one participant noted: *"I design assignments with Excel graphs and statistical interpretation, but that's just me. There's no department-wide framework."* This points to weak institutional social relations, where authority structures fail to mandate or support numeracy across curricula. Literature confirms this pattern: Clarence (2019) and Boughey & McKenna (2021) highlight how the burden of numeracy integration frequently falls on individual

lecturers, producing inconsistent student experiences. Barriers such as curriculum overload and time constraints were also consistently reported. One academic explained: *"The syllabus is already jam-packed. There's simply no space to add explicit numeracy lessons."* Another argued: *"Students should come with these skills from school. Why should we be filling gaps left by the secondary system?"* These sentiments reflect strong semantic gravity, with knowledge seen as bound to prior contexts, and reveal systemic assumptions that absolve higher education from addressing foundational skills. Yet, as Black & Yasukawa (2014) caution, neglecting numeracy at tertiary level reinforces inequities, particularly for students from under-resourced schooling backgrounds.

The absence of institutional guidelines further compounded the problem. A lecturer admitted: *"We don't have a university policy telling us how to handle numeracy, so it's left to interpretation. That's why it looks different everywhere."* This institutional silence leads to what Clarence & Dison (2017) term "pedagogical invisibility," where crucial competencies remain unarticulated and unevenly supported. From an LCT perspective, this represents weak semantic density, as the meaning of numeracy remains diffuse and poorly codified across departments. Despite these challenges, some staff recognised the potential of systematic integration. As one participant concluded: *"If we had cross-disciplinary benchmarks, numeracy could be threaded consistently through all programmes, not just left to chance."* This aligns with Hordern's (2014) call for curriculum planning to make visible the knowledge–practice relations of disciplinary numeracy, ensuring that students encounter consistent expectations across contexts. Stronger epistemic–social alignment could thus transform numeracy from an incidental skill into a deliberate graduate attribute.

Hence, curriculum planning practices around numeracy were marked by inconsistencies, often driven by individual efforts rather than systemic design. Staff accounts illustrated barriers of curriculum overload, assumptions about prior knowledge, and lack of institutional guidance. Using LCT, these findings reveal tensions between strong semantic gravity (discipline-specific, assumed knowledge) and weak semantic density (unclear, underdeveloped definitions). Addressing these requires universities to adopt coordinated planning frameworks that establish numeracy as a core graduate competence rather than a hidden or optional element.

5.3 Pedagogical Approaches to Numeracy

Academic staff reported employing a wide range of pedagogical strategies to support students' numeracy development, though these approaches varied significantly across disciplines and levels of expertise. A recurrent theme was the shift from abstract, decontextualised mathematics to applied numeracy that situates concepts within disciplinary and real-world contexts. This aligns with LCT's notion of semantic gravity, where lecturers strengthened meaning by linking abstract principles to tangible examples. As one lecturer explained: *"When I use examples from our field, like population data in sociology, students suddenly see the relevance of numbers, rather than fearing them."* Lecturers also highlighted the importance of multimodal strategies that engaged diverse learners. These included visual aids, simulations, and digital platforms such as Excel or SPSS. A participant noted: *"Students grasp graphs better when we use real-time software; it moves beyond chalk-and-talk and makes numbers come alive."* Another

observed: *"Some of my students struggle with equations, but when I use charts and case data, their confidence grows."* Such practices reflect an effort to balance semantic density by condensing complex quantitative concepts into accessible, practice-based forms (Maton, 2014).

Despite these innovations, challenges remained. Several academics admitted lacking specialised training in numeracy pedagogy, particularly those outside STEM disciplines. One confessed: *"I was never taught how to teach numbers; I just use what I know. Sometimes I oversimplify, sometimes I overwhelm them."* This unevenness echoes Boughey and McKenna's (2021) finding that many lecturers are disciplinary experts but not necessarily skilled in teaching foundational literacies like numeracy. Consequently, their strategies often lacked coherence, limiting students' ability to transfer skills across contexts. Formative assessment was frequently identified as a key mechanism for fostering numeracy. Lecturers emphasised that feedback on tasks involving quantitative reasoning enabled students to gradually build competence. As one participant reflected: *"When I give them feedback on statistical assignments, I see their progression. But honestly, I don't always have the time to give detailed feedback to everyone."* Another added: *"Continuous feedback helps, but class sizes and workload make it nearly impossible."* This demonstrates a tension between pedagogical ideals and structural constraints, where weak institutional social relations hinder the sustainability of effective practices (Clarence, 2019).

Importantly, some lecturers experimented with collaborative and problem-based learning approaches, which promoted peer-to-peer support in numeracy tasks. One participant explained: *"When I put them in groups to analyse a dataset, the weaker students gain confidence from stronger ones."* This resonates with Vygotsky's (1978) concept of the zone of proximal development, showing that social interaction supports numeracy acquisition. Within LCT, such practices also highlight the interplay between epistemic relations (numerical knowledge) and social relations (peer collaboration), suggesting that meaningful numeracy pedagogy requires both. Thus, while educators experimented with applied, multimodal, and collaborative methods to teach numeracy, gaps in training, workload pressures, and lack of systemic support limited consistency and impact. Using LCT, these findings illustrate how pedagogical approaches oscillated between strengthening semantic gravity (making numeracy contextually meaningful) and weakening it (retreating to over-generalised or assumed knowledge). To move forward, professional development must support lecturers—particularly in non-STEM fields—in designing pedagogy that balances abstraction with accessibility, and individual feedback with collaborative, scalable learning opportunities.

5.4 Institutional Challenges in Embedding Numeracy

Embedding numeracy institutionally emerged as a profound challenge, constrained by structural, cultural, and resource-related barriers. A key issue raised by participants was the absence of a clear institutional definition of numeracy, which created confusion and inconsistency across departments. One lecturer remarked: *"If you asked ten colleagues here to define numeracy, you'd get ten different answers, and that makes it hard to know how we should teach it."* This definitional ambiguity resonates with Boughey and McKenna's (2021) argument that universities often lack shared discourses around foundational literacies, undermining

coherent curriculum planning. Within LCT terms, the weak epistemic relations between departments constrained collective ownership of numeracy, reducing its institutional visibility.

Resource and funding constraints further hampered efforts to embed numeracy. Several staff indicated that numeracy support centres, technologies, and training were either underfunded or entirely absent. As one academic noted: *"We don't even have a proper numeracy support unit; students who struggle have nowhere to go."* Another explained: *"There's no budget for software or training; everything depends on individual goodwill."* These testimonies underscore the broader challenge of inequality in South African higher education, where historically disadvantaged institutions face systemic underfunding (Council on Higher Education, 2021). Weak infrastructural facilitating conditions thus perpetuate fragile support systems for numeracy, echoing Clarence's (2019) findings on resource gaps in academic literacies provision. Institutional culture also played a role in inhibiting numeracy integration. Many lecturers perceived numeracy as the responsibility of mathematics departments or academic support units rather than an embedded responsibility across the curriculum. One participant admitted: *"Most of us in humanities think numeracy is someone else's job—it belongs to maths, not us."* This reflects what Maton (2014) describes as weak social relations, where responsibility for knowledge practices is deflected, leading to siloed accountability. Such a culture stymies cross-disciplinary collaboration, limiting opportunities to normalise numeracy as a shared graduate attribute.

Bureaucratic inertia and rigid programme structures compounded these difficulties. Efforts to embed numeracy were often undermined by slow institutional processes and lack of leadership commitment. As one lecturer expressed: *"Even if we propose changes, they take years to get approved, and by then momentum is lost."* Another added: *"Management talks about graduate attributes, but there is no follow-through; it stays in policy documents."* These findings align with international studies that highlight institutional inertia as a key barrier to curricular reform (Leibowitz & Bozalek, 2016). Within LCT, this reflects a failure to strengthen both semantic density (formalising complex definitions into policy) and social relations (institutionalising collective responsibility). Finally, participants highlighted that even where individual champions advocated for numeracy, their efforts were not sustained. As one lecturer put it: *"There are a few passionate people pushing numeracy, but when they leave, the initiatives die out."* This over-reliance on individual agency rather than institutional systems creates fragility and inequity in student support. It mirrors what Clarence and Dison (2017) identify as the "projectisation" of literacies work, where innovations remain temporary and peripheral. Without formal embedding, numeracy risks being marginalised, leaving students' access to epistemic participation dependent on chance encounters with supportive lecturers.

Hence, institutional challenges in embedding numeracy stemmed from definitional ambiguities, inadequate resources, cultural silos, bureaucratic inertia, and over-reliance on individuals. Using LCT, these findings highlight how weak epistemic and social relations constrain systemic reform, preventing the movement of numeracy from a peripheral add-on to a core graduate competence. Addressing these barriers requires leadership-driven policies that formalise definitions, allocate resources, and institutionalise collaboration, ensuring that numeracy development is embedded across the curriculum rather than relegated to fragmented initiatives.

5.5 Policy and Support Structures for Numeracy Development

The findings revealed that policy guidance on numeracy development was limited, inconsistent, and often too vague to translate into meaningful practice. While some institutions articulated graduate attributes that implicitly included numeracy, these were rarely operationalised in teaching and learning frameworks. One participant reflected: *"The policy documents mention numeracy, but there's no real explanation of what it means for us in the classroom."* This lack of semantic density — where broad policy claims are not concretised into actionable strategies — undermines institutional coherence (Maton, 2014). It also reflects what Boughey and McKenna (2021) describe as "empty signifiers," where terms like numeracy circulate without clear pedagogical substance.

Support structures such as academic development centres provided some scaffolding, but their contributions were uneven and not always aligned with disciplinary needs. As one lecturer explained: *"We get workshops on general teaching, but nothing specific to numeracy—it feels like a gap."* Another echoed this sentiment: *"If the support units ran discipline-based numeracy programmes, I'd feel more confident embedding it in my course."* These findings align with Clarence's (2019) observations that generic academic support often fails to engage with epistemic relations within specific disciplines. Stronger disciplinary alignment would allow institutions to balance social relations (shared responsibility across departments) with epistemic relations (attention to the unique demands of different fields). Participants also expressed concerns about the absence of dedicated resourcing for numeracy initiatives. One commented: *"Numeracy is never given a budget line—it always feels like an add-on, not a priority."* Another emphasised: *"If we had proper funding, we could develop resources and staff training, but without it, numeracy stays marginalised."* These insights confirm what international studies have shown: without sustained investment, numeracy support remains peripheral and reliant on temporary projects (Leibowitz & Bozalek, 2016; Clarence & Dison, 2017).

Despite these challenges, staff highlighted examples where collaboration between departments, support units, and leadership teams had yielded positive outcomes. As one lecturer noted: *"When our department worked with the teaching and learning centre, we developed a numeracy module that students actually found useful."* Another added: *"Partnerships across faculties made it easier to share strategies and avoid duplication."* These examples reflect the potential of strong social relations to build collective capacity, thereby institutionalising practices that might otherwise remain fragmented. In summary, the lack of clear policy guidance, weak resourcing, and inconsistent support structures contribute to the marginalisation of numeracy in higher education. However, where collaborative networks were established, institutions were able to strengthen both epistemic and social relations, creating more sustainable frameworks for numeracy development. To move forward, universities must embed numeracy explicitly in teaching and learning strategies, allocate dedicated resources, and foster interdepartmental collaboration. Only then can numeracy shift from being an overlooked attribute to a central graduate competence that ensures equitable epistemic access for all students.

Discussion

This study highlights the uneven and often fragmented ways in which numeracy is conceptualised and embedded within higher education curricula. One of the central tensions lies in how staff position numeracy: while some lecturers frame it as central to disciplinary and

professional practice, others perceive it as peripheral or subordinate to literacy. These divergent views matter because they influence whether numeracy is explicitly integrated into curriculum design and assessment or left to implicit assumptions. Such contradictions align with international scholarship showing that the visibility of numeracy varies across contexts, often shaped by disciplinary traditions and institutional cultures (Geiger, Forgasz, & Goos, 2015; Goos, Geiger, & Dole, 2012). Where numeracy is seen as marginal, students are denied equitable epistemic access, reinforcing inequalities already prevalent in South African higher education (Boughey & McKenna, 2016).

The findings also revealed contradictions between policy rhetoric and lived classroom practices. While institutional documents sometimes reference graduate attributes that implicitly include numeracy, the absence of concrete operationalisation leads to weak semantic density (Maton, 2014). This gap mirrors global patterns where policies frequently articulate numeracy as a desired competence but provide little guidance on disciplinary enactment (Galligan & Hobohm, 2015). In the South African case, such disjuncture are exacerbated by resource constraints, large class sizes, and student under preparedness (Padayachee, Matimolane, & Ganas, 2018). Thus, despite the acknowledgement of numeracy's importance, systemic and institutional barriers hinder its coherent integration. Pedagogical approaches presented another site of tension. Some staff embraced applied, multimodal, and collaborative strategies to contextualise numeracy, strengthening semantic gravity and making concepts accessible. Others, however, lacked training in numeracy pedagogy and either oversimplified or overcomplicated content. This reflects findings internationally that academics outside STEM fields often struggle with numeracy pedagogy, leading to uneven student experiences (Frith & Lloyd, 2016; Clarence & McKenna, 2017). The contradiction highlights the importance of professional development that not only equips staff with technical knowledge but also supports them in balancing epistemic relations (numerical competence) with social relations (confidence, disciplinary identity).

At the institutional level, the study showed how siloed practices, bureaucratic inertia, and reliance on individual champions prevented sustainable embedding of numeracy. This reflects what Clarence and Dison (2017) describe as the "projectisation" of academic literacies, where initiatives remain temporary and peripheral rather than systemic. Internationally, similar challenges are evident in contexts where academic literacies are treated as add-ons rather than embedded competences (Wingate, 2006). Addressing these challenges requires leadership-driven policy frameworks that formalise definitions, allocate resources, and institutionalise collaboration across faculties (Leibowitz & Bozalek, 2016). Taken together, the findings underscore that contradictions in staff conceptions, curriculum practices, and policy enactments are not merely descriptive but have profound implications for equity and student success. Students from under-resourced schooling backgrounds are disproportionately disadvantaged when numeracy is assumed rather than taught, reinforcing the "gatekeeping" role of quantitative skills (Frith & Prince, 2006). International evidence supports the claim that integrated, discipline-sensitive numeracy practices are key to improving retention and learning outcomes (Geiger, Goos, & Forgasz, 2015). Therefore, coherent institutional frameworks and targeted staff support are critical for ensuring that numeracy becomes a genuine graduate attribute rather than a hidden curriculum expectation.

Practical Implications

To embed numeracy meaningfully across higher education curricula, institutions must develop explicit, cross-disciplinary policies that define numeracy as a core graduate attribute. These policies should ensure alignment between curriculum outcomes, pedagogy, and assessment, as advocated by Wingate (2006) and reinforced by national frameworks such as the Higher Education Qualifications Sub-Framework (CHE, 2013). Institutional responsiveness is key, requiring leadership commitment to epistemological access and inclusivity (McKenna & Boughey, 2014). This includes allocating resources for specialised workshops, digital tools, and academic development centres tailored to disciplinary needs (Frith & Lloyd, 2016). Without such structural support, numeracy risks remaining marginalised, particularly in non-STEM disciplines where its relevance is often underestimated (Frith & Prince, 2006; Madiba, 2012).

Equally important is the cultivation of cross-faculty dialogue and sustained professional development. Establishing professional learning communities can help address definitional ambiguity and disciplinary silos, enabling staff to build shared understandings of numeracy as a situated social practice (Lea & Street, 2006; Clarence & McKenna, 2017). Staff development initiatives should focus on enhancing pedagogical capacity, especially for educators in non-STEM fields, to support applied and contextualised numeracy teaching (Galligan & Hobohm, 2015). Collaborative leadership must drive these efforts, embedding numeracy within institutional teaching and learning strategies rather than relying on isolated champions or short-term projects (Archer & Parker, 2016). As Clarence (2020) notes, inclusive and responsive pedagogies are essential for demystifying numeracy and fostering student confidence, particularly among those from under-resourced educational backgrounds.

Conclusion

This study makes three key contributions to the discourse on numeracy integration in higher education. First, the findings reveal that academic staff across faculties hold diverse and often fragmented conceptions of numeracy, ranging from basic mathematical skills to more complex, discipline-specific applications. These varied understandings, coupled with inconsistent curriculum planning and limited pedagogical support, hinder the systematic embedding of numeracy across programmes. Institutional challenges such as siloed practices, lack of policy clarity, and uneven resource allocation further exacerbate the problem, underscoring the need for coordinated and intentional strategies.

Second, the study offers a theoretical contribution through its application of Legitimation Code Theory (LCT). By employing LCT's concepts of semantic gravity, semantic density, and specialisation codes, the research provides a nuanced lens for analysing how numeracy is legitimated within different disciplinary contexts. The distinction between epistemic and social relations helped illuminate how knowledge and knower attributes shape pedagogical decisions and student access. This theoretical framing advances understanding of how curriculum design and teaching practices can either enable or constrain epistemological access, particularly in applied fields like nursing and engineering.

Third, the study presents practical and policy implications for institutions seeking to enhance numeracy development. It calls for the reconceptualisation of numeracy as a core graduate

attribute, embedded through interdisciplinary, learner-centred pedagogies. Institutions must invest in staff development, foster cross-faculty collaboration, and align curriculum goals with national policy frameworks such as the Higher Education Qualifications Sub-Framework (CHE, 2013). By addressing systemic barriers and promoting inclusive pedagogical practices, universities can better prepare students for complex workplace demands and contribute to equitable, future-ready education.

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