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Research Article

Beyond the Spiral: Reimagining Curriculum Sequencing for Non-Linear Neurodivergent Cognition

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Abstract

Curriculum sequencing models encode epistemological assumptions about how cognition develops. The spiral curriculum and its constructivist antecedents presuppose stable executive regulation, staged abstraction, and synchronised cohort pacing — conditions that may structurally disadvantage neurodivergent learners whose cognitive architectures diverge from this neurotypical default. This paper argues that such frameworks tend to privilege linear cognitive profiles, and that prevailing sequencing architectures remain insufficiently responsive to the processing diversity documented in learners with ADHD, Autism Spectrum Condition, and dyslexia.

Drawing on the neurodiversity paradigm (Armstrong, 2010; Singer, 1998) and curriculum theory scholarship (Bernstein, 2000; Pinar, 2019; Young, 2008), this paper employs conceptual analysis and interdisciplinary synthesis to critique the structural logic of spiral and linear sequencing frameworks and to propose the Non-Linear Sequencing Architecture (NLSA) — an original theoretical reconstruction comprising networked curriculum nodes, modular progression, competency-clustered mastery, and temporal elasticity. Conceptual analysis here is situated within philosophical curriculum inquiry, drawing on purposive interdisciplinary literature selection guided by theoretical relevance to neurodivergent cognition and curriculum design. The NLSA is a conceptual model, not an empirically validated design; its contribution is architectural. Systemic implications for standards alignment, assessment redesign, and teacher planning are identified.

The central argument positions curriculum inclusion as structural redesign of cognitive architecture — not accommodation appended to existing systems. Cognitively plural curriculum design is proposed as both theoretical principle and policy imperative for education systems serving neurologically diverse student populations.

Keywords

Curriculum sequencing, Neurodiversity, Spiral Curriculum, ADHD, Autism Spectrum, Dyslexia, Cognitively Plural Curriculum, Temporal Elasticity, Constructivism, Pedagogic Discourse

1. Introduction

1.1. The Problem of Cognitive Neutrality in Curriculum Design

Curriculum design has long operated under an assumption that sequencing — the temporal and structural arrangement of learning content — is a neutral organisational decision. This assumption conceals a deeper reality: every sequencing architecture encodes implicit claims about how learners process, abstract, retain, and regulate knowledge. Sequencing is not merely temporal ordering; it is an epistemological claim about how knowledge unfolds and how cognition is presumed to develop (Pinar, 2019; Young, 2008). These claims constitute epistemological commitments embedded in curriculum frameworks as routine design choices, rarely surfaced as the cognitive assumptions they are.

The spiral curriculum, as formulated by Jerome Bruner (1960), represents the most enduring and widely influential sequencing model across Western and post-colonial curriculum traditions (Null, 2011; Sheppard & Wieman, 2020). Its structural logic — revisiting concepts at progressively increasing levels of abstraction across developmental stages — has shaped curriculum design in ways that embed particular cognitive presumptions. The spiral curriculum presupposes a learner who demonstrates stable executive functioning, gradual and predictable abstraction capacity, and cognitive pacing synchronised with age-graded cohort structures (Kirk et al., 2022). It presupposes, in short, a neurotypical cognitive architecture.

This paper contends that neurodivergent learners — those whose cognitive profiles diverge from this normative template — encounter not merely pedagogical mismatch, but structural disadvantage. Learners with ADHD demonstrate significant executive functioning variability, with documented disruptions to working memory, task-switching, and temporal planning (Barkley, 2015; Brown, 2013). Autistic learners frequently demonstrate pattern-driven abstraction that does not follow the concrete-to-abstract sequence assumed by spiral architectures (Grandin, 2022; Murray et al., 2005). Learners with dyslexia exhibit episodic learning patterns that resist cumulative mastery logic (Shaywitz, 2020; Wolf, 2018). It is important to note that considerable within-group variability exists across ADHD, autism, and dyslexia populations; the observations above are structural tendencies, not uniform cognitive profiles. These indicators do not call for accommodation within existing frameworks — they call for theoretical reconstruction of the frameworks themselves. This article employs

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conceptual analysis and interdisciplinary synthesis to reconstruct curriculum sequencing as a design problem.

1.2. Central Thesis

Central Argument: This paper argues that dominant curriculum sequencing architectures — particularly the spiral curriculum — require fundamental theoretical reconstruction to accommodate non-linear neurodivergent cognition. Cognitively plural curriculum design is not accommodation appended to an existing cognitive architecture; it is the redesign of that architecture. The paper proposes the Non-Linear Sequencing Architecture (NLSA) as a theoretically grounded alternative to the spiral model.

1.3. Conceptual Method

This paper employs conceptual analysis situated within philosophical curriculum inquiry, a tradition in which argument proceeds through the clarification, critique, and reconstruction of concepts rather than through empirical measurement. Literature was selected purposively rather than exhaustively, prioritising sources that (a) articulate the structural logic of dominant sequencing models, (b) document cognitive and neurological evidence on ADHD, autism, and dyslexia from established clinical and cognitive psychology sources, and (c) provide curriculum-theoretical vocabulary, principally Bernstein's (2000) concepts of classification and framing, Pinar's (2019) account of curriculum as discursive formation, and Young's (2008) social realist commitment to disciplinary knowledge, capable of connecting the two literatures. The interdisciplinary synthesis proceeds by holding curriculum-theoretical concepts and cognitive-psychological evidence in sustained juxtaposition, using each to interrogate the assumptions of the other, rather than by treating either literature as authoritative on its own. This is consistent with established practice in conceptual and philosophical curriculum scholarship, where argument construction, rather than data collection, constitutes the primary analytical method (Pinar, 2019). The status of all claims advanced in this paper is conceptual rather than empirical: they are offered as theoretical propositions intended to invite reconstruction and future empirical testing, not as findings established through direct investigation.

1.4. Research Questions

This conceptual paper is organised around five interrelated research questions progressing from foundational critique to original model construction and systemic policy implications (see Table 1):

Table 1

Research Questions, Theoretical Function, and Corresponding Sections

Research Question	Theoretical Function	Section
RQ1: How do dominant curriculum sequencing models — particularly the spiral curriculum — embed normative assumptions about cognitive development and executive functioning?	Establishes the foundational structural critique of canonical sequencing theory	Sections 2–3
RQ2: In what ways does the neurodiversity paradigm challenge the developmental linearity and cumulative mastery logic embedded in constructivist curriculum frameworks?	Connects paradigmatic reframing to curriculum epistemology	Sections 2.3–3
RQ3: What structural limitations emerge when linear abstraction and age-graded pacing are applied to non-linear cognitive processing patterns?	Grounds critique in neurological evidence and design implication	Sections 3–4
RQ4: How might curriculum sequencing be reconceptualised through networked, modular, and temporally flexible design architectures?	Introduces the original Non-Linear Sequencing Architecture (NLSA)	Section 5
RQ5: What implications would a non-linear sequencing model carry for standards alignment, assessment design, and accreditation frameworks?	Elevates the paper to systemic and policy significance	Section 6

Note. RQ = Research Question. The table maps each research question to its theoretical function within the paper's argument and to the section(s) in which it is addressed.

2. Theoretical Foundations

2.1 The Spiral Curriculum: Architecture and Embedded Assumptions

Bruner's (1960) spiral curriculum operationalises the conviction that any subject can be taught to any learner at any developmental stage, provided the content is appropriately structured. The model proceeds through recursive revisitation: core concepts are introduced in simplified form, then revisited at progressively increasing levels of abstraction across successive years (Bruner, 1960, 1996). The architecture serves dual purposes — consolidating prior knowledge while extending its conceptual reach.

Three cognitive conditions are presupposed but rarely rendered explicit. First, working memory must be sufficiently stable to permit meaningful revisitation of concepts encountered in prior years (Kirk et al., 2022). Second, abstraction develops gradually through Bruner's (1966) enactive, iconic, and symbolic modes in ordered sequence. Third, curriculum pacing can be synchronised across cohorts through age-graded progression without significant cognitive cost to diverse learners (Null, 2011). As Bernstein (2000) observes, the pedagogic discourse of curriculum is always the discourse of a particular social and cognitive order — the spiral curriculum's order is neurotypical in its foundational assumptions, even as it claims universality.

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2.2 Constructivism and the Assumption of Developmental Continuity

The spiral curriculum is situated within the broader epistemological framework of constructivism — the position that knowledge is actively constructed by learners through engagement with their environment (Piaget, 1952; Vygotsky, 1978). Constructivism provides the pedagogical logic underpinning scaffolding, the zone of proximal development, and staged developmental sequencing. Both Piaget’s (1952) stage model and Vygotsky’s (1978) social mediation thesis assert that cognitive development follows an ordered trajectory to which curriculum should be aligned.

The constructivist tradition is explicitly learner-centred, and its scaffolding emphasis provides a basis for pedagogical differentiation. Yet even within its learner-centred framing, constructivism retains a commitment to structured developmental continuity — the assumption that all learners will traverse broadly the same conceptual developmental sequence (Doolittle, 1997). Young (2008) extends this critique, arguing that constructivism’s social realist commitments still presuppose a universal knowledge structure that maps onto normative cognitive development. This assumption of developmental continuity is precisely what the neurodiversity paradigm places under theoretical pressure.

2.3 The Neurodiversity Paradigm: Reframing the Unit of Analysis

The neurodiversity paradigm, introduced by Singer (1998) and elaborated by Armstrong (2010), Thomas (2023), and others, reframes cognitive difference as natural human variation rather than pathological deficit. Conditions such as ADHD, autism, dyslexia, and dyscalculia are positioned not as disorders requiring remediation, but as distinct neurological architectures that differ from neurotypical norms without being inferior to them (Baumer & Frueh, 2021; Doyle, 2020; Clouder et al., 2020). ADHD, autism, and dyslexia are not unified cognitive profiles; each encompasses substantial within-group variability, and the traits discussed throughout this paper, such as pattern-driven abstraction, hyperfocus, or episodic learning, are documented tendencies rather than uniform features of every individual within these populations. Heterogeneity exists within neurodivergent populations and within neurotypical populations alike. The NLSA is accordingly framed as a means of increasing sequencing flexibility for the full range of learners, rather than as a replacement of one universal cognitive model with another.

Critically, the paradigm shifts the locus of analytical attention from the learner’s profile to the systems within which that profile operates. A learner with ADHD is not impaired in absolute terms; they are impaired relative to a system designed for a different cognitive architecture (Barkley, 2015; Cooper, 2008). Pinar (2019) frames curriculum as a discourse that is always already ideological — carrying assumptions about what it means to know, to develop, and to succeed. Applied to sequencing, this framing reveals that curriculum architecture is not a technical arrangement but a cognitive norm inscribed as universal design.

Paradigm Shift: From Accommodation to Architectural Redesign. Armstrong (2010) argues that the neurodiversity paradigm demands a shift from asking how to fix the learner to asking how to redesign the system. Pinar (2019) grounds this in curriculum theory: curricula are discursive formations that privilege certain modes of knowing. Thomas (2023) extends this to inclusive design, contending that architectural redesign — not individual accommodation — is the appropriate response to cognitive plurality. The NLSA proposed in this paper operationalises these commitments as a sequencing framework.

3. Structural Critique of Dominant Sequencing Models

3.1. The Linear Abstraction Problem

The movement from concrete to abstract representation — from direct experience through imagistic engagement to symbolic manipulation — is the central developmental movement assumed by spiral and constructivist sequencing frameworks. Operationalised in Bruner's (1966) enactive-iconic-symbolic progression, the critical assumption is not merely that abstraction is the developmental endpoint, but that it must be reached through this particular sequence in this particular order.

This assumption is challenged by evidence on autistic and twice-exceptional cognition. Grandin (2022) documents pattern-recognition and systems-thinking capacities that function at high abstraction levels without the scaffolded concrete progression constructivism treats as necessary. Murray et al. (2005) describe monotropic processing — deep, intensive domain focus — that enables abstract reasoning without prerequisite concrete grounding. Twice-exceptional learners demonstrate advanced conceptual reasoning while struggling with procedural linearity, exposing a mismatch between their cognitive architecture and mainstream sequencing (Baum et al., 2017). For these non-linear cognitive architectures, abstraction is associative and pattern-driven rather than the terminal product of a developmental ladder — and sequencing architectures premised on that ladder risk misrepresenting the capabilities they claim to develop.

3.2. Age-Graded Pacing and Executive Functioning Variability

Contemporary curriculum frameworks — including South Africa's CAPS, Thailand's Basic Education Core Curriculum, China's Compulsory Education Curriculum Standards, and the International Baccalaureate — embed age-graded progression as a structural assumption (Sheppard & Wieman, 2020). This assumption does not function as explicit policy; it is embedded structurally in scope-and-sequence documents, assessment calendars, and grade-level standards — what Bernstein (2000) would identify as the hidden framing of pedagogic discourse.

Research on executive functioning variability in ADHD directly challenges this framing. Barkley (2015) argues that ADHD is fundamentally a disorder of self-regulation rather than attention, with profound implications for the planning and temporal organisation of learning. Brown (2013) demonstrates that executive functioning in ADHD is context-dependent: highly functional in domains of intrinsic motivation, significantly impaired under extrinsic deadline pressure. The age-graded, deadline-structured, cohort-synchronised curriculum progression of mainstream schooling is structurally located in the latter condition for many ADHD learners. These are neurological structural differences, not motivational failures — and they interact predictably with time-based curriculum architectures (Cooper, 2008; Schweitzer et al., 2013). A sequencing model that embeds fixed temporal pacing as a design feature may generate disproportionate disadvantage for this population.

3.3. Cumulative Mastery Logic and Episodic Learning Patterns

The spiral curriculum's progression logic assumes each conceptual layer must be consolidated before advancement — a cumulative mastery model in which prior knowledge is the essential prerequisite for subsequent learning. Combined with age-graded pacing, this tends to position episodic or non-linear mastery patterns as deficit rather than as cognitive difference.

Cooper (2008) describes episodic learning — knowledge acquisition in intensive bursts separated by periods of apparent regression — as characteristic of ADHD functioning. Shaywitz (2020) documents parallel non-linear patterns in dyslexic learners, with significant fluency variation across modalities and contexts (Snowling & Hulme, 2012). Wolf (2018) demonstrates that reading brain pathways are multiple and overlapping, directly challenging the assumption that phonological consolidation must precede text-level comprehension. The cumulative mastery assumption carries an implicit deficit logic: episodic, domain-specific, or non-linear mastery is positioned as failure rather than as mastery achieved through a different temporal and cognitive architecture. A sequencing framework organised around competency clusters, cross-domain demonstration, and temporal elasticity can accommodate these architectures without reproducing deficit coding.

4. Neurodivergent Cognition and Sequencing: A Synthesis

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The cognitive traits most characteristic of ADHD, Autism Spectrum Condition, and dyslexia are precisely those for which spiral and linear sequencing architectures remain least responsive. The analysis below maps six key traits to their sequencing architecture implications, grounding the NLSA's design logic in the evidence base (Table 2). Intra-profile variation is acknowledged throughout (Baumer & Frueh, 2021; Doyle, 2020); the purpose of this mapping is structural, not diagnostic.

Table 2

Neurodivergent Cognitive Traits and Curriculum Sequencing Implications

Cognitive Trait	Neurodivergent Profile(s)	Sequencing Architecture Implication
Hyperfocus	ADHD; Autism Spectrum Condition (ASC)	Intensive domain-specific depth misaligned with paced, distributed spiral progression; a suppressed cognitive resource (Hupfeld et al., 2019; Attwood, 2023)
Episodic Learning	ADHD; Dyslexia	Knowledge acquired in bursts with variable consolidation; structurally incompatible with cumulative mastery logic (Cooper, 2008; Shaywitz, 2020)
Executive Functioning Variability	ADHD; ASC; Dyslexia	Disrupts planning, task-switching, and pacing synchrony; incompatible with age-graded cohort progression (Barkley, 2015; Brown, 2013)
Pattern-Driven Abstraction	ASC; Twice-Exceptional Learners	Abstract conceptual grasp may precede procedural mastery; linear sequencing structurally misrepresents cognitive capability (Grandin, 2022; Murray et al., 2005)
Working Memory Differences	ADHD; Dyslexia	Reduces effectiveness of prerequisite-heavy architectures; undermines spiral revisitation logic (Schweitzer et al., 2013)
Associative / Monotropic Processing	ASC; Dyslexia	Cross-domain knowledge transfer diverges from scaffolded linear curricula; cognitive strength lies in integration over sequential layering (Murray et al., 2005)

Note. ASC = Autism Spectrum Condition. The table summarises six cognitive traits documented in the ADHD, ASC, and dyslexia literatures and maps each to its implication for curriculum sequencing architecture, discussed further in Section 4.

4.1. Hyperfocus and Non-Linear Depth

Hyperfocus — intensive, sustained engagement with domains of high personal salience — is documented in both ADHD (Hupfeld et al., 2019) and autistic cognition (Attwood, 2023). It produces deep domain-specific mastery within concentrated time periods: qualitatively different from the distributed, paced attention assumed by spiral sequencing. Hupfeld et al. (2019) identify hyperfocal states as characterised by heightened intrinsic motivation, reduced distractibility, and sophisticated metacognitive engagement — precisely the cognitive conditions that standardised pacing architectures rarely access. From a sequencing perspective, hyperfocus is a cognitive resource that may be insufficiently supported by spiral curricula. Architectures incorporating domain-intensity modules, flexible engagement allocation, and recognition of depth-as-mastery would convert this resource from a classroom management concern into a curriculum design asset.

4.2. Episodic Learning and the Myth of Gradual Accumulation

The constructivist assumption of gradual, incremental accumulation is substantially complicated by episodic learning patterns in ADHD and dyslexic profiles. Cooper (2008) describes intensive acquisition bursts followed by plateaus, only to accelerate again in response to contextual or motivational triggers — a different temporal architecture of knowledge construction, not a deficit. Shaywitz (2020) documents context-dependent fluency in dyslexic learners: sophisticated oral comprehension coexisting with written processing difficulty, exposing the modality-specific assumptions embedded in conventional literacy sequencing. Wolf (2018) argues that the diversity of reading brain pathways demands a corresponding diversity of literacy sequencing pathways — a position the NLSA directly operationalises.

4.3. Executive Functioning Variability and Temporal Architecture

Executive functioning variability — across planning, working memory, task-switching, and inhibition — disrupts the temporal architecture of learning itself, not merely task completion (Barkley, 2015; Brown, 2013; Schweitzer et al., 2013). Brown's (2013) model is particularly instructive: executive functioning in ADHD is not globally deficient but contextually variable, activating under conditions of intrinsic motivation and immediate feedback, suppressing under conditions of extrinsic routine and abstract pacing. Conventional curriculum progression — characterised by extrinsic deadlines, deferred reward, and synchronised cohort pacing — is structurally located in the latter condition. The pacing architecture of conventional curriculum is not merely a poor fit for ADHD learners; it may be actively counterproductive for those whose executive regulation is context-dependent. This is a structural problem requiring a structural response.

5. Proposed Model: The Non-Linear Sequencing Architecture (NLSA)

The Non-Linear Sequencing Architecture (NLSA) is proposed as an original theoretical alternative to the spiral curriculum. It does not reject constructivist pedagogy — scaffolding, zone of proximal development, and active knowledge construction retain value within the NLSA framework. Rather, the NLSA reconceptualises structural organisation: replacing the hierarchical ladder logic of spiral sequencing with a networked, modular, and temporally elastic architecture that treats cognitive variability as a design parameter rather than a deficit.

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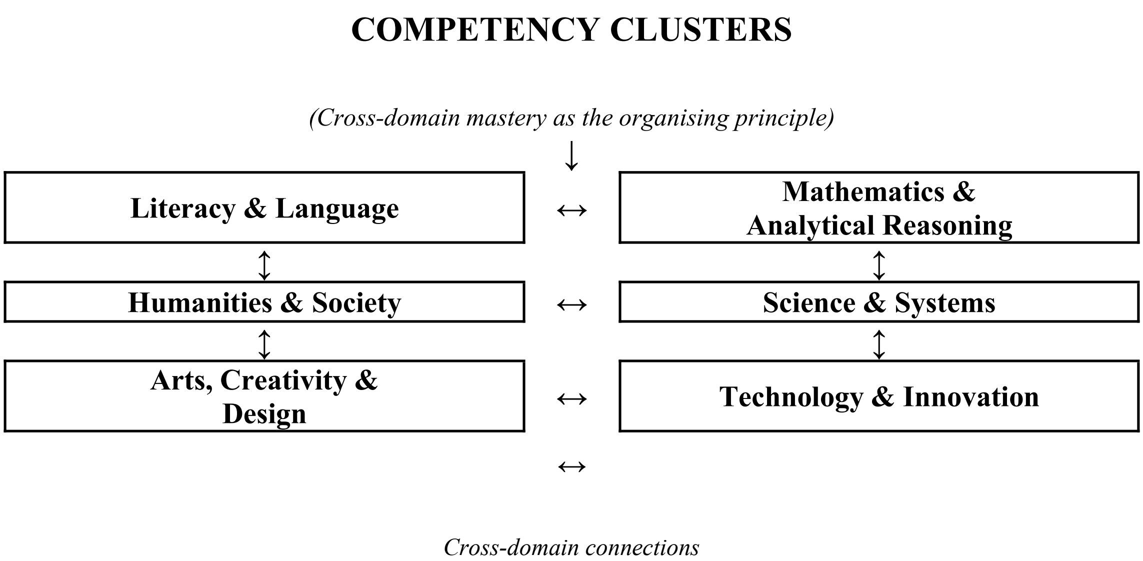
Young's (2008) concept of powerful knowledge — the idea that curriculum should provide access to structured forms of disciplinary understanding — is preserved within the NLSA, but decoupled from the normative cognitive assumptions about how that knowledge must be sequentially acquired.

Situating the NLSA within curriculum theory scholarship clarifies its theoretical register. Bernstein's (2000) concepts of classification and framing illuminate what is at stake: the NLSA proposes weakening the strong classification that insulates curriculum domains from each other by time and sequence, and relaxing the framing that fixes the pacing of pedagogic knowledge within those domains. Pinar's (2019) insistence that curriculum is a discursive formation — not a neutral technical arrangement — grounds the NLSA's central claim that sequencing encodes cognitive norms rather than natural knowledge order. Young's (2008) social realist commitment to disciplinary rigour ensures the NLSA does not dissolve structured content into knowledge relativism: curriculum domains are preserved; only the pathways through which learners access them are redesigned.

Figure 1

Non-Linear Sequencing Architecture (NLSA) — Conceptual Model



MULTIPLE LEARNER ENTRY POINTS

Entry determined by:

• Demonstrated competency • Cognitive architecture

• Prior learning • Learner interests

FLEXIBLE • BIDIRECTIONAL • NON-LINEAR

Learning may begin at any curriculum node

TEMPORAL ELASTICITY

Progression occurs when competency is demonstrated rather than according to chronological age, grade level, or fixed pacing.

Note. Non-Linear Sequencing Architecture (NLSA) — Conceptual Model. Nodes represent curriculum domains organised as interconnected clusters. Pathways are flexible and multi-directional. Learner entry points are determined by cognitive architecture and demonstrated competency rather than age or grade level.

5.1. Networked Curriculum: From Ladders to Nodes

The NLSA replaces the hierarchical ladder — in which each rung must be secured before the next is accessed — with a network of interconnected curriculum nodes. Each node is internally coherent and capable of generating meaningful learning outcomes independently of any prescribed sequence. Connections are multiple and bidirectional: engagement with Node D (Science and Systems) may reinforce and illuminate Node A (Literacy and Language) in ways a linear sequence is not designed to support. Entry points are determined by learner cognitive architecture, demonstrated competency, and interest domain — not by age or grade. This is the core architectural shift: from a single mandated pathway to a navigable landscape of competency domains. Unlike Universal Design for Learning, which modifies delivery and learner response within an existing sequence, the NLSA reconstructs the sequencing architecture itself. Unlike Universal Design for Learning, which primarily modifies how content is delivered and how learners respond to it, the NLSA reconstructs the sequencing architecture itself — the structure that determines what is taught, in what order, and on what timeline.

The NLSA's positioning relative to existing flexible architectures warrants explicit clarification. Applied behaviour analysis (ABA) approaches already incorporate individualisation, mastery criteria, and competency-based progression with neurodivergent learners, and the networked node structure proposed here shares lineage with node-based mapping of stimulus relations and conceptual networks, an approach developed extensively

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by Fields and colleagues in the experimental analysis of equivalence classes and relational learning. The NLSA differs from these traditions in scope and register: ABA and node-mapping research operate primarily at the level of individual learning and behavioural contingency, whereas the NLSA is proposed as a curriculum-level architecture intended to restructure sequencing, standards alignment, and assessment design across an education system. The contribution of the NLSA is accordingly architectural rather than clinical or instructional, extending rather than duplicating these existing approaches.

5.2. Modular Progression: Reducing Prerequisite Rigidity

Within the NLSA, curriculum content is organised into self-contained competency modules — units generating demonstrable outcomes without requiring prior completion of a preceding module in a fixed sequence. Logical dependencies between content areas are acknowledged and mapped, but treated as flexible recommendations rather than structural requirements. A learner may engage with modules in an order reflecting their cognitive architecture, mastery evidence, and motivational state. Coherence is maintained through competency clusters (Section 5.3) and dynamic planning tools (Section 6.3). The result is a curriculum retaining intellectual rigour while releasing the prerequisite-chain architecture that structurally disadvantages non-linear cognitive architectures.

5.3. Competency Clusters: Mastery Across Domains

The NLSA organises competencies into thematically integrated clusters grouping skills, knowledge, and dispositions by conceptual affinity rather than developmental sequence. A cluster in analytical reasoning, for example, incorporates mathematical logic, literary criticism, scientific methodology, and historical argumentation — recognising analytical reasoning as a cross-domain competency demonstrable through multiple content pathways. Mastery is demonstrated across the cluster, not through sequential progression through discrete steps. A learner demonstrating sophisticated analytical reasoning through their domain of hyperfocal strength — even if their procedural progress through the formal sequence is uneven — has demonstrated genuine competency. The cluster architecture makes this mastery creditable; conventional cumulative mastery logic would code the same pattern as failure. Analytical reasoning demonstrated through literary criticism or scientific methodology should, in this sense, be creditable toward the same competency cluster as analytical reasoning demonstrated through formal mathematical proof.

A concrete subject-area illustration clarifies how these design elements operate together. In a mathematics curriculum organised under the NLSA, a learner with a strong pattern-recognition profile might enter the numerical reasoning node through geometry, building proof and abstraction skills through spatial relationships before encountering algebraic notation, rather than being required to progress through the conventional arithmetic-to-algebra-to-geometry sequence. Competency evidence accumulated through geometric reasoning, such as logical proof construction and pattern generalisation, would be creditable toward the same competency cluster as equivalent reasoning demonstrated algebraically. Modular progression permits this learner to engage with algebra later, or in parallel, once geometric reasoning has established the underlying logical structures, while temporal elasticity allows mastery to be demonstrated when the learner is ready rather than at a fixed point in the academic calendar. This example is illustrative of the architecture's underlying logic rather than a complete curriculum design specification.

5.4. Temporal Elasticity: Decoupling Age from Stage

The most structurally significant feature of the NLSA is temporal elasticity: the replacement of age-graded, cohort-synchronised pacing with a mastery-window architecture in which learners progress when they demonstrate competency rather than when the curriculum calendar indicates sufficient time has passed. This decoupling of age from cognitive stage applies mastery learning principles systemically to curriculum architecture. For learners with executive functioning variability, the opportunity to demonstrate competency across multiple temporal windows substantially increases assessment accuracy and equity. A single-occasion, stage-locked examination systematically underestimates the capabilities of learners whose executive functioning is contextually variable (Barkley, 2015; Baum et al., 2017). The NLSA addresses this structural inequity at the design level (see Table 3).

Table 3

Comparative Analysis — Spiral Curriculum vs. Non-Linear Sequencing Architecture (NLSA)

Design Dimension	Spiral Curriculum	Non-Linear Sequencing Architecture (NLSA)
Structural Logic	Hierarchical ladder; sequential stage-based progression	Networked concept nodes; multiple entry points by cognitive architecture
Abstraction Timing	Staged: concrete → iconic → symbolic (Bruner, 1966)	Flexible; associative, pattern-driven, or interest-led
Pacing Model	Age-graded; cohort-synchronised advancement	Temporal elasticity; mastery-window based; age decoupled from stage
Mastery Logic	Cumulative consolidation required before progression	Cluster-based; episodic and cross-domain mastery accepted
Assessment Mode	Stage-locked examinations; single-instance demonstration	Portfolio-based; multi-modal; flexible demonstration timing

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Design Dimension	Spiral Curriculum	Non-Linear Sequencing Architecture (NLSA)
Exec. Functioning	Assumes stable, normative regulation throughout	Accommodates variability; planning support embedded in module design
Learner Positioning	Deviation from sequence coded as deficit	Cognitive variance treated as design parameter, not failure
Standards Alignment	Chronological benchmarks embedded in curriculum sequence	Competency-based outcomes; vertical coherence without rigid sequencing
Inclusion Mechanism	Accommodation appended to existing architecture	Structural redesign of the architecture itself — cognitively plural design

Note. NLSA = Non-Linear Sequencing Architecture. The table contrasts the spiral curriculum and the NLSA across eight design dimensions discussed in Section 5.

6. Policy and Accreditation Implications

The NLSA model carries substantive implications for curriculum policy, assessment design, and teacher professional practice. Three policy-relevant dimensions are addressed below (summarised in Table 4), drawing analytically on multiple national and international systems to identify the structural policy levers a non-linear sequencing architecture would necessarily engage. The analysis is not comparative; it is architectural — identifying where existing policy structures embed the cognitive assumptions the NLSA challenges.

6.1. Standards Alignment: Competency Over Chronology

Contemporary standards frameworks — including South Africa's CAPS (Department of Basic Education, 2011), Thailand's Basic Education Core Curriculum (Ministry of Education Thailand, 2008), China's Compulsory Education Curriculum Standards (Ministry of Education PRC, 2022), and the IB Diploma Programme — define educational standards primarily through chronological benchmarks tied to grade levels and ages. This chronological structuring embeds the age-graded pacing logic of conventional sequencing into the very policy infrastructure of education systems. Bernstein (2000) identifies this as classification — the degree to which curriculum categories are insulated from each other by boundaries of time and sequence. The NLSA proposes weakening that classification in the direction of cognitive plurality.

An NLSA-aligned approach would reframe standards as competency outcomes — specifying what learners should demonstrate without specifying when. Vertical coherence would be maintained through competency progression mapping in which intellectual complexity increases systematically without grade-level attachment. This reframing does not undermine rigour; it strengthens it by aligning assessment with demonstrated knowledge rather than time-in-system. Young's (2008) argument for powerful knowledge is compatible with this reframing: structured disciplinary understanding is preserved, but decoupled from the cognitive norms that have historically embedded its acquisition.

6.2. Assessment Redesign: Portfolio, Performance, and Temporal Elasticity

Stage-locked examinations — single-occasion assessments at fixed curriculum points — sit in considerable tension with the mastery-window architecture of the NLSA. They treat a snapshot of performance under particular conditions as a reliable competency indicator. For learners with executive functioning variability, this introduces systematic measurement error indistinguishable from — and coded as — learning failure (Baum et al., 2017). An NLSA-aligned assessment architecture centres portfolio-based evidence accumulation across multiple contexts, modalities, and time periods. Cross-module demonstration is credited regardless of which node generated the evidence. Temporal elasticity in demonstration timing substantially improves validity and equity by enabling performance when executive regulation and contextual conditions are optimal. This redesign is not without cost. High-stakes examination systems, including national matriculation and standardised entrance examinations, pose a genuine implementation constraint: their accountability function depends on the comparability that single-occasion, stage-locked assessment provides, and that comparability is precisely what temporal elasticity disrupts. Adopting portfolio-based assessment at scale would require parallel redesign of moderation procedures, inter-rater reliability mechanisms, and certification timelines, none of which follow automatically from the curriculum architecture itself. The NLSA does not resolve this tension; it identifies where the tension is structurally located and proposes that examination systems wishing to accommodate non-linear cognition will need to address assessment design as a distinct, substantial undertaking rather than a downstream implementation detail.

6.3. Teacher Planning Frameworks: From Fixed Maps to Dynamic Grids

Conventional curriculum maps presuppose a single pathway through which all learners progress in synchrony. An NLSA-aligned planning framework replaces the linear map with a dynamic curriculum grid — a multi-pathway tool mapping competency clusters, flexible sequencing options, and learner entry point decision-making. This transformation requires curriculum literacy — the capacity to reason about curriculum architecture — as a core teacher professional competency. Systems adopting NLSA-aligned frameworks would need to invest substantially in this professional capacity. The compensating benefit is meaningful professional autonomy: teachers exercising informed curriculum design judgement, exercising what Bernstein (2000) terms enhanced instructional discourse, rather than executing fixed prescriptions. Dynamic planning tools of this kind are particularly consequential for learners whose executive functioning varies by context, since a fixed curriculum map offers no mechanism for accommodating that variability, whereas a navigable grid allows pacing decisions to be revisited as a learner's regulatory and motivational state changes.

Table 4

Policy Domain Limitations and NLSA-Informed Transformations

Policy Domain	Current Limitation	NLSA-Informed Transformation
Standards Alignment	Chronological stage-locking; age-graded benchmarks	Standards reframed as competency outcomes; age decoupled from demonstrated stage
Assessment Design	Stage-locked examinations; single-instance demonstration	Portfolio accumulation; multi-modal and flexible demonstration timing
Accreditation Frameworks	Linear credit accumulation; rigid prerequisite chains	Modular credit recognition; competency-cluster certification pathways
Teacher Planning	Fixed curriculum maps; synchronised cohort pacing	Dynamic curriculum grids; individualised pathway variation and professional autonomy
School Timetabling	Age-cohort groupings; fixed lesson progression sequences	Flexible grouping structures; mastery-window progression
Professional Development	Deficit-model training; accommodation as supplementary add-on	Design-model training: curriculum architecture as the primary inclusion strategy

Note. The table summarises the structural limitation of each policy domain under conventional sequencing and the corresponding transformation proposed under the NLSA, discussed in Section 6.

7. Conclusion

7.1. Theoretical Synthesis

Dominant curriculum sequencing architectures encode normative cognitive assumptions — linear abstraction, age-graded pacing, cumulative mastery — that have been elevated to universal design status without adequate critique. The neurodiversity paradigm names this as a cognitive norm inscribed in structural form. As Bernstein (2000) and Pinar (2019) each contend, structural design choices always carry ideological and epistemological freight; the spiral curriculum's design choices are no exception. Bernstein's (2000) framing of classification and pacing clarifies precisely how this encoding operates: pacing is not a neutral administrative variable but a mechanism through which a particular cognitive norm is built into the temporal structure of curriculum itself.

The NLSA responds to this structural analysis with a structural alternative. Its networked nodes, modular progression, competency clusters, and temporal elasticity are not pedagogical

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accommodations; they are architectural principles that treat cognitive plurality as the foundational design condition rather than the exceptional case.

Central Theoretical Claim: Curriculum sequencing is an epistemological structure embedded with cognitive norms. Reimagining sequencing through the neurodiversity paradigm reframes inclusion not as accommodation appended to an existing architecture, but as structural redesign of the architecture itself. The Non-Linear Sequencing Architecture (NLSA) represents an original theoretical contribution to this redesign — a framework in which cognitive plurality is the foundational design principle, not an exception to be managed.

7.2. Scholarly Contribution and Limitations

The paper contributes three things to curriculum theory. First, a systematic structural critique of the cognitive assumptions embedded in canonical sequencing models, grounded in neuroscience, cognitive psychology, and curriculum theory (Bernstein, 2000; Pinar, 2019; Young, 2008). Second, the NLSA — an original curriculum architecture translating the neurodiversity paradigm into interconnected design principles for sequencing, progression, and assessment. Third, a systemic policy analysis articulating the NLSA’s implications across standards alignment, assessment redesign, and teacher planning.

The paper’s limitations are equally important. The NLSA is a theoretical framework, not an empirically validated curriculum design. Its evidence base draws primarily on clinical and cognitive psychology literature, and its translation into design implications involves theoretical inference requiring empirical testing. Future research should examine NLSA principles in implementation contexts, attending to the fidelity of networked curriculum delivery within existing school organisational constraints and to the professional development models most effective in supporting dynamic curriculum planning.

7.3. Implications for Curriculum Theory

Beyond neurodivergent-inclusive design, this paper advances a broader proposition: sequencing is an epistemological rather than merely organisational dimension of curriculum design. How knowledge is sequenced is a claim about what knowledge is, how it develops, and who can acquire it. Pinar (2019) argues that curriculum theory must attend to the discursive formations that constitute educational experience — and sequencing architectures are among the most consequential such formations, precisely because they operate beneath the threshold of explicit policy debate. Neurodiversity offers curriculum theory a productive interrogation site: whose cognitive architecture is presumed in the design of knowledge progression, and what might cognitively plural curriculum design look like if plurality were the starting point rather than a special case? The NLSA is offered not as a finished system but as a theoretical provocation for that interrogation.

7.4. Scope and Delimitations of the NLSA Model

Scope and Delimitations: Several delimitations govern the scope of the NLSA model as proposed in this paper and should be acknowledged explicitly. Conceptual status: The NLSA is a theoretical reconstruction, not a ready-for-implementation policy blueprint. Its translation into operational curriculum design will require empirical validation, stakeholder consultation, and context-specific adaptation. System feasibility: The NLSA is likely most immediately feasible in competency-based education systems and in contexts where assessment frameworks already support portfolio and performance-based evidence. It may face significant structural resistance in highly exam-intensive systems — including those in South Africa, China, and Thailand — where stage-locked high-stakes examinations carry strong accountability functions that cannot be redesigned at the curriculum architecture level alone. Implementation complexity: Dynamic curriculum grids, modular progression, and flexible demonstration timing require substantial investment in teacher professional development, curriculum mapping infrastructure, and assessment system redesign. These are not incidental implementation challenges; they are structural conditions of feasibility. These delimitations do not undermine the paper's theoretical contribution. They locate it appropriately as a conceptual provocation requiring empirical, systemic, and contextual translation before implementation.

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Author contributions

Thembelani Anele Gansa conceived the study, developed the theoretical framework, conducted the literature review and conceptual analysis, wrote the original manuscript, revised the manuscript, and approved the final version for publication.

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The author declares that there is no conflict of interest.

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The author has given consent for publication.

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