Embracing Neurodiversity in STEM in Faculty and Students

Beyond Accommodations: Building a Culture of Belonging through Holistic Accessibility

Jim Hoerricks, PhD

Notes for the lecture presented at the
John Brooks Slaughter
Leadership in Engineering DEI Summit
Los Angeles, CA USA
February 7, 2024

Learning Goal

By the end of this session, attendees will be able to describe Hoerricks' *interest-based nervous system thesis* and its relevance to neurodiversity, discuss challenges and benefits of embracing neurodivergence in STEM students and faculty, and identify at least three inclusive strategies or teaching accommodations to apply in their own classrooms and institutions to foster greater accessibility and belonging for neurodivergent individuals.

Contents

Introduction

When we think about diversity, we often consider visible differences in ethnicity, gender, age, ability, or cultural background that exist in any human community. But an equally profound yet invisible dimension of human diversity resides in our nervous systems, in the form of neurocognitive differences.

Just as there is naturally occurring diversity in human genetics and physical traits across populations, there exists a wide natural spectrum of cognitive skills, processing styles, and ways of learning. Some people have skill with words or language but struggle with mathematics and visual-spatial processing. Others are exceptionally gifted in logic or excel at understanding complex systems but have less verbal aptitude.

Whilst communities typically define a narrow set of cognitive and behavioural standards as "normal" based on majority traits, opting to medicalise or stigmatise those outside that norm, diversity advocates counter that normal exists along a far broader spectrum. There is no objectively definitive way of thinking, communicating, or learning that represents absolute health or correctness.

Rather, human neurocognition has evolved and benefited from different thinking styles the same way our gene pool has diversified to promote variation. Just as we embrace human physical diversity as naturally occurring rather than something to eliminate, we must expand our societal definition of "normal" cognition.

This expansive understanding of normal cognitive diversity is what the neurodiversity paradigm aims to propagate. It posits that there are endless variants of healthy, thriving neurocognition, shaped both by genetics and the social and material environment. When this innate neurodiversity is recognized and cultivated, human communities prosper by gaining access to a greater range of cognitive skills and talents. I look forward to exploring this further alongside you all.

Neurodivergent?

Neurodivergent is a term used by those in the 'neurodiversity community' to describe people with innately different neurocognitive functioning from what society typically labels as "normal." Identity-first language places emphasis on neurodivergence as a core component of a person's identity, just as important as other affinity markers like ethnicity, gender, or sexual orientation.

Those embracing the neurodivergent identity may include autistic individuals, ADHDers, AuDHDers, dyslexics, people with mood disorders like bipolar, tic disorders, dyspraxia, or various other ways of thinking and learning that differ from conventional developmental or behavioural standards.

However, the neurodivergent umbrella is deeply personal as well as complex, with some disagreeing on who can claim the identity. Whilst diagnoses can indicate neurodivergence, some argue that anyone who relates profoundly to the differences in processing and perceiving information that define common neurocognitive conditions has a right to self-identify as neurodivergent.

No matter how one defines membership under the neurodiversity umbrella, the identity serves to unite those who feel at odds with societal cognitive and behavioural norms. It empowers them to take pride in minds that work uniquely from the majority, advocating for their value in communities shaped for and by neurotypical, or non-neurodivergent, individuals.

By joining together under the neurodivergent identity, this growing community hopes to shift culture and systems to better accommodate different ways of thinking. Through strength in numbers and solidarity comes the promise of creating a more inclusive world for future generations to simply be their authentic neurodivergent selves.

Hoerricks' Interest-Based Nervous System Thesis

I'm getting a bit cheeky here in describing a phenomenon I regularly observe in my own family, in my classroom, and the world around me. It's a thesis that has emerged from the neurodiversity community posits that neurodivergent minds are often wired to develop intense, sustained passions towards specific subjects or activities from a very early age. This manifests as almost obsessive levels of interest, engagement, and talent cultivation around these narrow topics or skills.

Where neurotypical children may lightly dabble across a range of childhood hobbies and interests, sampling sports, instruments, games, and creative outlets on a surface level, neurodivergent kids quickly become utterly captivated by their particular passions of choice. These intense interests tend to persist through adolescence and into adulthood.

It is not fully understood why 'obsessions' form around such narrowly specific subjects. Perhaps in still-developing neurodivergent brains, early exposure to certain stimuli triggers hardwired pathways related to pleasure, reward, and dopamine activation. Or single-minded interests represent a coping mechanism, a way to organise and make sense of overwhelming sensory environments.

Regardless of origins, for those embraced by the neurodiversity community, these keen interests are viewed as differences to be nurtured rather than eliminated or corrected. When supported appropriately, they can unlock immense stores of latent talent and creativity, helping people connect to their deepest motivations and sense of self.

Termed colloquially "the interest-based nervous system," this neurocognitive phenomenon provides an alternative framework for understanding neurodivergent attention, distractions, talents, and life trajectories through the lens of passions - ones that can shape nervous systems fundamentally differently from neurotypical minds.

A quick deep dive

Speaking for myself and my lived experience, autistic individuals provide perhaps the most salient embodiment of intensely focused passions. From childhood onward, autistic children commonly develop specific subjects of interest they pursue with incredible zeal and dedication. These "special interests" forge neural pathways that shape development, relationships, and worldviews.

For example, while a neurotypical student may study dinosaurs or horses for a school project then move on, autistic kids with those passions will dedicate the entirety of their free time to learning taxonomy, evolutionary biology, or equine physiology in exhaustive detail. They proudly build their identity around being "the dinosaur kid" or "the horse girl."

Beyond mere hobbies, these interests impact how many 'on the spectrum' interact with environments and people. New places or groups are mapped to special interests to aid processing and social relatedness. A park may excite as a place to search for fossils. A party is appealing if filled with fellow equestrians to swap training tips. Interests provide frameworks to navigate the world.

Similarly, ADHDers frequently exhibit hyperfocus around activities that stimulate their passions - whether cuisines, videogames, sports, or music genres. When engrossed in these interests, ADHDers display an intensity of attentiveness, energy, and emotion visibly different from their scattered state when disengaged.

The obsessiveness and attentional variability expressed by these wonderful humans powerfully demonstrates how interests can profoundly shape neurodivergent engagement, performance and relationships based on stimuli that unlock their passions. Interest fuels their nervous systems.

Why the thesis is important

The intense passions associated with neurodivergence provides insight into tailoring educational approaches that unlock our potential. When interests direct focus, drive engagement, and confer identity, the imperative becomes structuring academic experiences around these passions.

For example, maths is notoriously challenging for many of my neurodivergent students due to overly wordy and deliberately confusing curriculum, abstract concepts, and the boring rote memorisation required to score well on assessments. Yet maths-oriented interests in astronomy, music, Pokémon, or finance can inspire self-directed mastery of calculation, ratios, graphing, and statistics - disciplines leveraged daily with pride by those deemed disinterested or innumerate.

Such examples underscore why 'interest-based education' is essential for neurodivergent students who think and learn differently. Tapping intrinsic motivations around narrow passions yields far greater achievement, creativity, and persistence than forcing square pegs into round holes.

Special interests also reveal profound strengths. The depth of knowledge accrued around favoured topics can exceed that of teachers, indicative of intellectual giftedness rather than deficits or limitation. Laser focus reflects capacity for flow states of peak performance. Unique synergies of information point to innovative meaning-making and problem conceptualisation.

In these ways, permitting - even encouraging - intense interests provides scaffolds for talent development, social discernment, and environmental control that guide fulfilment. By embracing rather than inhibiting passions, incredible personal growth can emerge from those previously marginalised.

Don't teachers pursue their passions in their classrooms?

Teachers often enter the profession driven by intrinsic passions to inspire youth and cultivate the next generation of thinkers, creators, and leaders. Whether neurodivergent (ND) or neurotypical (NT), educators draw from their unique interests and talents to light fires within students.

However, as I've experienced, institutional barriers often restrict personalised instruction and force rigid curricular standards onto populations with innately diverse skills and ways of knowing. This obedience training mentality, holding teachers accountable to fixed outcomes over nurturing variable potentials, particularly limits neurodivergent educators boasting unconventional gifts.

Reimagining classrooms as flexible spaces for passions to guide growth flips obstacles into opportunities. ND teachers can relate profoundly to the learning differences of ND students. Our capacity for hyperfocus tackles complex topics in interdisciplinary contexts aligned with student interests. Intense interests scaffold engaging, hands-on activities. Sensory sensitivities add empathetic insights.

Equally, embracing neurocognitive diversity in lesson planning benefits all student types. Tailoring instruction to leverage intrinsic motivations around narrow passions yields greater engagement for ND and NT learners alike than generalised material. Perceived eccentricities become teacher superpowers when interests steer strengths.

Inclusive education celebrates each teacher's distinctiveness alongside embracing every student's potential. Only by moving past outdated moulds can schools tap the inestimable gifts emerging from neurodiversity in both their staff and enrolled youth. Our shared future depends on this paradigm shift now to develop the next generation of thinkers and trailblazers.

Embracing Neurodiversity in Students

My 'interest-based nervous system' thesis helps my gestalt processing brain provide words for how intrinsic passions profoundly shape learning for many neurodivergent students. Intense childhood interests become enduring preoccupations that determine attention, performance, self-perception, and life trajectories.

For example, whilst NT students may study horses or World War II at a cursory level before moving onto unrelated topics, equine-oriented ND teens may devote hundreds of hours memorising breed anatomy, analysing riding disciplines, and perfecting equestrian skills. Military history obsessed ADHDers can recite WWII battle statistics, weapon innovations, and strategic blunders with uncanny accuracy.

These narrow interests drive learning by providing framing contexts and sparking dopamine-fuelled hyperfocus. An otherwise mundane mathematical concept triggers fervent concentration when explored through sports statistics analysis. Memorising anatomical structures becomes urgent for animal illustration accuracy. Interests supply intrinsic motivations for self-directed mastery exceeding any external incentive.

Additionally, passions shape identity in ND youth already grappling with fitting into school social structures. Special interests offer refuge as vocabulary for communicating authentic selves. Being "the reptile kid" feels far more genuine than masking eccentricities to appease peers. Interests provide bridges to communities where quirks draw rapt admiration rather than ridicule.

Within flexible educational ecosystems that nourish preoccupations by incorporating passions into lessons, neurodivergent students shift from disengaged to driven learners. They gain tools not just for demonstrating competency, but for articulating their distinctive brilliance shaped by the nervous systems they inhabit.

Benefits: focused talents, unique skills

Far from being merely trivial hobbies or idle pastimes, the passionate pursuits that captivate ND minds often incubate exceptional talents and confer unique skillsets. When interests harmonise with innate strengths, obsessed dedication unlocks remarkable gifts.

For example, an autistic teenager enamoured by vehicle design may parlay hyperfocus on automotive systems into drafting sophisticated chassis blueprints or constructing model engine parts with precision and artistry. Similarly, an ADHDer's passion for music composition enables improvising elaborate original scores thanks to exceptional sound discrimination and emotional attunement.

These innate talents cultivated around narrow interests frequently eclipse skills demonstrated in generalized academic subjects. A student who struggles with basic writing and calculation may unbelievable technical expertise about marine life, computer programming, or cosmological phenomena from self-guided study driven by ardent fascination.

In fact, nearly all child prodigies across creative disciplines like art, mathematics, music, and chess evidence ND traits. Their intellectual and artistic gifts emerge not in spite of their autistic system, but because of the focused interests and perseverance they confer.

Far too often, non-conforming passions in ND students get mislabelled as problems rather than the wellsprings of talent and empowerment they represent. Adjusting this deficit-centred perspective reveals how specialised interests unlock unique brilliance.

Challenges without support: frustration in rigid systems

Whilst narrow fixations can facilitate deep learning for neurodivergent students, these powerful passions also set up clashes with inflexible systems and unsympathetic instructors. Absent supports to explore interests meaningfully and leverage them as strengths, many ND students experience frustration and failure in rigid classroom environments. I know I have.

For example, a student with bipolar disorder who oscillates between pressured, racing thought patterns during manic episodes and periods of low functioning in depressive states risks having their capacities minimised without proper accommodations. Permitting flexible deadlines driven by mood fluctuations allows passions to still flourish in bipolar students.

Similarly, dyslexic students who display high intellectual reasoning or spatial skills in oral discussion may seek refuge in interests like animation or construction that deemphasise struggling areas like written analysis or spelling. Restricting creativity to just paper exams disallows such students from translating interests into talents.

Indeed, countless stories abound of associationally-thinking autistic savants, hyperverbally-gifted ADHD wordsmiths and creatively-brilliant dyslexic entrepreneurs blocked from fulfilling academic journeys by rigid disciplinary models intolerant of different learning needs and strengths.

Just as troubles ensue forcing students into narrow educational moulds, disaster unfolds extinguishing the internal fires that inspire ND minds by failing to fan their healing flames of passion. School communities either frees such spirits to soar or clips their wings unnecessarily.

Openness to strengths from students

Structural barriers in inflexible school systems often inhibit both student potential and teacher talents. Yet enlightened administration can shift restrictive environments into springboards for growth by embracing the spirit of neurodiversity.

Firstly, outdated disciplinary traditions and rigid standardised testing should become optional rather than compulsory. Students deserve freedom to demonstrate competencies through diverse mediums - portfolios of work samples, presentations, experiments, or creative performances aligned with innate strengths and interests rather than filling in bubbles.

Additionally, administrators must permit educators autonomy in customising curriculum based on student passions, skills, and needs. Prescribed instructional protocols strip responsive teaching and constrain the magic teachers contribute using their own distinctive gifts.

With bureaucracy barriers removed, classrooms transform into incubators nurturing ND brilliance rather than scrambling uniqueness into conformity. Students gain affirmation to translate intellectual intensity into original innovations. Teachers can relate through shared quests to understand complex concepts, not merely enforce simple ideas.

In these liberated ecosystems, the onus lifts from students apologising for non-conformity or performing false normalcy. Instead, catalysis occurs - creative collisions between unique minds yielding what no individual could alone conceive. This is the promise of truly embracing neurocognitive diversity, equity, and inclusion.

The first step is believing in every mind enough to set their talents free.

Collisions between unique minds

Rather than segregating students based on functioning labels or developmental norms, truly inclusive classrooms empower ND learners alongside their NT peers. In these integrated spaces guided by the strengths, needs and interests of all enrolled, creativity flourishes through collaborative collisions between differently-wired minds.

For example, NT students tend to easily discern social dynamics and shared cultural references that shape collaborative group tasks. Yet their thinking can also prove confined to conventional linear perspectives. When teams pair such socially-adept teammates with ND students boasting intense interests and systematising abilities, integrative solutions emerge spanning interpersonal and analytical realms.

Or, NT students may rely more on generalised learning strategies like visual concept mapping. Joining forces with ADHD partners proficient in divergent ideation and innovative risk-taking due to their diffuse attentional radar helps break through ordinary thinking ruts. Co-imagination soars.

Even at the individual level, NT and ND students find connections through shared interests and complementary abilities. An otherwise solitary autistic teen able to infodump about asteroid mining to a new classmate helps a burgeoning friendship form through this intellectual exchange marked by respect rather than ridicule of differences.

In such environments where frictions between different cognitive styles foster creative interplay rather than friction, everyone wins. NT students gain exposure to fresh modes of thinking and problem solving. ND students receive validation as experts worthy of emulation, not correction. Together, integrative solutions emerge that celebrate wonderful and essential neurological diversity.

Embracing Neurodiversity in Staff

Just as embracing neurocognitive diversity unlocks creativity and potential in students, championing ND strengths and perspectives among school staff confers analogous benefits enriching educational communities. Yet this requires moving beyond *token representation* to genuinely valuing alternative and nonconforming modes of thinking among administrators, educators, counsellors, and talent coordinators alike.

Where deficit-based perspectives may pity or seek to remediate differences, the neurodiversity paradigm views unique minds as essential assets we cannot afford to squander. Within this frame, structuring systems around the insights and abilities of ND faculty serves all stakeholders and equips youth for a thriving future of exponential discovery fuelled by neurological diversity.

By first spotlighting strengths in ND staff rather than striving to assimilate or accommodate deviations from stuffy norms, school cultures organically transform into landscapes nurturing maximal growth from planted seeds of potential in every student.

The value proposition of DEI

Within school staff, a diversity of neurotypes and learning styles confers immense riches benefiting all. Yet for too long, rigid definitions of teaching competence centred around NT strengths have discounted brilliant ND educators boasting unconventional gifts.

Empowering such ND staff requires moving beyond tolerance or tokenish representation towards genuinely valuing alternative and nonconforming talents and mindsets among administrators, teachers, counsellors and coordinators.

For ND teachers (professors, lecturers, assistants, etc), this means embracing the way attention differences confer strengths in adaptability and multifaceted thinking, how sensory sensitivity lends profound empathy and insights into classroom environments, or how narrow passions yield contagious enthusiasm and interdisciplinary connections.

Equally for support staff, it means recognising advantages with systematising or mathematical thinking in scheduling, visual-spatial talents in facilities, project coordination enhanced by detail orientation, and intense interests that aid relating with special needs.

In all staff, fluid cognitive patterns add creativity, intense focus powers productively, and non-linear associative reasoning solves dilemmas. By flexibly designing efficient systems leveraging these neurodivergent abilities rather than demanding rigid conformity, schools gain invaluable assets benefitting all.

Neurodiverse teachers as role models and mentors

Beyond merely accommodating ND perspectives among faculty, empowering ND teachers and staff to openly embrace and share their identities and experiences provides immense benefit to both ND and NT students.

Having visible autistic professors, ADHD counsellors or dyslexic administrators serves as inspiration for ND students who too frequently only encounter their own conditions in patronising media stereotypes or medicalised literature spotlighting challenges over accomplishments. Witnessing their paths to achievement fosters belief in their own potential.

Moreover, such transparent role models can provide vital mentoring navigating systems still filled with prejudice against nonconforming brains. Sharing lived stories about obstacles overcome and talents embraced smooths difficulties for the next generations whilst fuelling advocacy and evolution.

Equally valuable, showcasing open ND faculty provides education for NT students, dismantling misconceptions and building empathy. The diversity of minds encountered better equips graduates to champion equity and value colleagues' varied contributions in today's world where neurological discrimination remains rampant.

Elevating proudly open ND staff into visible mentoring roles demonstrates first-hand to all students that different cognitive wiring need not dictate limits on any ambition. Exceptionalism thrives with proper systemic and social support. And their trailblazing inspires lasting ripples.

Steps Towards Inclusion

Cultivating educational cultures that empower ND minds requires moving beyond piecemeal accommodations designed as retrofitted workarounds for atypical students' deficits. Instead, a paradigm shift towards Universal Design for Learning (UDL) bakes in flexibility and customization benefiting all unique minds from the ground up.

Unlike accommodations that represent after-the-fact additions offered to specific students identified as outside the norm, UDL principles embed choice, versatility, relevance and support into curricular building blocks and instructional practices by default. Rather than isolating nonconforming students side-lined as atypical exceptions, UDL environments normalize and nourish cognitive variability.

From multiple representation of concepts suiting different learning strengths to fostering community and backgrounds adding context, UDL guided teaching welcomes each neurodivergent mind exactly as wired while expanding horizons for neurotypical learners too. It epitomizes true inclusion and empowerment in action.

By taking a UDL approach guided by the goal of accessibility and growth for all minds from the outset, educators progress towards customizable systems where remediating or camouflaging differences gives way fully to nurturing potential.

Let's further explore what embedded UDL principles can achieve in providing empowering and responsive learning experiences equitably to both ND and NT students.

A UDL Example Set

As a Resource Specialist Program teacher (RSP) assisting students across core subjects under the inclusion model, I witness firsthand the barriers rigid, one-size-fits-all lessons can pose to diverse young minds. My role involves partnering with general education teachers to provide appropriate scaffolds and supports aligning with students' unique challenges and capabilities documented in their Individualized Education Plans (IEPs).

Drawing from my experiences co-teaching geometry over the last years, I want to illustrate targeted differentiation in action across various learner profiles. Below you'll find links to a series of articles article applying Universal Design for Learning (UDL) to make the same geometry lesson accessible for students with specific learning disabilities (SLDs), attention or processing differences, language barriers, twice exceptionalities, and more.

My aim is demystifying the modification process to equip you in evaluating our own lessons for barriers and areas of inflexibility inhibiting certain students from engaging meaningfully. By walking through real examples of how UDL can transform instruction to play to strengths and bypass challenges from the onset, I hope to reveal UDL's immense potential for creating classrooms that empower and celebrate all student identities, wiring differences and all. The skills to design inclusive environments are learnable. Indeed, equity relies first and foremost on teachers proactively building in supports versus needing accommodations requests.

Please spend some time exploring what genuine accessibility and empowerment looks like when applied deliberately across eligibilities. By spotlighting strategies directly from my practice of differentiating the same geometry curriculum and activities using UDL for diverse profiles, my goal is making differentiation attainable rather than abstract theory. Please find the full article series via the links below.

- Students with Specific Learning Disabilities (SLD) (click here)
- Students with Other Health Impairments (OHI) (click here)
- Autistic Students (ASD / AUT) (click here)
- English Language Learners (ELLs) and Emergent Bilinguals (EBs) (click here)
- Twice Exceptional Students (2e) & Gifted Learners (click here)
- Supporting Unfinished Learning (click here)
- Direct/Explicit Instruction and Pre-Teaching Key Vocabulary (click here)
- 10-22-2023 - Why no UDL for adult professional meetings? (click here)

Building atmosphere of respect

The first step towards cultivating an inclusive environment of understanding and respect is for professors to examine their own attitudes and assumptions regarding atypical minds. Reflecting on areas of bias or prejudice when it comes to our students and colleagues allows us to evolve past mindsets hindering equity.

From there, professors set the tone early by sending the clear, consistent message that diverse perspectives and modes of processing are integral to collective wisdom. Professors can integrate principles of radical respect, disability and identity, and the social model framing exclusion as resulting from systemic barriers versus deficient students. Highlight the science behind diverse cognitive wiring early on to counter bullying or discrimination if it arises later.

When periodic moments of conflict or exclusion do occur, responses should avoid punitive measures against one party. Restorative justice facilitating victim-offender mediation around underlying needs is optimal. Moreover, bystander training equipping all members of the classroom ecology to speak up against injustice prevents othering dynamics taking root by institutionalising compassion.

Adjusting policies and structures comes next, as even well-intentioned mindsets require enabling environments to foster belonging. Build choice into attendance and participation policies accommodating episodic challenges some students face. Rethink rigid assessment procedures potentially disadvantaging processing differences. Solicit student input designing adaptations.

Ultimately, inclusion relies on flexible pedagogy leveraging UDL principles that assume and design for learner variability versus standardization. Training in differentiating instruction and making accommodations prevents needing after-the-fact accommodations. Progress towards participatory parity, wherein power balances support each person contributing strengths while reliably securing essential accommodations.

In these ways, professors lay the foundation blocks to give diverse minds wings rather than relegating anyone to margins or afterthoughts.

Fostering community and belonging

In crafting classrooms welcoming to all brains, lessons flow from diverse informational sources - yet the environment nurturing growth matters most. As theorist Lev Vygotsky underscored, rich social interaction enables the co-construction of meaning critical for learning. Community catalyses development.

Equally vital, though frequently critiqued, Urie Bronfenbrenner's ecological framework reveals how systemic layers shape identity formation beyond isolated efforts. From school-wide cultures to higher education landscapes, embracing neurodiversity must infuse policies, pedagogies, and social fabrics for enduring impact.

Fostering such ecosystems requires spotlighting each student's intrinsic strengths whilst securing necessary supports for their full participation. Diversifying demonstration options, connecting to real-world contexts, and incorporating student perspectives humanizes instruction. Deep, sustained relationships where students feel truly seen and valued drives motivation intrinsically versus extrinsically.

Such environments adopt principles of UDL that proactively personalise experiences based on dynamic learner profiles, not static diagnoses, or labels. Here, identity exploration is welcomed rather than restrained by traditions. Wisdom emerges from lived experience, not just textbooks.

When classrooms move from passive to active incubation chambers for each learner's *becoming* alongside mentors modelling vulnerability and growth of their own, the alchemical sparks of authentic human transformation ignite within unlikely minds. Deficits dissolve. Diversity intermingles. Potential unfolds.

This is true inclusion - not tolerating deviations from frozen norms but *participatory co-creation* of more capacious norms embodying equity and care at their core.

Closing this section

Our ongoing work towards inclusive, identity-affirming spaces relies foremost on cementing foundational values of diversity, equity, and inclusion in the blueprint guiding reform.

Diversity recognises and celebrates the incredible range of human neurocognition and ways of learning as assets enriching communities. Equity demands proactively designing accessible systems and flexible policies that empower every student. Inclusion moves beyond tolerance to fostering classrooms and schools where each person feels valued, heard, and supported.

Grounding efforts in these principles is critical as we audit biases in beliefs about intelligence, abilities, and potential; integrate marginalised voices and counter narratives into formal training programs; and implement more participatory, customisable educational models driven by learner variability over standardisation.

I urge fellow educators and their administrators to continually expand understanding of diverse minds and realities; embrace identity expression over conformity or masking; leverage passions and interests in instruction; establish meaningful relationships and mentorships with students; promote student leadership and self-determination in the process; and amplify advocates from within communities served in this transformation journey.

Sustaining this work relies on collective conviction that our schools can and must nurture the dignity and dreams of every student that walks through their doors, without exception. By easing rigid moulds, fresh growth unfolds - in all of us.

Natural Language Acquisition and its implications in higher-ed STEM classes

Switching gears, it's time to dive deep and introduce you to the 40% of your class (on average) who are likely to be gestalt processors of language. Here, I'm plagiarising from a paper I presented a few years ago to another group of educators – the professional trainers who are training the next generation of digital / multimedia forensic scientists, my former profession. I've kept the high-level language of the original presentation as it will better facilitate your self-exploration of this vital topic.

--

In the evolving landscape of education, particularly within the realms of STEM, the incorporation of programming languages into the curriculum has become a hallmark of modernity. This shift recognises the indispensable role of computational skills in navigating the complexities of contemporary scientific inquiry and technological innovation. Central to fostering a proficient and adaptable workforce is an understanding of the diverse cognitive processes that underpin learning. The Natural Language Acquisition (NLA) model, a framework that clarifies the innate mechanisms by which humans acquire language, offers profound insights into this domain. By drawing parallels between the acquisition of natural languages and programming languages, the NLA model can provide a scaffold for examining how individuals with different cognitive processing styles—namely Analytic Language Processors (ALPs) and Gestalt Language Processors (GLPs)—navigate the learning landscape.

ALPs are characterised by their sequential, detail-oriented approach to language acquisition, thriving on structured information and systematic analysis. Conversely, GLPs, like me, exhibit a predilection for holistic understanding, pattern recognition, and the integration of information into broader conceptual frameworks. These cognitive processing styles not only influence the acquisition of natural languages but also extend to the learning of programming languages, a critical component of STEM education.

Despite the critical role of programming in STEM disciplines, curriculum designers and educators often overlook the cognitive diversity within their classrooms. This oversight can lead to pedagogical strategies that inadvertently favour ALPs, who may find the sequential and structured nature of programming education aligns naturally with their cognitive approach. Meanwhile, GLPs, despite our potential for rapid conceptual integration and pattern recognition, might encounter significant barriers in environments that emphasise syntactic details and linear problem-solving methods without acknowledging the holistic context. The absence of instructional strategies that cater to GLPs can hinder our academic performance and engagement, ultimately impacting their confidence and interest in STEM fields.

This part of the notes aims to bridge this gap by exploring the application of the NLA model to STEM education, with a focus on programming instruction. It seeks to define key terms associated with cognitive processing styles, elucidate the challenges faced by GLPs in traditional learning environments, and propose inclusive pedagogical strategies that accommodate the diverse cognitive landscapes of all learners. By acknowledging and addressing the needs of both ALPs and GLPs, educators can foster a more inclusive and effective learning environment, thereby empowering a broader spectrum of students to excel in the digital age.

Learning content AND learning to code as a GLP

For GLPs, again who excel in grasping concepts in a holistic manner and rely heavily on pattern recognition, the conventional approach to teaching programming alongside subject content in college classes can pose unique challenges. These challenges stem from the dual demand of mastering a new “language” whilst also applying it to learn and explore complex subject matter. Unlike ALPs, who might thrive in the step-by-step logical progression typical of coding exercises, GLPs may struggle with the segmented and linear nature of coding syntax and logic, which can seem at odds with their innate cognitive style.

One significant hurdle for GLPs is the fragmentation of knowledge that can occur when learning to code is treated as a separate, discrete skill rather than being seamlessly integrated with subject content. This separation can disrupt GLPs’ ability to form a cohesive understanding of both the programming concepts and the subject matter. For instance, when a biology student learns Python to analyse genetic sequences, the disconnect between learning Python syntax and understanding its application to genetic data can hinder the student’s ability to see the broader implications of their work, a key strength of GLPs.

Furthermore, the abstract nature of many programming concepts, coupled with the immediate need to apply these concepts to solve domain-specific problems, can exacerbate feelings of frustration and confusion for GLPs. The abstract syntax and rules of programming languages may not readily translate into the intuitive, big-picture thinking that GLPs favour. When these abstract concepts are introduced concurrently with complex subject content, GLPs may find it challenging to synthesize the information effectively, potentially leading to a superficial understanding of both the programming language and the subject matter.

Additionally, the traditional emphasis on error correction and debugging in programming education can be particularly demotivating for GLPs. Whilst ALPs might view debugging as a puzzle to be solved through analytical reasoning, GLPs, who may already feel overwhelmed by the dual learning objectives, can perceive these challenges as evidence of their inadequacy, further discouraging engagement and exploration.

To mitigate these challenges, educational strategies need to be reimagined in a way that leverages GLPs' strengths. For example, incorporating project-based learning that aligns coding exercises with real-world applications in the subject matter can help GLPs form a more integrated and meaningful understanding of both. By recognising and addressing the unique challenges faced by GLPs in learning to code while mastering subject content, educators can foster a more inclusive and effective learning environment that empowers all students to achieve their full potential.

A brief look at the NLA model

The NLA model outlines the stages through which individuals progress as they learn and master a language. This model, whilst initially conceptualised to describe the acquisition of a first or primary language, can also provide insights into how individuals learn additional languages, including programming languages. The stages are typically described as follows, with the understanding that a college student learning a programming language or advancing their proficiency in their L1 is likely to be between Stage 4 and 6:

- Stage 1: Pre-Production or Silent Period - At this initial stage, learners have minimal comprehension and do not produce the language. They are primarily listeners, absorbing the new language and its sounds, with understanding often relying on body language and visual cues.
- Stage 2: Early Production - Learners begin to produce simple words or phrases, often consisting of one- or two-word responses. Their understanding of the language is still limited, but they start to practice its use in a very basic form.
- Stage 3: Speech Emergence - At this stage, learners can communicate using simple sentences and questions. Their vocabulary has expanded, allowing for more significant interaction with the language, though grammatical errors are common.
- Stage 4: Intermediate Fluency - Learners have a good grasp of the language and can engage in more complex conversations and discussions. They can express thoughts and opinions more clearly and understand the language used in academic settings. College students new to programming or advancing in their L1 might be at this stage, where they are comfortable with basic concepts but still refining their understanding and usage.
- Stage 5: Advanced Fluency - At this stage, learners have achieved near-native proficiency in the language. They can understand and use nuanced and complex language, both in verbal and written forms. College students, especially those further along in their studies or with a strong background in the language, might be at this stage, exhibiting a strong command over language subtleties and able to engage in specialized academic or technical discussions.
- Stage 6: Continued Language Growth and Mastery - Learners continue to refine and expand their language skills, learning new vocabulary, idioms, and expressions, and improving their understanding of cultural nuances. College students specializing in areas that require advanced language skills, such as literature, linguistics, or advanced technical subjects requiring specialized vocabulary, might be progressing through this stage.

In the context of programming as a language, a college student is likely to be navigating between Stages 4 to 6, where they are moving beyond basic syntax and constructs (Stage 4) to more sophisticated problem-solving and application of programming concepts (Stages 5 and

6). Understanding where a student falls within these stages can help educators tailor their teaching strategies to support further language acquisition and mastery, whether in a natural or a programming language.

Which languages are “easier” to learn for GLPs?

For GLPs, characteristics of programming languages can make them more accessible and easier to master quickly. Modern programming languages that are designed with readability, simplicity, and a high level of abstraction can be particularly suitable for GLPs. Here are a few that stand out in this regard:

1. Python
    a. Readability: Python is often recommended for beginners due to its emphasis on readability and its syntax that closely resembles natural language. This can make it easier for GLPs to grasp programming concepts as they can see the big picture and understand the intent behind the code without getting bogged down by complex syntax.
    b. High-Level Abstraction: Python handles many low-level details automatically (e.g., memory management), allowing programmers to focus on solving problems rather than managing technical minutiae. This abstraction aligns well with GLPs' strengths in conceptual thinking.
    c. Versatility: Python's versatility in various domains, such as web development, data analysis, artificial intelligence, and more, provides a broad canvas for GLPs to explore and apply their holistic understanding in different contexts.
2. JavaScript
    a. Interactivity and Immediate Feedback: JavaScript, being “the language of the web,” allows for creating interactive web pages. This can be gratifying for GLPs as they can immediately see the effects of their code in a web browser, facilitating a more intuitive learning process.
    b. Event-Driven Model: JavaScript's event-driven programming model can resonate with GLPs who excel at understanding systems in terms of actions and reactions, a natural way of thinking about how user interactions affect a web page.
3. Ruby
    a. Elegant and Concise Syntax: Ruby is known for its elegant syntax that prioritizes simplicity and productivity. Its principle of “There’s more than one way to do it” can appeal to GLPs who enjoy exploring different ways to solve a problem and seeing how different solutions fit into the larger picture.
    b. Ruby on Rails: The Ruby on Rails framework emphasises convention over configuration, which means that many decisions are made automatically. This can help GLPs focus on high-level application design rather than getting stuck on configuration details.
4. Swift
    a. Intuitive Syntax: Swift, designed for iOS and macOS app development, has an intuitive and expressive syntax that makes it easy for beginners to understand.

Its design aims to be safe and enables GLPs to experiment without worrying excessively about causing errors.

b. Playgrounds: Swift Playgrounds provide an interactive and fun way to learn programming, allowing GLPs to experiment with code and see immediate results, which can help in understanding abstract concepts through direct manipulation and visualization.

Each of these languages has features that cater to the strengths of GLPs, such as readability, abstraction, and the ability to see immediate results of their coding efforts. The choice of language might also depend on the specific interests or goals of the learner, such as web development, data science, or mobile app development. Starting with a language that offers a gentle learning curve and encourages exploration and experimentation can help GLPs quickly build confidence and competence in programming.

Which languages might be harder to learn for GLPs?

For GLPs, programming languages that require a high degree of attention to detail, have a steep learning curve due to complexity or verbosity, or lack clear, intuitive syntax can be more challenging to grasp and learn. Here are some characteristics of programming languages that might pose difficulties for GLPs, along with examples of such languages:

1. Low-Level Languages
   Example: C, Assembly
   Challenge: These languages provide minimal abstraction from the computer's hardware. Programming in these languages requires managing memory manually, understanding computer architecture, and dealing with bitwise operations. The detailed and meticulous nature of low-level programming can be challenging for those who prefer to think in broader, more abstract terms.
2. Languages with Verbose Syntax
   Example: Java, C++
   Challenge: Languages that require extensive boilerplate code or have a highly verbose syntax can be daunting for GLPs. Such languages often require paying close attention to syntactical details, which might distract from understanding the overall purpose or design of the code.
3. Languages with Complex Type Systems
   Example: Haskell, Scala
   Challenge: Languages that employ complex type systems or functional programming paradigms can initially be difficult for GLPs. These languages often involve abstract concepts like monads, immutability, and higher-order functions, which require a shift from thinking about code execution in terms of tangible steps to understanding code as a composition of mathematical or logical operations.
4. Languages with Unconventional Syntax or Paradigms
   Example: Prolog, Lisp
   Challenge: Languages that diverge significantly from the imperative programming paradigm (which is more intuitive for many learners) or have unique syntax can pose a

learning curve. Prolog, based on formal logic, and Lisp, with its heavy use of parentheses and prefix notation, require adapting to very different ways of expressing solutions to problems.

Overcoming Challenges

Whilst these languages might present initial hurdles for GLPs, it's important to note that with the right approach, anyone can learn any programming language. Here are a few strategies for GLPs tackling more challenging languages:

- Seek Visualizations: Look for resources that provide visual explanations of how code executes, especially for low-level languages or understanding complex type systems.
- Break Down Problems: Try to decompose complex problems into smaller, more manageable parts that can be understood as a whole once solved individually.
- Practice and Projects: Engaging in practical projects can help contextualize abstract concepts and make learning more tangible.
- Study Groups and Mentoring: Collaborating with others can provide different perspectives and explanations that might resonate more clearly.

It's also worth mentioning that the perceived difficulty of a programming language can be highly subjective and dependent on the learner's background, interests, and the specific context in which they're learning to program.

So, how long might it take for a GLP student to "master" a programming language?

Estimating the time it takes to "master" a programming language, such as Python, JavaScript, Ruby, or Swift, particularly for an adult at Stage 6 in their L1 acquisition, involves considering several factors. Stage 6 indicates a high level of proficiency in their L1, suggesting an ability to use language in sophisticated, nuanced ways, which could transfer positively to learning programming languages. However, the concept of "mastery" in programming can vary widely depending on the depth of understanding and the breadth of application one aims to achieve.

Factors Influencing Learning Speed

1. Previous Programming Experience: If the learner has no prior experience with programming, the initial learning curve might be steeper, as they need to understand fundamental concepts like variables, control structures, functions, and object-oriented programming.
2. Learning Environment: Access to quality resources, mentorship, practice opportunities, and a supportive community can significantly accelerate learning.
3. Time Dedicated to Learning: The more time a learner can dedicate to practicing coding, the quicker they can master a language. Consistent daily practice is more effective than sporadic, intensive study sessions.

4. Learning Approach: An approach that aligns with the learner's natural processing style (GLP vs. ALP) and leverages practical, project-based learning can facilitate faster mastery.

Estimated Timeframes for Mastery

Given these factors, and assuming the adult learner is dedicated and has access to good resources, here are rough estimates for reaching a proficient level in each language. These estimates assume the learner is starting from scratch and aims to achieve a level of proficiency where they can independently develop projects and solve complex problems in the language.

- Python: 6-12 months. Python's simplicity and readability make it one of the easier languages for beginners to learn. Mastery could be achieved within a year with consistent practice, especially given its extensive documentation and supportive community.
- JavaScript: 6-12 months. Like Python, JavaScript could take a similar timeframe to master due to its integral role in web development and the abundance of learning resources available. The timeframe might extend if the learner also aims to master various frameworks and libraries (e.g., React, Angular, Node.js).
- Ruby (including Ruby on Rails): 8-12 months. Ruby itself is a straightforward language to learn, but mastering Ruby along with the Rails framework might require a bit more time, especially to gain proficiency in building complex web applications.
- Swift: 9-18 months. Swift could take a bit longer to master, especially if the learner aims to develop sophisticated iOS or macOS applications. The complexity of mastering app development, including understanding the ecosystem and tools like Xcode, contributes to the longer timeframe.

Caveats

These estimates are highly speculative and can vary widely based on individual learner differences, the specific goals of learning (e.g., web development, data science, mobile app development), and the "depth of mastery" desired. Some individuals may progress faster by focusing on specific application areas, whilst others may take longer if they aim for a comprehensive understanding of the language and its ecosystem.

Achieving "mastery" is an ongoing process, as programming languages evolve, and new tools and best practices emerge. Continuous learning and adaptation are key components of being proficient in any programming language.

Given all of this, how might schools accommodate all students in STEM classes?

Creating inclusive educational programs in STEM that accommodate both ALPs and GLPs requires a multifaceted approach to curriculum design and teaching methods. The goal is to offer a learning environment where students with varying cognitive processing styles can thrive and understand complex concepts, including programming. Here are strategies that curriculum designers and professors can employ:

1. Diverse Teaching Methods
    a. Integrate Various Instructional Strategies: Combine lectures with visual aids, hands-on projects, group discussions, and interactive simulations. This variety ensures that both ALPs, who may prefer structured and detailed information, and GLPs, who thrive on holistic understanding and patterns, find engaging and effective ways to learn.
    b. Use Real-world Examples and Case Studies: Apply theoretical concepts to real-world problems. This helps GLPs see the big picture and understand the application of what they're learning, while ALPs can delve into the details and structured analysis of the cases.
2. Flexible Learning Materials
    a. Offer Multiple Resources: Provide learning materials in various formats, such as textbooks, videos, interactive coding platforms, and software tools. This allows students to choose resources that best match their learning style.
    b. Incorporate Visual and Interactive Tools: Use diagrams, flowcharts, and coding environments with immediate feedback to help GLPs grasp abstract concepts. Simultaneously, detailed documentation and step-by-step tutorials can support ALPs' learning.
3. Collaborative Learning Opportunities
    a. Encourage Peer Learning and Team Projects: Group students with diverse thinking styles together for projects and assignments. This encourages the exchange of different perspectives and approaches, enriching the learning experience for both ALPs and GLPs.
    b. Facilitate Discussion and Reflection: Create opportunities for students to discuss their thought processes and problem-solving strategies. This helps students appreciate different approaches and understand their own cognitive preferences.
4. Adaptive Assessment Methods
    a. Use Varied Assessment Techniques: Employ a mix of quizzes, coding assignments, projects, and presentations to evaluate understanding. This ensures that assessments are fair and can accurately reflect the diverse strengths of both ALPs and GLPs.
    b. Provide Feedback in Multiple Forms: Offer constructive feedback that addresses both the process and the content of assignments. This helps students understand not only what they need to improve but also how they can approach learning more effectively.
5. Incorporate Project-Based Learning
    a. Design Projects for Diverse Interests and Skills: Projects allow students to apply concepts in ways that align with their interests and strengths. By offering a choice of projects, students can engage deeply with topics that resonate with their cognitive processing style.

6. Supportive Learning Environment
    a. Promote a Growth Mindset: Encourage students to view challenges as opportunities to grow and learn. This mindset can help reduce the anxiety associated with learning difficulties and promote persistence.
    b. Provide Resources for Self-Discovery: Offer workshops or resources that help students identify their learning preferences and strategies for leveraging their cognitive strengths.
7. Continuous Feedback Loop
    a. Solicit Student Feedback: Regularly gather feedback on teaching methods, materials, and assessments. Use this feedback to refine the curriculum and teaching practices to better accommodate diverse learning styles.

By implementing these strategies, curriculum designers and professors can create more inclusive and effective educational programs in STEM fields. These approaches recognise and value the diversity of thought and learning preferences, ultimately fostering an environment where all students can succeed and contribute their unique perspectives to the field.

Concluding thoughts …

As we navigate the complexities of modern education, particularly within the domains of STEM and programming, it becomes increasingly clear that success hinges on our ability to recognise and appreciate the diversity of learners within our classrooms. Despite the widespread influence of the NLA model in understanding language learning processes, its implications for identifying and supporting GLPs alongside ALPs remains largely underexplored in academic settings. The assumption that all learners process information in a linear, analytical manner overlooks the rich tapestry of cognitive styles that students bring to their learning environments. This oversight not only hampers the potential for *inclusive education* but also diminishes our capacity to foster a learning community where every student can thrive.

UDL principles offer a powerful framework for addressing this challenge, emphasising the need to know who is in the room and to adapt teaching strategies accordingly. However, the realization of UDL's full potential demands more than mere acknowledgment of learner diversity; it requires actionable strategies that leverage this knowledge to create a truly inclusive educational experience. By integrating insights from the NLA model and recognising the unique strengths and challenges of both GLPs and ALPs, educators can design curricula and instructional methods that cater to a broader range of learning preferences.

The journey toward inclusive education begins with a shift in perspective—from viewing diversity in cognitive processing as an obstacle to be overcome, to seeing it as an opportunity to enrich the learning environment. This shift entails not only identifying the GLPs and ALPs in our classrooms but also actively engaging with this diversity through tailored pedagogical approaches, supportive technologies, and flexible assessment methods. Success, therefore, is not a static achievement but a dynamic process of continuous adaptation and growth, driven by a commitment to understanding and responding to the needs of all learners.

In conclusion, the path to creating inclusive educational programs that ensure the success of every student lies in our willingness to recognise the diversity of cognitive styles and to act upon this knowledge thoughtfully and creatively. By embracing the principles of UDL and incorporating insights from models like NLA, educators can cultivate a learning environment that not only acknowledges who is in the room but also empowers each student to reach their full potential. In doing so, we not only enhance the educational experience for individual learners but also contribute to the development of a more adaptable, innovative, and inclusive society.

More information and helpful resources … in no particular order

- My path to becoming a SpEd RSP (click here).
- An example of a scientific "mentor text" from my previous career in digital / multimedia forensics, from my old blog (click here).
- Years ago, I wrote Statistics for Forensic Analysts and validated it for an asynchronous micro-learning delivery. Here, I discuss the results.
- You can find my recent book, No Place for Autism?, on Amazon or at other major online booksellers.
- When my upcoming book, Holistic Language Instruction, is published, you will be able to find it here, and on Amazon.
- You can still find my first book, 2008's Forensic Photoshop, on Amazon.
- 20 of my articles on empathy (click here).
- 40 of my articles on the various aspects of IEPs (click here).
- 96 of my articles on the so-called 'science of reading,' 'evidence mills, and other such nonsense (click here).
- An autistic deep dive into quackery (click here).
- Hoerricks, K.J., 2018. Higher education support strategies: An evaluation of needs satisfaction on Autistic college student retention (Doctoral dissertation, Trident University International) (click here).

About the Speaker

Jim Hoerricks, PhD
(They / Them)

Affiliations
Founder and CEO of the Towcester Abbey Praeceptory, a 501(c)3 autism support agency and current SpEd RSP Teacher at Sotomayor Arts / Sciences Magnet (LAUSD). Opinions presented herein are their own and do not represent those of employers / clients either present or past.

Guiding Principle
"*I teach to learn what I know*."

About Jim
Jim Hoerricks, PhD, (they/them), is a person of diverse talents, serving as an educator, prolific author with numerous books and countless articles/papers, public speaker, elected official, researcher, and a retired forensic scientist. They faced challenges in traditional education due to being autistic and a gestalt processor (non-verbal). Unfortunately, the lack of understanding and support for their unique system and processing style led to them graduating high school functionally illiterate during a time when such conditions were not well-recognized.

Dr. Hoerricks categorizes their life into three distinct eras:

Pre-literate era: In search of employment, they traversed the United States and Europe, settling in California after an unsuccessful quest. During this period, they engaged in various occupations such as construction, IT, commercial art, and personal protection.

Emerging literate era: In their early thirties, by sheer luck, they carved out a career in public service, eventually retiring from the LAPD in 2016 as its senior multimedia forensic analyst. Along the way, they became a Certified Audio/Video Forensic Analyst and author of Forensic Photoshop. They also co-authored the Best Practices for the Retrieval of Video Evidence from Digital CCTV Systems for the US' Combating Terrorism Technical Support Office, as well as serving as a founding member the the Organization of Scientific Area Committees on Forensic Science (OSAC) at the National Institute of Standards and Technology (NIST), finishing their two terms as the Video / Image Technology and Analysis (VITAL) Video Task Group Chair. During this period, they earned advanced degrees including a PhD in Education, Master's in Education - Instructional Design and Master's in Organizational Leadership. All of this was in support of their creation of a 300-/400-level digital multimedia forensics curriculum. In their spare time, they taught the first generation of analysts from over 40 countries, aided the Republic of South African in its forensic science reforms, and worked high-profile cases privately.

Fully literate era: Amid the COVID-19 pandemic and the subsequent shutdown of the justice system, Dr. Hoerricks joined AmeriCorps' Teach For America, taking on a teaching role. They earned a Master's in Special Education and Teaching, plus certifications in teaching English as a foreign language and literacy instruction. Their journey to the classroom informed their book No Place for Autism? and the upcoming Holistic Language Instruction. They are now a Resource Specialist Program teacher at Sotomayor Arts / Sciences Magnet in the Glassell Park neighbourhood of northeast Los Angeles.

Dr. Hoerricks' diverse lived experiences reinforce their belief that there are many ways humans can acquire and use knowledge, and instruction should reflect this diversity. They bring over five decades of experience as both a student and teacher to the learning events they facilitate. In their upcoming talk, Dr. Hoerricks will share their personal journey to literacy and employment as an autistic adult, including the lessons they learned that now inform their approach to teaching. They aim to exemplify how holistic, inclusive teaching practices can support diverse learners at all stages of life.

More information about Dr. Hoerricks can be found here, here, and here, or follow them on LinkedIn and Instagram.

Thank you.

There's way more to be found on my Substack.

If you've found any of this to be helpful or valuable, and you feel inclined to do so, feel free to buy me a coffee.